Rectal Wall Properties in Women with Obstructed Defecation

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RECTAL WALL PROPERTIES IN WOMEN WITH OBSTRUCTED DEFECATION

FUNCTIONELE ASPECTEN VAN DE RECTUMWAND BIJ VROUWEN MET BEMOEILIJKTE STOELGANG

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The supreme happiness of life is the conviction that we are loved - loved for ourselves, or rather, loved in spite of ourselves

Victor Hugo

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Chapter 1

General Introduction and Aims of the Study

INTRODUCTION

Constipation is a frequently occurring complaint in our western society. In women, constipation is three times more common than in men, with an increase after the age of 65 years (1). Constipation can be a symptom of many diseases. Although endocrine, metabolic, pharmacological, and organic abnormalities may play a role in the pathogenesis of constipation, it is widely accepted that the main causes of constipation are low fibre intake, emotional responses, and minimal physical exercise. Based on the criterion of defecation frequency, that a 'normal' defecation frequency is three or more times per week, the estimated prevalence of severe constipation in the United States is 2 percent (1,2). There is a group of predominantly female patients, in whom the common measurements such as dietary changes, increased fluid intake, addition of bulk, regular physical exercise, and use of laxatives and stool softeners, are not successful and in whom no causative disease or condition can be found. In these patients further evaluation is recommended. During the past three decades, new methods to study functional aspects of the colon, rectum, and pelvic floor muscles have been introduced. These methods comprise a collection of dynamic tests, such as anorectal manometry, evacuation proctography, electromyography of the pelvic floor, balloon expulsion test and colonic transit time studies. Furthermore, a thorough anamnesis regarding abdominal symptoms, such as stool frequency and evacuation are necessary. Overall, two main types of constipation can be distinguished: **slow transit constipation** and **obstructed defecation** (3). In some patients, a combination of both types is found.

Slow transit constipation (STC), or colonic inertia, was first described in 1909 by Sir Arbuthnot Lane. He described a syndrome of "chronic intestinal stasis, almost confined to women, the majority of whom were under 35 years" (4). In these predominantly female patients, symptoms mostly start at puberty and slowly become worse until they are severe by the third decade. Only in a minority, the symptoms have begun after an abdominal operation (5). STC seems to be the result of a primary colonic abnormality. Patients present with a defecation frequency of two or fewer per week. During the days or weeks in between these bowel movements, they have no urge to defecate. The act of defecation itself can be

uncomplicated. Accompanying symptoms are abdominal pain and bloating, malaise, nausea, and sometimes vomiting. It has been reported that most patients tend to have additional symptoms, such as poor peripheral circulation, blackouts, and loss of female secondary characteristics. Furthermore, an increased incidence of urological and gynecological problems, such as urinary retention, painful and irregular menstrual periods, infertility, and ovarian cysts has been noted (4-6).

In patients with STC, transit time studies show a delayed passage of ingested radiopaque markers through the colon. In specimens of the colonic wall of patients with STC, the neuron density of the myenteric plexus is lower compared to controls (7-9). These intrinsic neural changes result in severely impaired or dyscoordinated peristalsis. STC is remarkably resistant to conservative measurements. In most patients, surgical intervention remains the only option left. Surgical treatment by subtotal colectomy was originally described in 1909 (4). Currently, subtotal colectomy and ileorectal anastomosis are advocated (17). It has however been observed that in many patients, motility disturbances are not limited to the colon. Comparable deflections have been found in the proximal digestive tract. Furthermore, it has been observed that many patients with STC are the victims of sexual abuse (see below). It might be possible that this persistent somatization is able to sustain impairment of bowel function, and therefore has a negative influence on the outcome of subtotal colectomy in many of these patients.

In **obstructed defecation**, or anorectal outlet obstruction, feces do reach the rectum, but rectal emptying is extremely difficult. These patients have a feeling that defecation is blocked. They do have a frequent call to stool, but despite repetitive attempts, evacuation of rectal content is frequently not possible. The patient mentions symptoms as continuous feelings of an urge to defecate, prolonged and unsuccessful straining at stool, feelings of incomplete evacuation, manual assistance, such as digital removal of feces, and the regular use of laxatives and enemas. It has been described that several abnormalities can give rise to the symptoms of obstructed defecation, as outlined below.

Anismus

In 1910, Beddard suggested that abnormal function of the pelvic floor muscles might lead to difficulty in defecation (10). In 1964, Wasserman et al. described four patients with obstructed defecation attributable to "a type of stenosis of the anorectum caused by a spasm of a component of the external anal sphincter muscle". He named it "the puborectalis syndrome" (11). Currently, this syndrome is referred to as "spastic pelvic floor syndrome", or "anismus". Anismus is defined as an inappropriate contraction of the pelvic floor during attempted evacuation (12). The past two decades, anismus has been cited as the principal cause of obstructed defecation. Characteristic symptoms, such as prolonged and repeated straining to defecate, manual assistance, feelings of incomplete evacuation, and need for laxatives are suggestive, but not conclusive for this syndrome. On physical examination, the paradoxical contraction of the pelvic floor can be assessed by palpation of the puborectalis muscle while the patient is straining (13). However, most clinicians do not rely on palpation and advocate the use of specific tests to diagnose anismus. Electromyography of the pelvic floor, the balloon expulsion test, and evacuation proctography are the most frequently used tests. In electromyography (EMG), the activity of the pelvic floor is measured with a needle or wire electrode, inserted in the puborectalis muscle, with the patient in left lateral position. Anismus is diagnosed when EMG shows an increase in activity of the puborectalis muscle during straining. It has been suggested that such an inability to relax the puborectalis muscle is due to a response to (fear of) pain caused by the needle electrode (12,14). This is confirmed by the observation that using EMG, the same prevalence of anismus was found in control subjects and in patients with obstructed defecation (12,15).

To perform the balloon expulsion test (BET), the patient is positioned in the left lateral or sitting position, and a balloon filled with air or water is installed in the rectum. The patient is asked to expel the balloon. To diagnose anismus by this test, the patient should not be able to pass the balloon. It has been observed, however, that control subjects are also not able to expel a balloon in this test (12,15,16). It has been suggested that this may be caused by the inability to comply with the requests of this somewhat odd test, in the rather unfamiliar and

unphysiologic circumstances in the laboratory (14).

Evacuation proctography (EP) is performed by asking.the patient to evacuate thickened bariumsulfate, which has been introduced in the rectum, under radiological control. EP provides a useful tool to detect anatomical abnormalities of the rectum. Furthermore, movement of the pelvic floor and signs of anismus can be evaluated. On EP, anismus is characterized by a lack of widening of the anorectal angle during attempted evacuation of contrast. This angle depends on the tone of the puborectalis muscle. During straining, the anorectal angle becomes more obtuse, because of relaxation of the puborectalis muscle. No or minimal increase of the anorectal angle on straining (because of lack of relaxation of the puborectalis muscle), sometimes associated with accentuation of the puborectalis impression, is considered to be an important radiological sign of anismus. The prevalence of anismus on EP in control subjects varies between 0 and 50 percent (12).

If anismus represents a major contributing factor to the problem of obstructed defecation, this 'syndrome' should be a specific finding in patients with evacuation difficulties. However, it has been reported that signs of anismus have been noted in controls, patients with anorectal pain and even in subjects with fecal incontinence (12,13,17-19). The clinical significance of anismus has also been questioned because the agreement between EMG, BET and EP is extremely poor (12,16,20,21). In view of latter observations, doubt has been raised upon the clinical significance of anismus. This has been confirmed by three clinical studies. Loening-Baucke studied 38 children with constipation. All of these children showed abnormal contractions of the pelvic floor during straining. These children underwent biofeedback training, to learn to relax their pelvic floor. After the therapy, twenty-eight of the children could relax their pelvic floor well. Despite this beneficial outcome of biofeedback, 14 of these children had no improvement of symptoms of constipation (22). Duthie and Bartolo performed a subtotal colectomy with an ileorectal anastomosis in 32 patients with STC. Fifty percent of these patients demonstrated signs of anismus on EP. Comparing patients with and without signs of anismus, no differences were noted with regard to the final result of subtotal colectomy (21). Finally, Van Dam et al. found that the results of rectocele repair in patients with

signs of anismus were similar to those obtained in patients without anismus (23). Based on these reports, it is questionable whether the diagnosis 'anismus' has clinical consequences.

Rectocele

A rectocele is a herniation of the anterior wall of the rectum into the lumen of the vagina. On EP, a rectocele can be visualized as an anterior bulge outside the line of the anterior rectal wall occurring during defecation (24) (Figure 1).

Figure 1. A rectocele as shown on evacuation proctography

A rectocele becomes symptomatic when there is retention of feces in the herniation, and the patient is not able to expel this fecal mass (24-27). Most patients with a rectocele have symptoms of a continuous urge to defecate, frequent and prolonged straining, and feelings of

incomplete evacuation after defecation. Many patients have to insert a finger into the vagina to support the rectovaginal septum during evacuation. Whether rectoceles can give rise to feelings of prolapse remains questionable (28). In asymptomatic female controls, rectoceles have been observed in 15-80 percent (29-37). The rectoceles in female controls are however usually small, and only a minority is larger than 2 cm. In women with obstructed defecation, large rectoceles (more than 3 cm) have been observed on EP in 4 to 72 percent (30,34,38-40). Van Dam et al. reported that following rectocele repair, symptoms of obstructed defecation disappeared in 63 out of 89 patients with a large, symptomatic rectocele (69%) (41). In the remaining 26 patients, rectocele repair had no influence on symptoms of obstructed defecation. Colonic transit time studies in 14 of these patients showed a prolonged passage of radiopaque markers through the colon in 12 (41). The same observation was made by others (42,43). These reports suggest that concomitant colorectal dysfunction might be responsible for symptoms of obstructed defecation in patients with no response following rectocele repair.

Internal intussusception

Internal intussusception is defined as an internal prolapse of the rectum. On EP, internal intussusception appears as a circumferential infolding of the rectal mucosa. Intussusception has been observed in 13-50 percent of healthy control subjects (31,35,36). In patients with obstructed defecation, intussusception is considered to be the most frequent finding on EP, with a prevalence of 28-50 percent (30,34,38-40). In literature, it has been described that intussusception contributes to obstructed defecation, but that it can also give rise to fecal incontinence (44). Surgical elimination of internal intussusception appeared to have no, or only a limited effect on symptoms of obstructed defecation (45-51). It has therefore been stated that internal intussusception is either a secondary phenomenon after prolonged straining, or a common part of a normal aging process, rather than the cause of obstructed defecation (45,50,51).

Enterocele

Enterocele is defined as a herniation of the peritoneal sac between the vagina and the rectum. This hernial sac contains either small bowel or sigmoid colon (52) (Figure 2).

Figure 2. An enterocele as shown on evacuation proctography

Enterocele can be diagnosed by means of EP, including oral administration of barium, in order to opacify the small bowel, and visualization of the vagina by coating of the vaginal wall with barium paste. EP has revealed an enterocele in 10% of female controls (53-54). The reported prevalence of enterocele in patients with obstructed defecation varies between 19 and 28% (55-58).

The symptoms most frequently attributed to enteroceles are related with pressure of the bulging mass on the pelvic floor, such as feelings of prolapse, pelvic pressure and false urge to defecate. Another frequent symptom is lower abdominal pain, frequently radiating to the

back (52,59-61). It has been suggested that the downward displacement of the herniated mass results in a direct compression of the rectum, what may give rise to obstructed defecation (62). Utilizing EP, Jorge et al. have observed this direct compression of the rectum by the enterocele, resulting in impaired rectal emptying (63). However, this observation could not be confirmed by others (55,61,64). Moreover, we found that symptoms of obstructed defecation persist after adequate enterocele repair (61). The same observation was made by Mellgren et al (64). Based on these findings, it seems unlikely that enteroceles are a cause of obstructed defecation.

Life Events

It is well known that somatization is a potential defensive tactic to deal with psychological distress. Recently, there is growing interest in the influence of psychological distress on bowel dysfunction. Devroude et al. (6) have compared women with STC to a control group of women with arthritis. They reported that the constipated women demonstrated a conversion pattern, which indicated the presence of a somatization defense mechanism. This finding has been confirmed by Heymen et al (65). Drossman et al. demonstrated that a history of sexual abuse and physical harassment is a frequent finding in women with functional gastrointestinal disorders (66). Of 209 consecutive gastrointestinal female patients, 89 (44%) reported a history of having been victim to abuse. It was remarkable that regarding this, only 17% of these patients had informed their doctor. The high prevalence of sexual abuse among gastrointestinal patients, has also been confirmed by Leroi et al (67). They reported that 40% of patients with a functional disorder of the lower digestive tract, had a history of sexual abuse. This was in contrast to 10% in patients with an organic disease, and to approximately 20% in the general population. The most frequently reported symptoms of these sexual maltreated patients were of constipation and obstructed defecation. The prevalence of sexual abuse was found to be four times higher in patients with lower functional gastrointestinal motor disorders, compared to those with upper functional disorders.

Surgery

It is remarkable that some women report that obstructed defecation has started following surgery. A relationship between hysterectomy and disordered bowel function has been reported frequently (68-76). In a retrospective study, we observed an incidence of post-hysterectomy changes in bowel function of 43% (74). In contrast with these reports are the data reported by Prior et al, who found that following hysterectomy symptoms of constipation are more likely to disappear than to develop (72). No prospective studies evaluating bowel function before and after hysterectomy have been performed. Also following rectopexy, a surgical method to correct intussusception, deterioration in bowel function has been reported (79-82,85), whereas other authors report no change (83,84).

Functional outlet obstruction - involvement of the rectal wall?

It seems obvious, that the currently most popular concept that in patients with obstructed defecation without anatomical deviations, anismus is the main causative factor, has little scientific basis. Recently it has been suggested that obstructed defecation might be caused by an impaired function of the rectum. Åkervall et al. demonstrated that in patients with constipation, the outcome of subtotal colectomy with ileorectal anastomosis was successful in those patients with a normal rectal sensory perception. In patients with blunted rectal sensation however, the operation was ineffective (86). As described previously, Loening-Baucke reported that a group of children with constipation did not recover from constipation despite successful relaxation of their pelvic floor. She observed that these children showed significantly decreased rectal sensory perception as compared to the recovered children (22).

Grotz et al. investigated rectal wall contractility in controls and patients with chronic severe constipation (87). They found that in patients with obstructed defecation and constipation, the increase in rectal contractility following a meal and after the administration of a cholinergic agonist, was significantly blunted. According to these authors, the reduced rectal tone provided an explanation for the inability of these patients to expel stool.

These observations suggest that it might be worthwhile to get more insight in rectal wall properties in women with obstructed defecation.

AIMS OF THE STUDY

The aim of this thesis was to investigate rectal wall properties in both control subjects and in women with obstructed defecation:

1. To study the tonic response of the rectal wall during an evoked urge to defecate
3. To examine the compliance of the rectal wall
4. To study rectal sensory perception and to evaluate the usefulness of utilization of two different distension protocols
5. To study the tonic response of the rectum following a meal
6. To study the tonic response of the rectum following topical application of bisacodyl
7. To evaluate the impact of digital pressure upon the perineum on rectal tone.

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Chapter 2

Rectal Tone in Response to an Evoked Urge to Defecate

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Adapted from: Diseases of Colon and Rectum 1998;41:473-479.

ABSTRACT

The aim of this study was to examine rectal tone in response to an evoked urge to defecate and to identify differences between female controls and women with obstructed defecation.

One hundred women with obstructed defecation entered the study. Sixty-nine of these women had a normal, and 31 a prolonged total colonic transit time. For comparison, 40 female controls were also studied. Under radiological control an 'infinitely' compliant polyethylene bag was inserted over a guide wire into the proximal part of the rectum. Additionally, a latex balloon was introduced into the distal part of the rectum. This latex balloon was inflated until an urge to defecate was experienced. Simultaneously rectal wall tone was assessed by measuring the variations in bag volume. These variations were expressed as percentage changes from the baseline volume. Comparing controls and patients with obstructed defecation, a significant difference was found regarding mean distending volume required to elicit an urge to defecate (median value: 125 (range: 25-200) versus 320 (range: 25-450) cc of air, $p< 0,001$). Twenty-four women (24%) did not feel an urge to defecate at all. In all controls the evocation of an urge to defecate induced a pronounced increase in rectal tone, proximal to the distal stimulating balloon (mean value: 32,3±9%). In the women with obstructed defecation, this increase in rectal tone was significantly lower (mean value: 19,8±8%, $p<0,001$). Thirty-one patients (31%) showed no increase in rectal tone at all. In 15 of these patients, it was not possible to evoke an urge to defecate by balloon distension. Regarding rectal tone in response to an evoked urge to defecate, no significant difference was found between patients with normal, and those with prolonged transit time. In conclusion, the assembly used in this study provides a useful tool for the investigation of rectal tone in response to an evoked urge to defecate evacuation. During evocation of an urge to defecate by rectal distension, rectal tone increases in women with obstructed defecation, the increase in rectal tone in response to an evoked urge to defecate is absent or significantly blunted.

INTRODUCTION

For almost two decades anismus, or the spastic pelvic floor syndrome, has been cited as the principle cause of obstructed defecation. As outlined in chapter 1, it seems obvious that the concept that obstructed defecation is mainly due to inadequate pelvic floor muscle coordination, has little scientific basis. It has been suggested that impaired rectal sensory perception and altered rectal motor function might play a role in obstructed defecation (chapter 1). However, the diagnostic methods, currently available for the evaluation of obstructed defecation, such as electromyography, the balloon expulsion test and evacuation proctography are mainly focused on the 'inappropriate' contraction of the pelvic floor during attempted evacuation. These diagnostic methods poorly represent the natural physiology of defecation, since most subjects do not have a call to stool during examination. Straining without a natural desire to defecate might provide findings unrelated to the underlying disorder.

Normal rectal evacuation requires adequate intrarectal pressure, which can be raised by increasing intrapelvic pressure, achieved by voluntary contraction of the diaphragm and abdominal wall muscles. In addition, normal rectal sensory perception and propulsive contractile activity seem to be major contributing factors.

The aim of this study was to develop a more physiologic test for the investigation of rectal evacuation, and to examine rectal tone in response to an evoked urge to defecate, both in female controls and in women with obstructed defecation.

PATIENTS AND METHODS

Patients

Between January 1997 and December 1998, 100 female patients (median age: 39, range: 18-70 years) with obstructed defecation entered the study. Obstructed defecation was diagnosed when two or more of the following symptoms were present: prolonged and unsuccessful straining at stool, feeling of incomplete evacuation, manual assistance during attempted evacuation, and the regular use of laxatives and enemas.

In all patients, total colonic transit time was assessed using a method described by Dorval,

using a single type of radiopaque marker, ingested once a day during six days, and one abdominal X-ray performed on the seventh day (1). Sixty-nine patients had a normal and 31 a prolonged colonic transit time. Forty-one women reported symptoms had started following pelvic surgery (hysterectomy: 33, rectopexy: 4, other: 4), divided equally over the patients with normal and those with prolonged transit time. In the other 59 patients, onset of symptoms was less clear. None of the patients had a history of bowel surgery or rectocele repair. Seventy-six patients had children (mean: 2, range 1-4) (vaginal deliveries in 72, caesarian section in 4).

For comparison, 40 female controls (median age: 39, range: 21-71 years) were also studied. Twenty-nine subjects were healthy volunteers, 5 were recruited from those awaiting surgery for familial adenomatous polyposis coli, and 6 for a small peri-anal fistula, both not affecting the rectum. None of the control subjects had symptoms or signs of rectal disease. All were continent and all had a normal defecation pattern. None of them complained of abdominal pain. None of the control subjects had undergone abdominal or pelvic surgery previously. None of the controls was taking medications, except oral contraceptives (N= 8). All female volunteers of childbearing potential had a negative urine pregnancy test before participation in the study. The study was approved by the local ethical committee. All subjects gave written informed consent.

Methods

For the purpose of this study, a double-catheter assembly was used. Two polyvinyl catheters, each seven millimeters in outer diameter, were firmly tied together. A thin, 'infinitely' compliant (see chapter 3) polyethylene sandwich bag was fastened hermetically at both ends to one of the catheters, proximal and distal of 3 holes, located at a distance of 5 to 7 cm from the end of the catheter. The other end of this catheter was linked to a strain gauge and a computer-controlled air injection system (G&J Electronics Inc, Ontario, Canada). The second catheter served for the guide wire (Figure 1). All subjects underwent bowel preparation with Klean Prep®(Helsinn Birex Pharmaceuticals Ltd, Dublin, Ireland), administered 24 hours before measurement. First, endoscopic

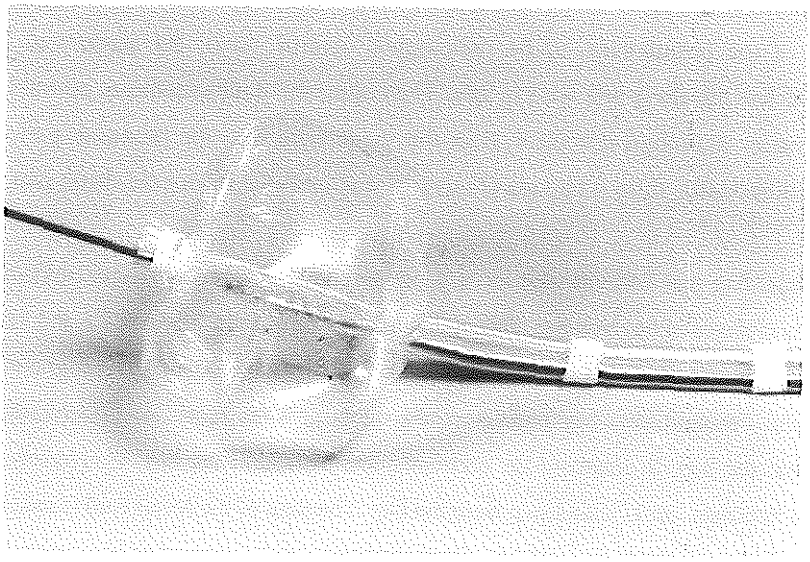

Figure 1. Double catheter assembly with the barostat bag at the end of one catheter and a guide wire through the lumen of the other.

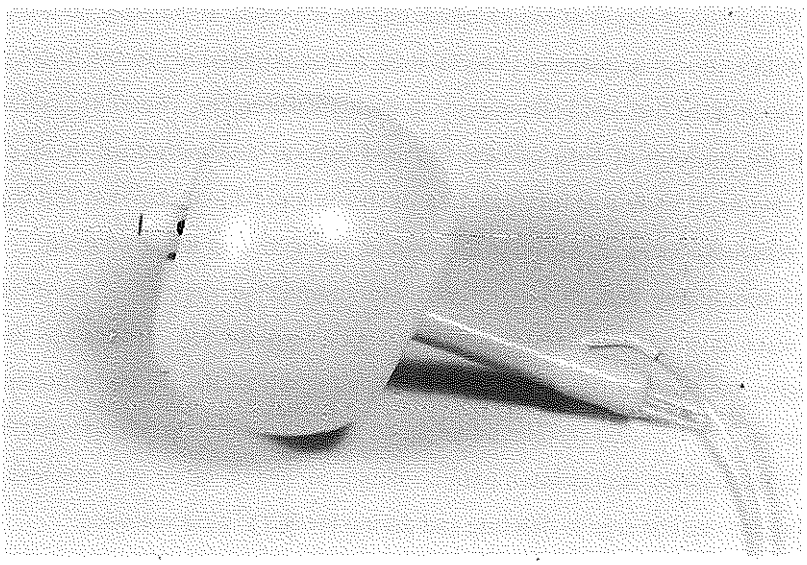

Figure 2. Inflated stimulating balloon.

examination of the distal part of the large bowel was performed. Then, a guide wire was inserted through the scope and positioned into the proximal part of the rectum, just above the level of the promontory, under radiological control. Next, the scope was gently withdrawn, leaving the guide wire in situ. Thereafter, the double-catheter assembly was inserted, under radiological control, over the guide wire into the proximal part of the rectum. Additionally, a latex balloon (Figure 2) was introduced into the distal part of the rectum.

The proximal bag was inflated with air to a pressure at which respiratory excursions were recorded as changes in bag volume. This operating pressure varied between 7.5 and 12.5 mm Hg. The computer-controlled air injection system ('barostat system') is programmed to maintain this constant intra-bag pressure. Subsequently, when rectal tone decreases, air is injected into the bag, to maintain the constant pressure within the bag. Conversely, when rectal tone increases, air is withdrawn from the bag. The tone of the rectal wall is assessed by measuring the variations in bag volume. These variations are expressed as percentage change from the baseline volume.

The distal latex balloon was inflated with air until the patient experienced an urge to defecate. Since compression of the proximal bag by the distal stimulating balloon would interfere with a correct assessment of rectal tone, it was essential to prevent direct contact between the inflated bag and balloon prior to each measurement. Therefore, radiological control of the position of both inflated bag and balloon was performed in all patients (Figure 3 and 4). If there was no contact between bag and balloon, balloon and bag were deflated. After an adaptation period of 20 minutes, the recording was continued.

The distal stimulating balloon was inflated with cumulative steps of 25 cc of air. The patients were instructed to report when they first experienced an urge to defecate. Additionally, the balloon was inflated to a volume at which the patient experienced an irresistible urge to defecate (maximum tolerated volume, MTV). When no sensation was perceived, the balloon was inflated until a volume of 450 cc of air was reached. Rectal tone during the earliest urge to defecate and during the MTV were recorded.

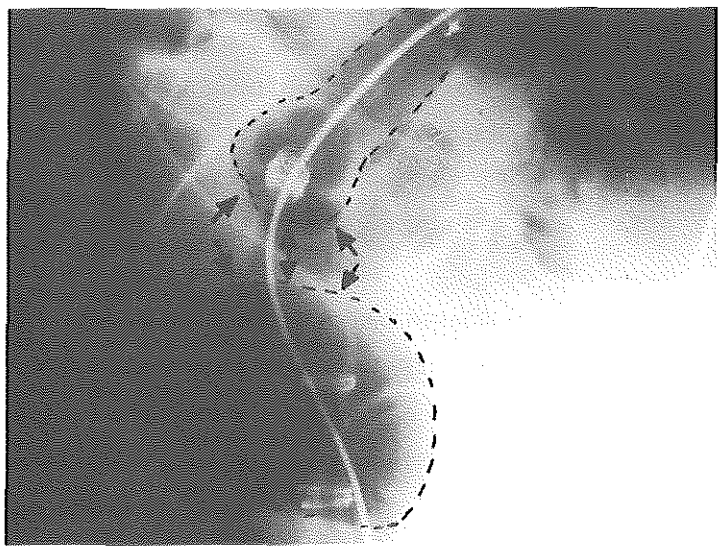

Figure 3. Radiographic view of correct position of inflated bag and balloon. There is no direct contact between bag and balloon.

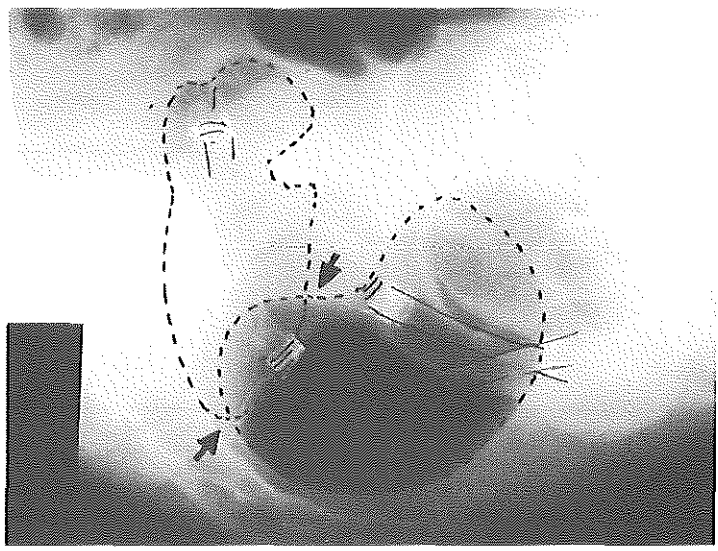

Figure 4. Radiographic view of incorrect position of inflated bag and balloon. There is contact between them.

Statistical Analysis

Volumes required to evoke the earliest urge to defecate and MTV are given as median and range. Results of increase in rectal tone are given as mean value ± standard deviation. Data of patients and control subjects were compared using the Mann-Whitney U-test for unpaired data. Statistical significance was assigned to any probability value of less than 0,05 (two-sided).

RESULTS

The median distending volume required to elicit an urge to defecate was 125 (range: 25-200) cc of air in the controls and 320 (range: 25-450) cc of air in the women with obstructed defecation. The difference between these values was statistically significant ($p<0,001$). Twenty-four patients (24%) did not feel an urge to defecate at all. In all controls the evocation of an urge to defecate induced a pronounced increase in rectal tone (mean value: 32,3±9%), proximal to the distal stimulating balloon. Rectal tone recovered gradually after deflation of the distal stimulating balloon (Figure 5).

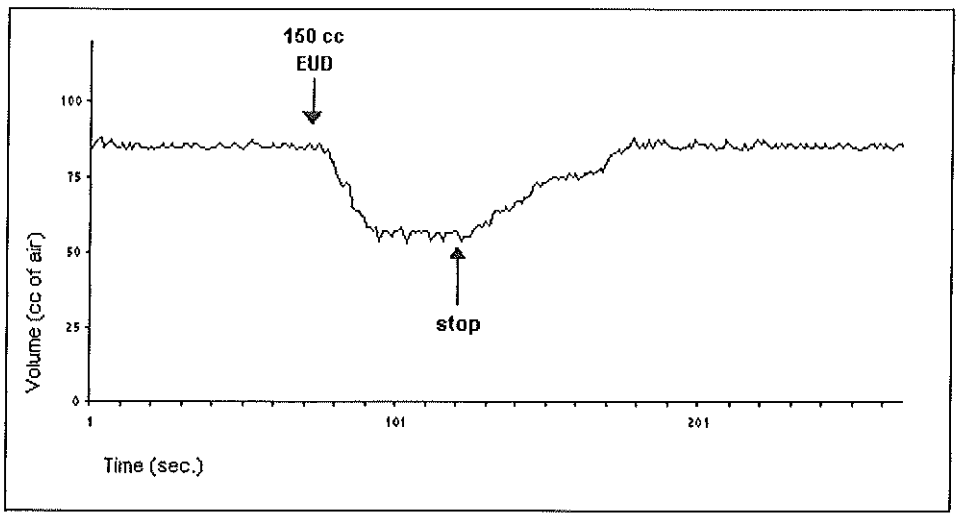

Figure 5. Increase in rectal tone during the perception of an urge to defecate in a female control. The earliest urge to defecate (EUD) is provoked by inflation of the distal balloon with 150 cc of air. After deflation of the stimulating balloon, rectal tone recovers gradually.

In women with obstructed defecation, the increase in rectal tone during the evocation of an urge to defecate was significantly lower (mean value: 19,8 ±8%, p<0,001, Figure 6).

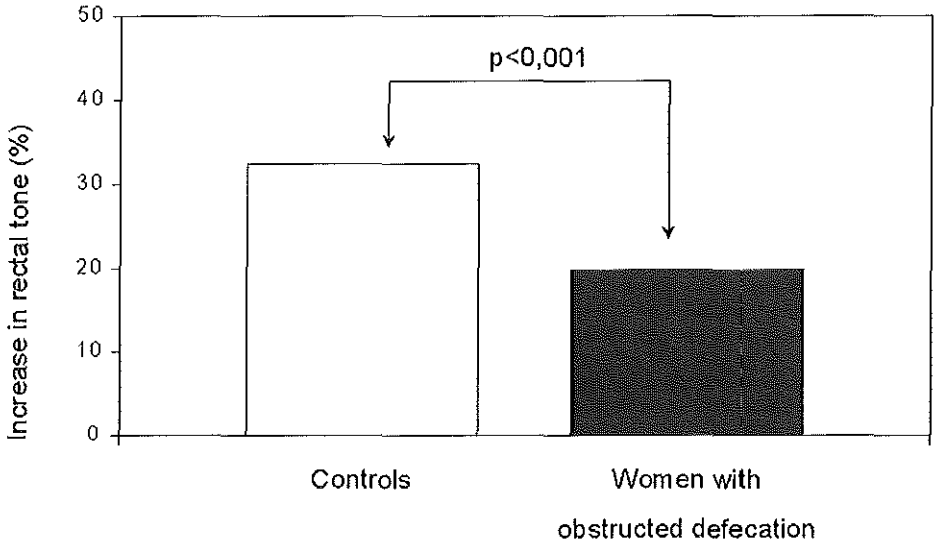

Figure 6. Increase in rectal tone during the perception of an urge to defecate in controls and in women with obstructed defecation.

Thirty-one patients (31%) showed no increase in rectal tone at all. Fifteen of these patients also felt no urge to defecate during balloon distension.

The median distending volume to elicit the maximum tolerable volume was 250 (range: 50-325) cc of air in the control subjects. In women with obstructed defecation, this volume was 400 (range: 100-450) cc of air (p<0,001). As described above, 24 patients did not experience any rectal filling sensation at all in the volume range between 25 and 450 cc of air. Furthermore, in 11 other patients who did experience an urge to defecate, no MTV could be reached. In the controls, MTV induced a mean increase in rectal tone of 38,2±10%. In women with obstructed defecation, the increase in rectal tone during the

MTV was significantly lower (mean value: 23,1±8%, p<0,001). Of the 31 patients who had showed no response to the earliest urge to defecate, 27 also showed no response to the MTV. In 4 patients a small increase in rectal tone during MTV was measured (mean value: 8,1±3%) (Figure 7).

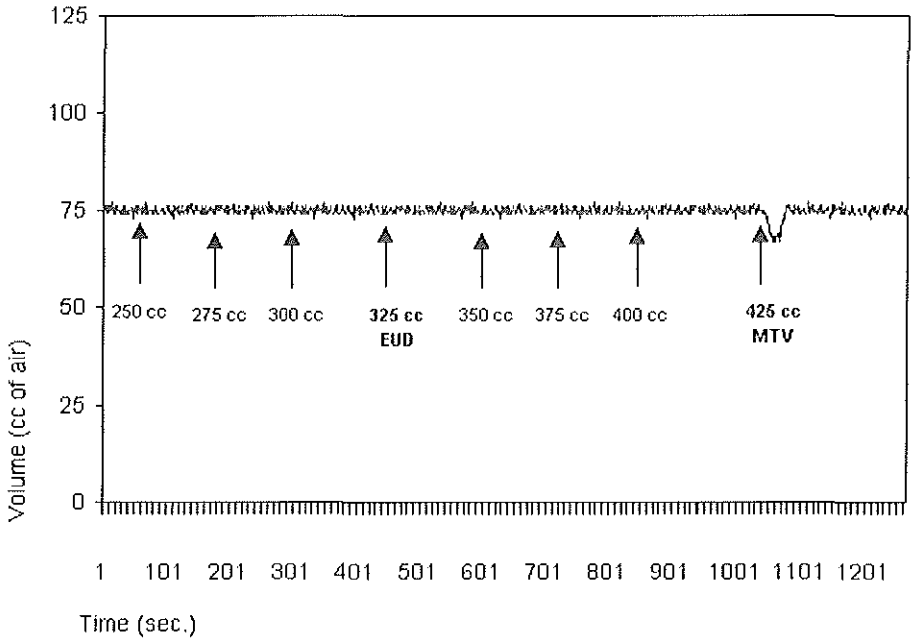

Figure 7. Recording tracing of a woman with obstructed defecation. No increase in rectal tone is observed in response to normal distending stimuli. The earliest urge to defecate (EUD) is evoked by inflation of the distal balloon with 325 cc of air. At that moment, no increase in rectal tone is measured. A small increase in rectal tone is observed during stimulation with 425 cc of air (MTV).

Regarding rectal tone in response to an evoked urge to defecate, no significant difference in outcome was found between patients with a normal, and those with prolonged transit time, between patients with and without previous pelvic surgery or between patients with and without previous pregnancy. Results observed in older subjects (>60 years) were similar to those found in younger subjects (<60 years).

DISCUSSION

In 1985, Azpiroz and Malagelada introduced the computer-controlled electromechanical air injection ('barostat') system, to measure gastric tone. (2). In 1988, Åkervall et al. reported the utilization of this technique to measure rectal tone (3). Until then, rectal motor activity had only been assessed by intraluminal pressure measurements. It has been shown, however, that changes in tone, as reflected by changes in barostat bag volume, are not demonstrable by such intraluminal pressure recordings (4,5). Based on this finding, it has been stated that barostat recordings provide more information regarding the contractile state of the rectum. Utilizing a single barostat balloon placed in the rectum, Grotz and co-workers investigated rectal wall tone in controls and in patients with chronic severe constipation (6). They found that the increase in rectal wall tone in response to feeding and to the administration of a cholinergic agonist, was significantly blunted in constipated patients. According to these authors, the reduced rectal tone provided an explanation for the inability of their patients to expel stool.

Until now, no data are available regarding the relationship between the perception of an urge to defecate and rectal wall tone. The results of our study show that an urge to defecate is associated with a significant increase in rectal tone: the expelling force of the rectum. Furthermore, we observed that obstructed defecation is associated with impaired rectal sensorimotor function. Impaired rectal sensory perception, has been reported previously in patients with constipation (7-10).

Rectal sensory perception, as well as rectal motor function are thought to be mediated by the extrinsic parasympathetic sacral nerves (8,10,12-22). Furthermore, the pons cerebri might have a coordinating function (20,21,22). There is growing evidence that the impaired sensorimotor function in women with obstructed defecation might be caused by a deficit of these extrinsic parasympathetic sacral nerves. It well known that in some women, obstructed defecation starts following pelvic surgery. Patients who have undergone rectopexy frequently experience diminished rectal sensory perception. This has been attributed to the division of the 'lateral ligaments', which contain branches of the parasympathetic sacral nerves (23-30). Following hysterectomy, changes in bowel function have in retrospect been

reported by 43% of the women (31). The parasympathetic sacral nerves run from and to the rectum through branches which are situated on each side of the rectum, around the cervix uteri, and both lateral vaginal surfaces. This extensive network of nerve fibres is difficult to spare during hysterectomy and dissection of the rectovaginal septum (32-36). Gurnary et al. (32) showed that constipation occurred more frequently the more radical the hysterectomy was performed. Varma et al. studied rectal function in 14 women with intractable constipation following hysterectomy. These patients had significantly decreased rectal sensory perception (10). Also patients with the cauda equina syndrome suffer from obstructed defecation (37,38). Furthermore, direct injury to the extrinsic parasympathetic sacral nerves has been reported to result in obstructed defecation (39-42). Finally, low spinal anesthesia, blocking all parasympathetic sacral nerves, abolishes rectal sensory perception (43). These observations confirm that the extrinsic parasympathetic sacral nerves play an important role in rectal sensorimotor function.

In conclusion, the assembly used in the present study enables the investigation of the relationship between an urge to defecate and changes in rectal tone, thereby providing a more physiologic tool for the investigation of rectal evacuation. An urge to defecate is associated with an increase in rectal tone. In women with obstructed defecation, rectal sensorimotor function is significantly impaired.

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Chapter 3

Rectal Compliance in Women with Obstructed Defecation

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Adapted from manuscript, Diseases of Colon and Rectum, accepted for publication.

ABSTRACT

Aim of this study was to investigate whether rectal compliance is altered in women with obstructed defecation. Eighty female patients with obstructed defecation and 60 control subjects were studied. Rectal compliance was measured with an 'infinitely' compliant polyethylene bag. This bag was inserted in the rectum and inflated with air to selected pressure-plateaus (range: 0-60 mm Hg, in cumulative steps of 2 mm Hg, each with a duration of ten seconds) utilizing a computer-controlled electromechanical air injection system. Volume changes at the levels of distending pressures were recorded. The distending pressures, needed to evoke first sensation of content in the rectum (FS), earliest urge to defecate (EUD) and the maximum tolerable volume (MTV) were noted.

In all cases the compliance curve had a characteristic tri-phasic (S-shaped) form. The mean compliance curve obtained from the patients was identical to that of the controls. In 14 patients however, the course of the compliance curve fell above the normal range (mean + 2 SD). In 10 of these patients (71%), a large rectocele was seen at evacuation proctography. Such a rectocele was observed in only 5 patients (7,6%) with a normal compliance curve ($p<0,001$).

Eighty percent of the controls experienced EUD during the second phase of the curve. In 75% of the patients, this occurred in the third phase. The mean pressure threshold for FS, EUD, and MTV were significantly higher in patients compared to control subjects. Ten of the patients experienced no sensation at all in the pressure range between 0 and 60 mm Hg. In conclusion, in women with obstructed defecation, the compliance of the rectal wall is normal

INTRODUCTION

In chapter 2, we have shown that an urge to defecate, evoked by rectal distension with a balloon, is associated with an increase in rectal tone, proximal to the distending balloon. This expelling force as well as rectal sensory perception appeared to be absent or significantly blunted in women with obstructed defecation. These data do confirm that the sensorimotor function of the rectum plays an important role in the pathogenesis of obstructed defecation. We were interested if alterations in rectal compliance are also contributory. Rectal compliance reflects the distensibility of the rectal wall. Compliance is defined as the volumetric response of the rectum to stretch when subjected to an increase of intraluminal pressure (1). Until now, it is not clear whether alterations in rectal compliance contribute to the problem of obstructed defecation. Some authors observed an increase of rectal compliance (2-4), whereas others found no difference between patients and controls (5-10). These conflicting data are mainly due to the variety of methods and devices, used to assess the compliance. According to Toma et al. (11) and Whitehead et al. (12), the optimal method to determine rectal compliance is by recording the change in rectal volume per unit change in rectal pressure. This should be accomplished with the help of a polyethylene bag and a computer-controlled air injection system with a minimal internal compliance. By means of the computer system, the polyethylene bag is inflated to selected pressure-plateaus, and volume-changes at these various levels of distending pressures are recorded. After plotting a pressure-volume curve (i.e. pressure on the x-axis), the slope of this curve ($\Delta V/\Delta p$) can be determined. Aim of our study was to investigate whether rectal compliance is altered in women with obstructed defecation, with the help of the guidelines described above.

PATIENTS AND METHODS

Patients

Between May 1997 and July 1998, eighty female patients (median age: 50, range: 18-75 years) with obstructed defecation entered the study. Obstructed defecation was diagnosed when two or more of the following symptoms were present: prolonged and unsuccessful straining at stool, feeling of incomplete evacuation, manual assistance and the regular use of laxatives and enemas. Of these women, 38 reported onset of symptoms following pelvic surgery (hysterectomy N=31, rectopexy N=2, other N=5), and 4 following vaginal childbirth. In 38 women, the onset of symptoms was less clear. None of the women was known to suffer from a neurological disease, connective tissue disorder, or diabetes mellitus.

In all patients, total colonic transit time was assessed according to Dorval, as described in chapter 2. Sixty-two patients had a normal and 18 a prolonged transit time.

For comparison, 60 control subjects (Male/Female ratio: 15/45; median age: 46, range: 23-72 years) were studied. Thirty-five subjects were normal healthy volunteers and 7 were recruited from those awaiting surgery for familial adenomatous polyposis coli, not affecting the rectum. The other 18 subjects were undergoing surgery for a small peri-anal fistula. None of the control subjects had symptoms or signs of rectal disease, all were continent and all had a normal defecation pattern. None of these subjects had undergone abdominal or pelvic surgery in the past. They were not taking any medication, except for oral anticonceptives (N=8), and had no concomitant disease. The study was approved by the local ethical committee. All subjects gave written informed consent.

Methods

For the purpose of this study, a thin, 'infinitely' compliant polyethylene sandwich bag was fastened hermetically at the end of a polyvinyl catheter (7 mm in outer diameter and marked at each 10 centimeters), proximal and distal of 5 holes, covering a distance of 5 to 7 cm from the end of the catheter. The bag is fastened at both ends of the polyvinyl catheter to prevent axial expanding, thereby allowing the bag to fully engage the rectal

wall circumferentially. In this bag, no tension is created in the walls of the bag in the interval between 0-600 cc of air and therefore, distending pressure is transferred entirely on the rectal wall.

The catheter was linked to a strain gauge and a computer-controlled air injection system (G&J Electronics Inc, Ontario, Canada). The device was switched on at least 45 minutes before the measurement, in order to allow the device to warm up. This time allows for the temperature drift of the pressure transducer to reach its maximum.

All patients and control subjects were asked to try to empty their bladder and rectum before measurement.

With the patient in left lateral position, the bag was inserted into the rectum, 10 cm from the anal canal. This was accomplished with the help of the scale on the catheter. Before each measurement, approximately 100 cc of air was injected in and aspirated from the bag to unfold it. After an adaptation period of 15 minutes, the bag was inflated with air to selected pressure-plateaus (range: 0-60 mm Hg; rising in cumulative steps of 2 mm Hg, at stimulation duration of ten seconds) with the help of the computer-controlled electromechanical air injection system. Volume-changes at the various levels of distending pressures were recorded and expressed in cc of air. The bag was deflated automatically when a pre-selected pressure of 60 mm Hg and/or a pre-selected volume of 600 cc of air was reached.

Subjects were instructed to report when they experienced: first sensation of content in the rectum (FS), earliest urge to defecate (EUD) and the maximum tolerable volume (MTV). The various levels of distending pressures, needed to evoke these different sensations were noted. First, the entire pressure-volume curves of all patients and control subjects were plotted and compared. Second, the compliance of the rectal wall was calculated by taking the slope of the pressure-volume curve ($\Delta V/\Delta p$) at the three different sensation levels.

In all patients, evacuation proctography with coating of the vaginal wall was performed according to Ginai (13). The 'non-relaxing puborectalis syndrome' ('anismus') was

defined radiologically according to the following criteria: decrease or insufficient increase (<5%) of the anorectal angle despite an adequate straining effort, represented by sufficient perineal descent

Statistical Analysis

Distending pressures required to evoke rectal filling sensations are given as median and range. The value of rectal compliance is given as mean value ± standard deviation. Continuous data of patients and control patients were compared using the Mann-Whitney U-test for unpaired data. Percentages were compared using Fisher's exact test. The limit of statistical significance was set at p=0,05 (two-sided). As data points in the $\Delta V/\Delta p$ diagram of individual cases showed a sigmoidal (S-shaped) appearance, logistic functions were fitted using non-linear regression.

RESULTS

Evacuation proctography showed a large rectocele (>3 cm) in 19 patients. A small rectocele (<3 cm) was observed in 10 patients. Three women had a small bowel enterocele, and four an internal intussusception. In 19 women, a non-relaxing puborectalis syndrome was observed on evacuation proctography.

In all cases the compliance curve, obtained from plotting the measured rectal volume versus the change in rectal pressure, showed a sigmoid (S-shaped) relationship. All individual curves of the control subjects were averaged. The resulting tri-phasic curve, plus or minus 2 SD, was taken to represent the normal range in the $\Delta V/\Delta p$ diagram (Figure 1).

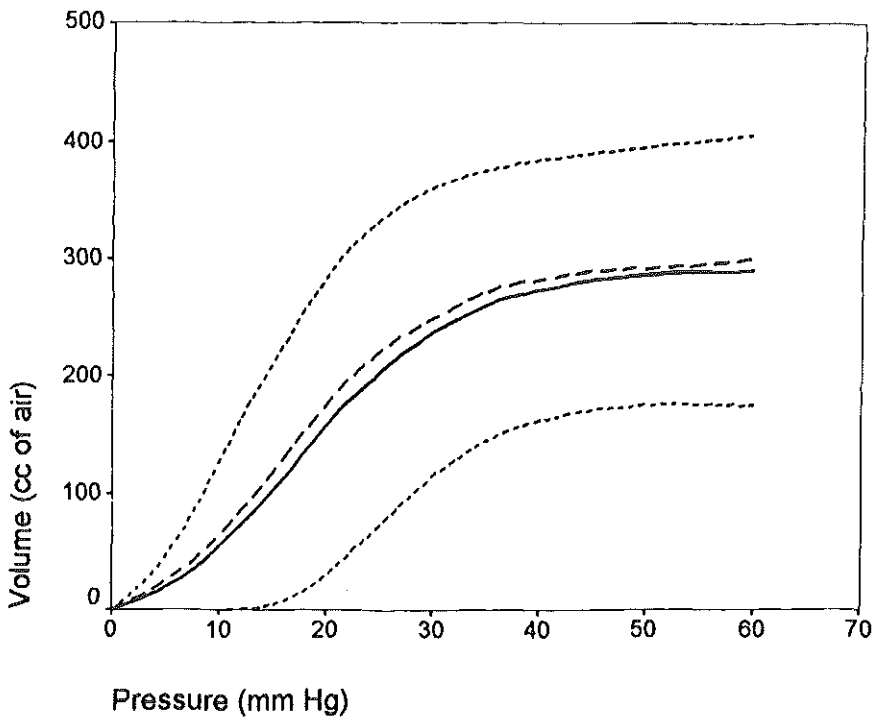

Figure 1. Intrarectal volume variation in response to cumulative intrarectal distension. The mean of controls is represented by the solid line, the mean of patients by the intermitted line. The dotted lines indicate the normal range.

The mean compliance curve obtained from the patients with obstructed defecation was almost identical to the mean compliance curve of the control subjects. In 14 patients, however, several points of the compliance curve fell above the normal range. In 10 (71%) of these 14 patients, a large rectocele (>3 cm) was seen at evacuation proctography. Such a large rectocele was observed in only 5 patients (7,6%) out of the 66 with a normal compliance curve (p<0,001). Comparing patients and controls, no differences were found in rectal compliance, calculated from $\Delta V/\Delta p$ at the three different sensation levels, as outlined in the following Table.

	Controls (N=60)	Obstructed defecation (N=80)	Statistical Significance
Pressure (mm Hg)			
FS	14,7 (5–20)	26,2 (14-60)	p<0,001
EUD	24,2 (9-31)	41,3 (19-60)	p<0,001
MTV	37,5 (17-56)	54,6 (24-60)	p<0,001
Rectal Compliance*			
FS	6,3 (3,0)	7,3 (3,0)	NS
EUD	7,5 (2,5)	7,9 (2,7)	NS
MTV	6,8 (2,0)	7,3 (1,9)	NS

* $\Delta V/\Delta p$ (cc of air/mm Hg), calculated at each point of individual perception threshold
NS = Not statistically significant

Table. Rectal pressures needed to evoke an urge to defecate (median and range), and compliance (mean value ± standard deviation).

Patients with obstructed defecation needed significantly higher pressures for each sensation level compared to controls (p<0,001). Ten of the women with obstructed defecation experienced no sensation at all in the pressure range between 0 and 60 mm Hg. Eighty percent of the control subjects experienced a call to stool during the second phase of the curve. In 75% of the patients, this occurred significantly later, at the end of the third phase. Compliance did not vary by duration of symptoms, age (<60 years versus >60 years), or factors underlying onset of symptoms. Furthermore, a normal

compliance was found in the women with radiographic evidence of the non-relaxing puborectalis syndrome, in women with a small rectocele (<3 cm), small bowel enterocele, or rectal intussusception. There was no difference in outcome between patients with normal, and those with prolonged colonic transit time.

Recordings obtained in the male and female control subjects showed no significant differences.

DISCUSSION

Rectal compliance reflects the distensibility of the rectal wall, i.e. the volumetric response of the rectum to stretch when subjected to an increase of intraluminal pressure. It has been suggested that determination of rectal compliance is useful since alterations in rectal distensibility adversely affect rectal function (1). Irradiation of the rectal wall, for example, may result in fibrosis due to obliterative endarteritis with subsequent local tissue ischaemia. In patients with fibrosis of the rectal wall the slope of the pressure-volume curve is declined, indicating a reduced distensibility (14,15). Decreased rectal compliance is associated with urgency and increased stool frequency (16). Based on these findings, it has been suggested that alterations in rectal compliance are contributory to obstructed defecation.

In previous studies, a variety of methods and devices have been used to assess rectal compliance and therefore, a wide range of normal values has been reported (1). The methods as well as the devices used in previous studies have been criticized (1,11,12,17). In most studies rectal compliance is assessed by volumetric distension of a latex balloon with air or fluid (2-10). The intrarectal pressure, responding this volumetric distension, is recorded with a pressure transducer within or outside the balloon. The data obtained are plotted in a pressure-volume curve (i.e. pressure on the x-axis), and the slope of this curve ($\Delta V/\Delta p$) is considered to represent rectal compliance. It has been stated, however, that the pressure response to a given volume stimulus reflects elastance rather than compliance (11). Furthermore, it is mathematically not right to plot the dependent value (i.e. volume) on the y-axis. A major draw-back of a latex balloon is that it supplies a

compliance term of its own. Toma et al. (12) compared latex balloons with polyethylene bags. In contrast with polyethylene bags, latex balloons continue to increase when high pressures are applied, i.e. they still expand within a rigid tube, thereby not reflecting its low compliance. The authors also confirmed that polyethylene bags have an 'infinitely high compliance'.
Using a pressure transducer in or outside the distending latex balloon, the recorded pressure is partly generated by the tension of the balloon itself (18).

In 1988, Åkervall et al. introduced manovolumetry for rectal compliance measurements. They recorded rectal volume in response to rectal distension with a pre-set pressure (18). This technique was originally designed for the investigation of compliance of the bladder and the stomach (19,20) and is now considered as the correct way to measure compliance (11,12,17). At present, the optimum device to measure compliance correctly is a computer-controlled electromechanical air injection system, as originally introduced by Azpiroz and Malagelada (21). This device is able to provide a constant cumulative pressure stimulus and to record the corresponding volume at each pressure step. Although we have not corrected our data for the internal compliance of our device, we think that we are allowed to compare the individual data of our patients and controls, because this small error is systematic. Nevertheless, in order to be able to compare our data with data from other studies, correction for the distensibility of the internal system of the device will be necessary.
Some authors advocate the determination of the Incremental Elastic Modulus (IEM) of the rectal wall in order to investigate the viscoelasticity of the rectal wall during stress and strain. Stress is evaluated by inflating a balloon with air and simultaneously measuring the pressure within the balloon. Stress is calculated by relating the area under the pressure-radius curve. Strain is measured by inflation of a balloon in the rectum and simultaneously measuring the intrarectal radius by endosonography. Strain is taken as the ratio of change in radius to the original radius. Thereafter, a stress-strain graph is plotted, the slope of this curve reflecting rectal wall stiffness, or IEM (22). Simultaneous

measurement of pressure within the balloon and radius of the rectum can be performed by impedance planimetry (23,24). It is unclear whether this method provides more information than the compliance measurement used in this study.

In most studies, compliance has been given as one single value, calculated from the slope of the curve ($\Delta V/\Delta p$, 2-8,10). In none of the reports has it been made clear which slope was taken. In our opinion, it is difficult to determine which slope of S-shaped curve should be used. It might be worthwhile to investigate entire pressure-volume curves. To our knowledge, only De Medici et al. (9) have compared entire compliance curves of control subjects with those of patients with obstructed defecation. In their study, the mean compliance curve of the patients was found to fall within the normal range. In our study, the mean compliance curve obtained from the patients with obstructed defecation was identical to the mean compliance curve of the control subjects (Figure 2).

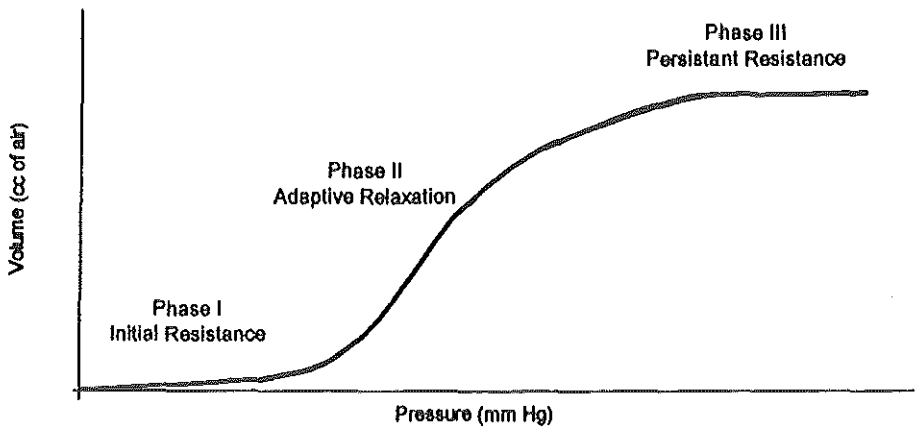

Figure 2. Fitted logistic curve, with one point of inflection.

Despite this finding, the course of the compliance curve fell above the normal range (mean + 2 SD) in 14 patients. In 10 of these 14 patients (71%), a large rectocele (>3 cm) was seen at evacuation proctography. Such a large rectocele was observed in only 5 (7,6%) of the 66 patients with a normal compliance curve. It has been suggested that

rectoceles are due to laxity of the rectovaginal septum. In our opinion, this laxity might be represented by the steeper compliance curve. Another explanation for the increased compliance in women with a large rectocele might be the fact that the barostat bag assumed the shape of the rectum including the rectocele at the anterior side, thereby measuring rectal plus rectocele capacity and compliance.

The measurement of rectal volume in response to cumulative pressure steps with a polyethylene bag connected to a computer-controlled electromechanical barostat system, reveals a characteristic tri-phasic compliance curve (Figure 2). Others have observed the same curve (25,26). During the first phase, the increase of pressure only gives rise to a small increase of volume, probably reflecting an initial resistance of the rectal wall. The second phase of the compliance curve is situated around the mathematical 'point of inflection' and is characterized by a larger increase of volume, presumably reflecting an adaptive relaxation of the rectal wall. The last phase of the compliance curve is more flattened and probably represents increasing resistance of the rectal wall against further distension. At this point the distensibility of the rectal wall is reaching its limits.

There are very little data concerning the tri-phasic shape of the curve and the morphology of the rectal wall. It is interesting to consider what may contribute to the shape of the curve. Passive mechanical properties as well as active muscular components may be involved. Passive mechanical properties are represented by connective tissue and non-contractile muscle fibres. Collagen fibres are coiled at low pressures (17). This aspect probably accounts for the plateau of the first phase. When the load is increased, collagen fibres gradually uncrimp (17). This might explain the steep increase of the second phase, the point of inflection. Finally, the third phase is reached, in which the collagen fibres are actually being over-stretched. This hypothesis may be confirmed by comparing compliance of the human rectum in vitro and in vivo, with the administration of appropriate smooth muscle relaxants, combined with histological research. We have found some reports regarding rectal wall properties in vitro, but to our knowledge no reports correlating in vitro and in vivo data have been published yet (11,17.27).

It might also be possible that the tone of the smooth muscle fibres in the rectal wall contribute to the shape of the compliance curve. Active muscular resistance may account for the first and the third phase, adaptive relaxation of the smooth muscle fibres for the second phase. This is supported by the observation that the rectal compliance curve has been found to be almost linear in patients with complete spinal cord lesions. After implantation of sacral spinal stimulators in these patients, the pressure-volume curve regains its characteristic tri-phasic shape (25).

In patients with active ulcerative colitis, the compliance of the rectal wall has been found to be decreased, in contrast to patients with quiescent ulcerative colitis and healthy controls. Since ulcerative colitis is known to be a disease mainly affecting colonic mucosa, it is likely that the decrease of rectal compliance is caused by an increase of smooth muscular tone (28,29).

We suppose it is likely that a combination of passive elements, combined with active contractile properties of smooth muscles in the rectal wall, account for the distensibility of the rectum, but further research on this subject is warranted.

Defecation requires adequate intrarectal pressure, which can be raised by increasing intrapelvic pressure, achieved by voluntary contraction of the diaphragm and abdominal wall muscles. Furthermore, increase of rectal wall tone proximal to the fecal mass, as well as normal feelings of an urge to defecate, are essential for normal rectal evacuation. Our patients with obstructed defecation required larger pressures as well as higher volumes to evoke an urge to defecate when compared to control subjects. Diminished rectal perception of balloon distension has been reported previously in patients with constipation (4-10).

Eighty percent of the control subjects experienced a call to stool during the second phase of the compliance curve. In 75% of the patients, this occurred significantly later, at the end of the third phase. These data do suggest that rectal sensory perception is interwoven with rectal compliance. However, in our patients with obstructed defecation the mean pressure-volume curve was similar to that found in control subjects. Following this finding, it is unlikely that alterations in rectal wall components, such as collagen and

smooth muscle fibres, contribute to the problem of obstructed defecation. Based on the results outlined in chapter 2, and the results of the present study, it seems that patients with obstructed defecation have a derangement that mainly affects rectal sensorimotor function.

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Chapter 4

Rectal Sensory Perception in Women with Obstructed Defecation

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Adapted from manuscript, Diseases of Colon and Rectum, accepted for publication.

ABSTRACT

Parasympathetic afferent nerves are thought to mediate rectal filling sensations. The role of sympathetic afferent nerves in the mediation of these sensations is unclear. Sympathetic nerves have been reported to mediate "nonspecific" sensations in the pelvis or lower abdomen in patients with blocked parasympathetic afferent supply. It has been reported that the parasympathetic afferent nerves are stimulated both by 'slow ramp' (cumulative) and 'fast phasic' (intermittent) distension of the rectum, whereas the sympathetic afferent nerves are only stimulated by 'fast phasic' distension. Therefore, it might be useful to utilize the two distension protocols in order to differentiate between a parasympathetic or sympathetic afferent deficit. Sixty control subjects (M/F: 9:51) and 100 female patients with obstructed defecation entered this study. Rectal sensory perception was assessed with an 'infinitely' compliant polyethylene bag and a computer-controlled air injection system. This bag was inserted into the rectum and inflated with air to selected pressure-levels according to two distension protocols (fast phasic and slow ramp). The distending pressures, needed to evoke rectal filling sensations, first sensation of content in the rectum (FS), earliest urge to defecate (EUD) and the maximum tolerable volume (MTV) were noted. In all controls rectal filling sensations could be evoked. Twenty-one patients experienced no sensation at all in the pressure range between 0 and 65 mm Hg neither during slow ramp, nor during fast phasic distension. The pressure thresholds for FS, EUD, and MTV were significantly higher in patients with obstructed defecation ($p<0,001$). In each subject the pressure thresholds for FS, EUD, and MTV were, regardless the type of distension, constantly the same. In conclusion, rectal sensory perception is blunted or absent in the majority of patients with obstructed defecation. The fact that this abnormality can be detected by both distension protocols, suggests that the parasympathetic afferent nerves are deficient. Since none of the patients experienced a "nonspecific" sensation in the pelvis or lower abdomen during fast phasic distension, it seems likely that the sympathetic afferents are also defect. This finding implies that it is not worthwhile to use different distension protocols in patients with obstructed defecation.

INTRODUCTION

Many women with obstructed defecation report that their feelings of a call to stool are blunted or absent. Balloon distension of the rectum is a widely used, simple method to measure rectal sensory perception. It has been shown that the perception of a balloon distending the rectal wall is reduced in patients with obstructed defecation (chapter 2 and 3, 1-9). In these studies, different balloons of different shapes and sizes were used. Some workers inflated the stimulating balloon with air, whereas others used water (1-9). Some investigators used 'phasic' distension, characterized by periods of balloon inflation, separated by periods of balloon deflation. Other workers used 'ramp' distension or 'staircase' distension, both characterized by cumulative stimuli. Recently it has been described that an 'infinitely' compliant polyethylene bag is the optimum device for the evaluation of rectal sensory perception. The pressure in this bag truly represents the pressure inserted on the rectal wall (10,11). Sensory signals from the rectum are transported both by parasympathetic and sympathetic afferent nerves. The parasympathetic afferent nerves are thought to mediate rectal filling sensations (12-14). Although the exact role of the sympathetic afferent nerves is not clear, there is growing evidence that these nerves mediate feelings of abdominal pain in patients with the irritable bowel syndrome (15-17). It has been reported that the parasympathetic afferent nerves are stimulated by both 'slow ramp' (cumulative) and 'fast phasic' (intermittent) distension of the rectum. The sympathetic afferent nerves are only stimulated by 'fast phasic' (intermittent) distension (12-16,18,19). In patients with a complete thoracic spinal cord lesion below T7, the parasympathetic pathway is blocked completely, whereas the sympathetic pathway through the splanchnic thoracolumbar nerves is partially intact. These patients experience no rectal filling sensations, neither during slow ramp, nor during fast phasic distension (15). However, during fast phasic distension, the majority of the patients report a "nonspecific" sensation in the pelvis, or lower abdomen, characterized as "fullness", "stool", or "discomfort" (15,18,20). This sensation is supposed to be mediated by the sympathetic afferent nerves. Patients with a high cervical

lesion, in whom the parasympathetic and the sympathetic pathways are both blocked totally, perceived no sensation whatsoever during balloon distension (18).

Based on the assumption that different distension protocols stimulate distinct afferent nerve pathways, it might be possible to utilize slow ramp and fast phasic distension protocols in order to differentiate between a parasympathetic or sympathetic afferent deficit in women with obstructed defecation.

PATIENTS AND METHODS

Patients

Between January 1998 and September 1998, 100 female patients (median age: 50, range: 18-75 years) with obstructed defecation entered the study. Obstructed defecation was diagnosed when two or more of the following symptoms were present: prolonged and unsuccessful straining at stool, feeling of incomplete evacuation, manual assistance and the regular use of laxatives and enemas. Of these women, 49 reported onset of symptoms following pelvic surgery (hysterectomy: N=36, rectopexy: N=8, other: N=5) and 6 following vaginal childbirth. In 45 women the onset of symptoms was less clear. Twelve women used antidepressant drugs. None of the patients were known to suffer from a systemical neurological disease, or diabetes mellitus. In all patients, total colonic transit time was assessed according to Dorval, as described in chapter 2. Sixty-seven patients had a normal and 33 a prolonged transit time.

For comparison, 60 control subjects (Male/Female ratio: 9:51; median age: 48, range: 20-70 years) were also studied. Thirty-five subjects were normal healthy volunteers and 8 were recruited from those awaiting surgery for familial adenomatous polyposis coli, not affecting the rectum. The other 17 subjects were awaiting surgery for a small peri-anal fistula. None of the control subjects had symptoms or signs of rectal disease, all were continent and all had a normal defecation pattern. They were not taking any medication, except for oral contraceptives (N=16), and had no neurological disease. This study was approved by the local ethical committee. All subjects gave written informed consent.

No bowel preparation was used. All patients were asked to attempt defecation and to empty their bladder prior to the measurements. A digital examination was performed to ensure that the rectal ampulla was empty of feces.

Methods

A thin, 'infinitely' compliant polyethylene bag, and a computer-controlled air injection system were used, as described in chapter 2 and 3. The air injection system was switched on at least 45 minutes before the measurement, in order to allow the device to warm up. This time allows for the temperature drift of the pressure transducer to reach its maximum. With the patient in left lateral position, the bag was inserted into the rectum and positioned at 10 cm from the anal verge. This was accomplished with the help of the scale on the catheter. Before each measurement, the bag was inflated and deflated with approximately 100 cc of air, in order to unfold it. After an adaptation period of 15 minutes, the bag was inflated with air according to one of the following distension protocols.

Slow ramp distension: The bag is continuously inflated at a rate of approximately 40 cc of air per minute (Figure 1).

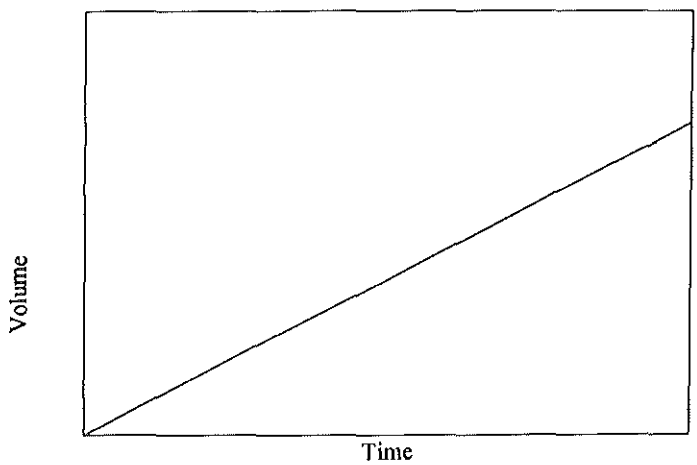

Figure 1. Representation of slow ramp distension protocol

Fast phasic distension: The bag is inflated to a baseline pressure of 5 mm Hg. Then, the pressure within the bag is increased in steps of 5 mm Hg for 20 seconds. After each step, the bag is deflated until the baseline pressure is reached (Figure 2). After 40 seconds the next cycle begins. The bag is inflated with a rate of approximately 1800 cc of air per minute.

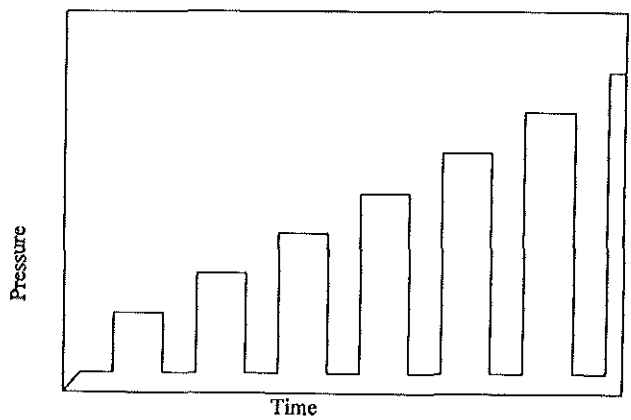

Figure 2. Representation of fast phasic distension protocol

All subjects were instructed to report when they experienced rectal filling sensations: first sensation of content in the rectum (FS), earliest urge to defecate (EUD) and an irresistible, painful urge to defecate (maximum tolerable volume, MTV). The various levels of distending pressures, needed to evoke these different sensations were noted.
In all cases, the bag was deflated when the patient or control subject experienced severe discomfort (maximum tolerable volume). The bag was deflated automatically when a preselected pressure of 65 mm Hg and/or a preselected volume of 600 cc of air was reached.

Statistical Analysis

Results are given as median values and range. Data of patients and control patients were compared using the Mann-Whitney U-test for unpaired data. Paired T-tests were used to

compare the different inflation protocols. The limit of statistical significance was set at p=0,05 (two-sided).

RESULTS

All control subjects experienced rectal filling sensations in the range between 0 and 65 mm Hg. Recordings obtained in male and female controls showed no significant differences. During slow ramp distension, the median pressure threshold for EUD in the control group was 26,2 mm Hg. This threshold was similar to that obtained during fast phasic distension (25,0 mm Hg). Regarding the pressure thresholds for FS and MTV in both distension protocols, similar findings were noted, as outlined in the following Table.

	Controls (N=60)	**Patients (N=100)**	**Statistical Significance**
Slow ramp distension			
FS	17,0 (5-26)	28,2 (12-65)	p<0,001
EUD	26,2 (13-38)	40,3 (16-65)	p<0,001
MTV	36,8 (19-58)	56,2 (23-65)	p<0,001
Fast phasic distension			
FS	15,4 (8-25)	27,3 (10-65)	p<0,001
EUD	25,0 (14-36)	39,3 (14-65)	p<0,001
MTV	36,2 (19-60)	55,1 (24-65)	p<0,001

Table. Median pressures (and range, mm Hg) to evoke the first sensation (FS), earliest urge to defecate (EUD), and maximum tolerated volume (MTV).

Twenty-one patients with obstructed defecation experienced no sensation at all in the pressure range between 0 and 65 mm Hg, neither during slow ramp, nor during fast

phasic distension. In the entire group of patients, the median pressure threshold for EUD was 40,3 mm Hg during slow ramp distension. This threshold was similar to that obtained during fast phasic distension (39,3 mm Hg). There was no significant difference in perception of FS and MTV comparing slow ramp and fast phasic distension (Table 1). In the patients with obstructed defecation, the pressures needed to evoke rectal filling sensations were significantly higher compared to control subjects (p<0,001, Figure 3 and 4). The pressure thresholds observed in older subjects (>60 years) were similar to those found in younger subjects (<60 years). No difference in outcome was observed between patients with normal, and those with prolonged transit time.

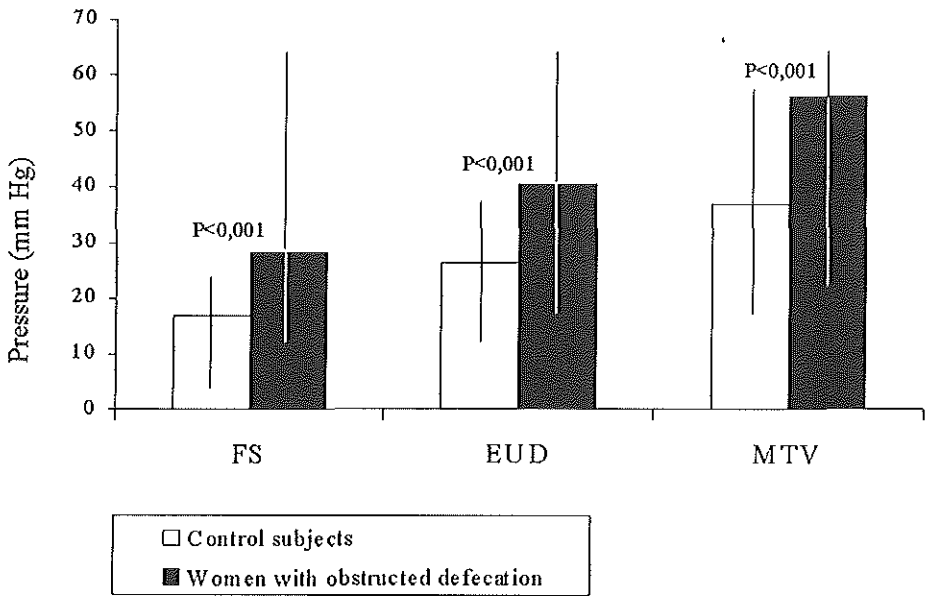

Figure 3. Thresholds for rectal filling sensations during slow ramp distension.

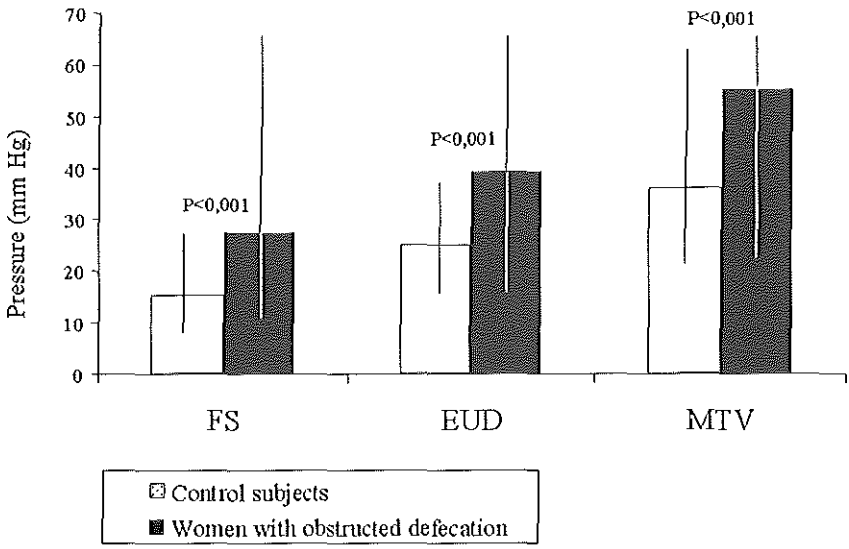

Figure 4. Thresholds for rectal filling sensations during fast phasic distension.

DISCUSSION

Initially, it was thought that rectal sensory perception depends on receptors located in the rectal wall, as well as in the pelvic floor. Based on recent studies, the role of the pelvic floor in sensory perception, is doubted (21,22). Sensory signals from the rectum are transported by both parasympathetic and sympathetic afferent nerves (21). The parasympathetic afferent nerves run from the rectum through branches which are situated on each side of the rectum, and around the cervix uteri. They also run on both lateral vaginal surfaces, and are applied to the lateral surfaces and base of the bladder. All these parasympathetic afferent nerves join in the inferior hypogastric (pelvic) plexus and run to the 2nd and 3rd sacral segments of the spinal cord (23-25). The parasympathetic afferent nerves mediate rectal filling sensations (12-14). Goligher and Hughes investigated rectal sensory perception in 6 patients before and after induction of low spinal anesthesia. Due to this anesthesia, all parasympathetic afferent nerves were blocked. None of the patients experienced any sensation during continuous (ramp) distension of the rectum with a balloon (26). Gunterberg et al. examined anorectal function in 4 patients with unilateral

and 3 patients with bilateral loss of sacral nerves after radical tumor excision. In the patients with unilateral loss of the sacral nerves, no significant impairment of anorectal function was noted. However, in the patients with bilateral loss of sacral nerves, there was a serious impairment of rectal filling sensations (27). The same observation was made by Nakahara et al (28).

The sympathetic afferent nerves run from the rectum together with the parasympathetic afferent nerve branches. They cross the inferior hypogastric plexus and run through the superior hypogastric plexus to the spinal cord between the 3rd thoracic and 3rd lumbar segments. Some sympathetic branches run directly to the sacral portion of the sympathetic trunk, and run upward via the thoracolumbar sympathetic trunk to the 3rd thoracic and 3rd lumbar segments (23-25). The physiological role of the sympathetic afferents is poorly understood (13,16). In the rat, destruction of these nerves has no effect on their defecation pattern (13). In the fifties, extensive sympathectomy was frequently employed to treat essential hypertension. During this procedure, the sympathetic outflow from T3 to L3 on both sides of the spine was divided. This operation also deprived the entire colon and rectum from their sympathetic afferent nerves. After this procedure, patients were still able to perceive normal rectal filling sensations during ramp (continuous) distension (26). The sympathetic afferent nerves have been reported to mediate "nonspecific" sensations in the pelvis or lower abdomen in patients with thoracic spinal cord lesions, in whom the parasympathetic afferent nerves are completely blocked, whereas the sympathetic afferent nerves are partially intact (15,18,20). The pathophysiology of obstructed defecation is still incompletely understood. Diminished rectal perception of balloon distension in patients with obstructed defecation has been reported previously (1-9). The cause of this alteration in rectal sensory perception is not clear. Increased rectal compliance might be a contributing factor, since it would require larger volumes to reach an adequate stimulating pressure on the rectal wall. However, as outlined in chapter 3, we found that rectal compliance was normal in patients with obstructed defecation, in whom rectal sensory perception was impaired. This finding is in accordance with those of De Medici et al (2). It has also been suggested that impaired

rectal sensory perception is due to a derangement of parasympathetic afferent nerves. It is well known that in some women, obstructed defecation starts, or deteriorates following pelvic surgery. Patients who have undergone rectopexy frequently experience diminished rectal sensory perception, attributed to the division of the 'lateral ligaments', which contain branches of both the parasympathetic and sympathetic afferent nerves (29-36). Also following hysterectomy, impairment of rectal sensory perception has been reported. The parasympathetic afferent nerves that run from the rectum through branches which are situated on each side of the rectum, around the cervix uteri, and both lateral vaginal surfaces are difficult to spare during hysterectomy (37-42). Varma et al. found that patients with symptoms of obstructed defecation following hysterectomy, had significantly increases thresholds for rectal filling sensations to ramp distension (43).

It has also been suggested that a central neurogenic deficit may attribute to impaired rectal sensory perception. It is most likely that this central deficit is situated in the anterior side of the pons cerebri, were also the coordinating center of micturition is located (44). Fukuda et al. have reported that neurons in the reticular area of the pons respond to stimulation of parasympathetic afferent nerves which run from the rectum (45). Moreover, it has been observed that patients with a vascular lesion of the pons did not have any sensation during balloon distension at all (46). The parasympathetic afferent nerves can be stimulated by both slow ramp and fast phasic distension of the rectum. The sympathetic afferent nerves can only be stimulated by fast phasic distension (15-19). This implies that it might be useful to utilize these two distension protocols in order to differentiate between a parasympathetic or sympathetic afferent deficit. If the parasympathetic afferent nerves are intact, normal rectal filling sensations will be experienced. In case of a parasympathetic deficit and normal functioning of sympathetic afferents, no rectal filling sensations will be experienced, except for a "nonspecific" sensation in the pelvis or lower abdomen at fast phasic distension (15,18,20). If both afferent pathways are defect, no sensation whatsoever will be experienced. In control subjects, as well as in women with obstructed defecation, no difference was found in perception of slow ramp and fast phasic distension. The same observation was made by

Hammer et al, who report that different distension protocols and different rates of inflation had little effect on rectal perception (46). However, Sun et al. observed a higher perception threshold for fast distension rates compared to slow rates in control subjects. Furthermore, they observed that during phasic distension, rectal volumes required to elicit filling sensations were lower than during ramp distension (47). Plourde et al. also found that sensory thresholds increased with increasing rate of distension, whereas they observed that rectal sensory perception for ramp and phasic distensions were similar (48). We have no explanation for the fact that our findings are not in accordance with those reported by Sun and Plourde. Twenty-one patients did not perceive any rectal filing sensation at all, neither during slow ramp nor during fast phasic distension. This observation suggests a parasympathetic deficit in these patients. If the sympathetic afferent nerves would be intact, the patient would be able to feel "nonspecific" sensations in the pelvis or lower abdomen during fast phasic distension. During fast phasic distension however, none of the women experienced such a sensation. This suggests that the sympathetic afferent nerves are defect as well. In the majority of the remaining patients, rectal filling sensations were blunted, both during slow ramp and fast phasic distension. These patients also did not perceive a "nonspecific" sensation during fast phasic distension. It seems likely that also in these patients both afferent pathways are deficient. Because symptoms of obstructed defecation started shortly after pelvic surgery in 49 of the patients, we assume that this deficit is located at a peripheral level and not at a central level.

In conclusion, rectal sensory perception is blunted or absent in the majority of patients with obstructed defecation. The fact that this abnormality can be detected by both distension protocols, suggests that the parasympathetic afferent nerves are deficient. Since none of the patients experienced a "nonspecific" sensation in the pelvis or lower abdomen during fast phasic distension, it seems likely that the sympathetic afferents are also defect. This finding implies that it is not worthwhile to use different distension protocols in patients with obstructed defecation.

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Chapter 5

The Gastrorectal Reflex in Women with Obstructed Defecation

And then to breakfast, with what appetite you have

William Shakespeare, King Henry VIII

M.J. Gosselink and W.R. Schouten

Adapted from manuscript, International Journal of Colorectal Disease, accepted for publication.

ABSTRACT

The aim of this study was to evaluate the tonic response of the rectum to a meal in women with obstructed defecation. Fifteen control subjects and 60 women with obstructed defecation were studied. Total colonic transit time was normal in 30 patients (group I) and prolonged in the other 30 (group II). After over-night fasting, an 'infinitely' compliant polyethylene bag was inserted into the rectum. Rectal tone was assessed by measuring variations in bag volume with a computerized electromechanical air injection system. After an adaptation period of 30 minutes, all subjects consumed a 450-kcal liquid meal. Postprandial recordings were continued for three hours. In a second recording session, we investigated the tonic response of the rectum to an evoked urge to defecate. In a third session rectal sensory perception was assessed. Following the meal, all controls showed an increase in rectal tone (mean value: 74,8±17%). Patients in whom colonic transit time was normal showed a similar tonic response. In group II, the increase in rectal tone was significantly lower (mean value: 27,8±10%, $p<0,001$). Three patients of this group showed no response to a meal at all. All controls showed an increase in rectal tone during an evoked urge to defecate (mean value: 39,2±9%). In group I and II, this tonic response was absent or significantly blunted (mean values: 15,3±6% and 16,4±5%, respectively, $p<0,001$). In both patientgroups rectal sensory perception was significantly impaired. In conclusion, in patients with obstructed defecation in whom colonic transit time is normal, the gastrorectal reflex is intact. The increase in rectal tone after a meal is absent or blunted in patients with obstructed defecation, in whom transit time is prolonged. The tonic response of the rectum to an evoked urge to defecate, as well as rectal sensory perception are significantly impaired both in patients with a normal and in those with a prolonged transit time.

INTRODUCTION

The stimulating effect of food on colonic motility is a frequently reported finding, a response called 'the gastrocolonic reflex' (1). Until recently, the influence of a meal on the rectum was less clear. Utilizing intrarectal pressure recordings, some authors observed no increase in rectal motility after a meal (2-6), whereas others found a significant rectal response to a meal (7-11).

Until the introduction of barostat techniques, measurements of rectal motor activity could only be assessed by these intraluminal pressure recordings (12). As described previously, changes in tone, as measured with the electromechanical barostat system, are not demonstrable by intraluminal pressure recordings (13,14). With the help of barostat techniques, it has been demonstrated that rectal tone increases significantly after a meal (15-17). During this increase in rectal tone, simultaneous intraluminal pressure recordings revealed no concomitant changes in baseline pressure (17). Based on these findings, it may be concluded that there is a clear gastrorectal reflex.

Considering the impaired sensorimotor function of the rectum in women with obstructed defecation, as described in the previous chapters, we were interested in the tonic response of the rectum to a meal in those patients.

PATIENTS AND METHODS

Patients

Between February 1997 and August 1998, sixty female patients (median age: 32, range: 18-74 years) with obstructed defecation entered the study. Obstructed defecation was diagnosed when two or more of the following symptoms were present: prolonged and unsuccessful straining at stool, feeling of incomplete evacuation, manual assistance and the regular use of laxatives and enemas.

In all patients, total and segmental colonic transit time was assessed according to Dorval, as described in chapter 2. Based on the total colonic transit time, the patients were divided in two groups. Group I consisted of 30 patients with a normal total colonic transit time, and group II consisted of 30 patients with a prolonged transit.

Forty patients reported symptoms had started following pelvic surgery (hysterectomy: 30, rectopexy: 5, other: 5), divided equally over the two groups. None of the patients had a history of bowel surgery or rectocele repair. Forty-seven patients had children (mean: 2, range 1-4), (vaginal deliveries in 45, caesarian section in 2).

For comparison, fifteen control subjects (Male/Female ratio: 2/13; median age: 32, range: 21-67 years) were also studied. Eleven subjects were healthy volunteers and 4 were recruited from those awaiting surgery for familial adenomatous polyposis coli, not affecting the rectum. None of the control subjects had symptoms or signs of rectal disease. All were continent and all had a normal defecation pattern. None of them complained of abdominal pain. None of the control subjects had undergone abdominal or pelvic surgery previously. None of the controls was taking medications, except oral contraceptives (N= 3). All female volunteers of childbearing potential had a negative urine pregnancy test before participation in the study. The study was approved by the local ethical committee. All subjects gave written informed consent.

Methods

Recording session I - Tonic response of the rectum to a meal

A thin, 'infinitely' compliant polyethylene bag and a strain gauge with a computer controlled air injection system were used, as described in chapter 2. After insertion of the bag into the rectum, the computer-controlled air injection system keeps a constant intra-bag pressure. When rectal tone decreases, air is injected into the bag, to maintain the constant pressure within the bag. Conversely, when rectal tone increases, air is withdrawn from the bag. Rectal wall tone is assessed by measuring the variations in bag volume. These variations are expressed as percentage change from the baseline volume.

In all patients and control subjects, the recording was started after a 12 hours fasting period.

No bowel preparation was used. Patients and control subjects were asked to attempt defecation and to empty their bladder prior to the recording session. A digital examination was performed to ensure that the rectal ampulla was empty.

With the patient positioned in left lateral position, the bag was inserted into the rectum, at 10 cm from the anal canal. This was accomplished with the help of the scale on the catheter. Before each measurement, approximately 100 cc of air was injected in and aspirated from the bag to unfold it. Next, the bag was inflated to a pressure at which respiratory excursions were recorded as changes in intrabag volume. This operating pressure varied between 7,5 and 12,5 mm Hg. After an adaptation period of 30 minutes, all subjects consumed a liquid meal comprising a milkshake containing 450 kcal (48% carbohydrate, 39% fat and 13% protein, Nutridrink, Nutricia NV, Zoetermeer, The Netherlands). No change in position was permitted during ingestion of the meal. Postprandial recordings were continued for three hours.
Intra-bag volume variations due to moving, talking, laughing, and coughing were continuously monitored. Start of food ingestion and finishing of the meal were marked. During the whole recording session, individuals were instructed to signal feelings of an urge to defecate.

Recording session II - Tonic response of the rectum to an evoked urge to defecate
This recording was performed as described in chapter 2. Under radiological control an 'infinitely' compliant polyethylene bag was inserted over a guide wire into the proximal part of the rectum. Additionally, a latex balloon was introduced into the distal part of the rectum. This latex balloon was inflated until an urge to defecate was experienced. Rectal tone in response to this evoked urge to defecate was recorded.

Recording session III - Rectal sensory perception
With the patient in left lateral position, an 'infinitely' compliant bag was inserted into the rectum and positioned at 10 cm from the anal verge. Before each measurement, the bag was inflated and deflated with approximately 100 cc of air, in order to unfold it. Next, the bag was continuously inflated at a rate of approximately 40 cc of air per minute (see Figure 1 from chapter 4). Subjects were instructed to report when they experienced an urge to defecate. The level of distending pressure, needed to evoke this sensation was

noted. The bag was deflated automatically when a preselected pressure of 65 mm Hg and/or a preselected volume of 600 cc of air was reached.

Data analysis

Results of recording sessions I and II are given as mean value ± standard deviation. Results of session III are given as median and range. Data of patients and control subjects were compared using the Mann-Whitney U-test for unpaired data. The limit of statistical significance was set at p=0,05 (two-sided).

RESULTS

In group II, 18 patients had a prolonged transit time in all three colonic segments (right, left, and rectosigmoid colon). Twelve patients had a prolonged transit time in two segments.
The results of the three recording sessions are outlined in the following Table.

	Controls N=15	**Group I N=30**	**Group II N=30**
Tonic response of the rectum to a meal (%, mean ± standard deviation)	74,8±17	71,2±19 NS	27,8±10 p<0,001
Tonic response of the rectum to an evoked urge to defecate (%, mean ± standard deviation)	39,2±9	15,3±6* p<0,001	16,4±5* p<0,001
Pressure threshold evoking an urge to defecate (mm Hg, median and range)	27,2 (13-32)	42,7 (18-65) p<0,001	40,1 (18-65) p<0,001

* in N = 29 patients
NS = Not statistically significant

Table. Results of three recording sessions

Recording session I

All individuals completed the postprandial recording session lasting for 3 hours. There was no displacement of the bag during the recording session. All individuals were able to consume their meal within 15 (range: 7-15) minutes. The fasting volumes observed in the patients were similar to those found in controls.

After a mean time interval of 28,2±9 minutes, all control subjects showed a postprandial increase in rectal tone (mean value: 74,8±17%). Ten controls (67%) experienced a slight call to stool at the beginning of this tonic response of the rectum. Figure 1 shows a recording tracing of a control subject.

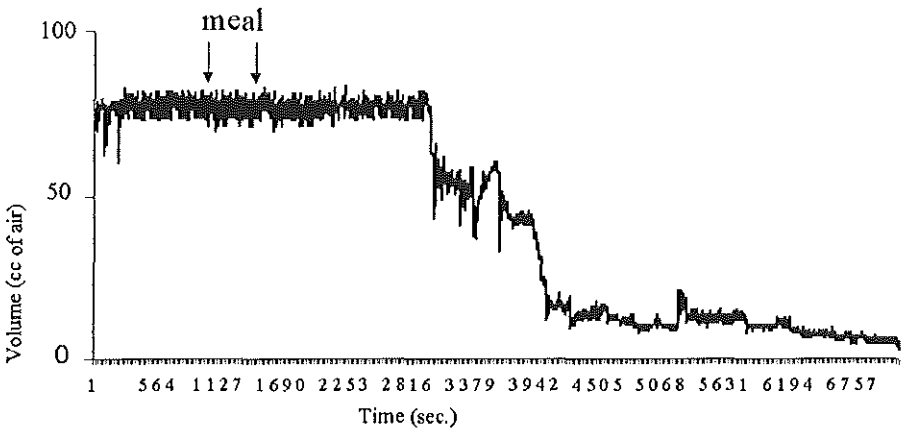

Figure 1. Rectal tone in response to a meal in a female control: the gastrorectal reflex.

After a mean time interval of 30,3±8 minutes, all patients in group I showed a postprandial increase of rectal tone, similar to that found in control subjects. Eighteen of these patients (60%) felt a slight call to stool during the first minutes after the increase in rectal tone. In five control subjects, and in 8 patients of group I, the barostatbag volume decreased to near zero and remained so until the recording was ended.

After a mean time interval of 32±12 minutes, the patients in group II showed a postprandial increase of rectal tone which was significantly lower compared to the tonic response of the rectum observed in controls and in patients with a normal transit time (mean value:

27,8±10%, p<0,001, Figure 2). Three patients in group II showed no change in rectal tone following a meal at all (Figure 3). They had an increased transit time in all three colonic segments. Eleven patients (37%) felt a slight call to stool during the first minutes after increase of rectal tone.

There was no significant difference between controls and both patientgroups regarding the duration of the postprandial response. The median duration of this response was 98 minutes (range: 41 minutes-still present at end of measurement).

Recording session II

In all control subjects the evocation of an urge to defecate induced an increase in rectal tone (mean value: 39,2±9%), proximal to the distal stimulating balloon.

In two patients with obstructed defecation, the measurement of rectal tone in response to an evoked call to stool could not be performed, since radiological control revealed compression of the proximal barostatbag by the distal stimulating balloon. In group I and II, the tonic response of the rectum was significantly lower compared to controls (mean values: 15,3±6% and 16,4±5%, respectively). Four of the patients in group I, and 3 in group II showed no response of the rectum at all.

Recording session III

All control subjects experienced an urge to defecate in the pressure range between 0 and 65 mm Hg. The median pressure threshold for an urge to defecate in the control group was 27,2 mm (range: 13-32) mm Hg. Recordings obtained in male and female controls showed no significant differences. In both patientgroups, the pressure thresholds for an urge to defecate were significantly higher compared to control subjects (p<0,001).

In group I, the median pressure threshold was 42,7 mm Hg (range 18-65). In this group, 7 patients experienced no urge to defecate in the pressure range between 0 and 65 mm Hg.

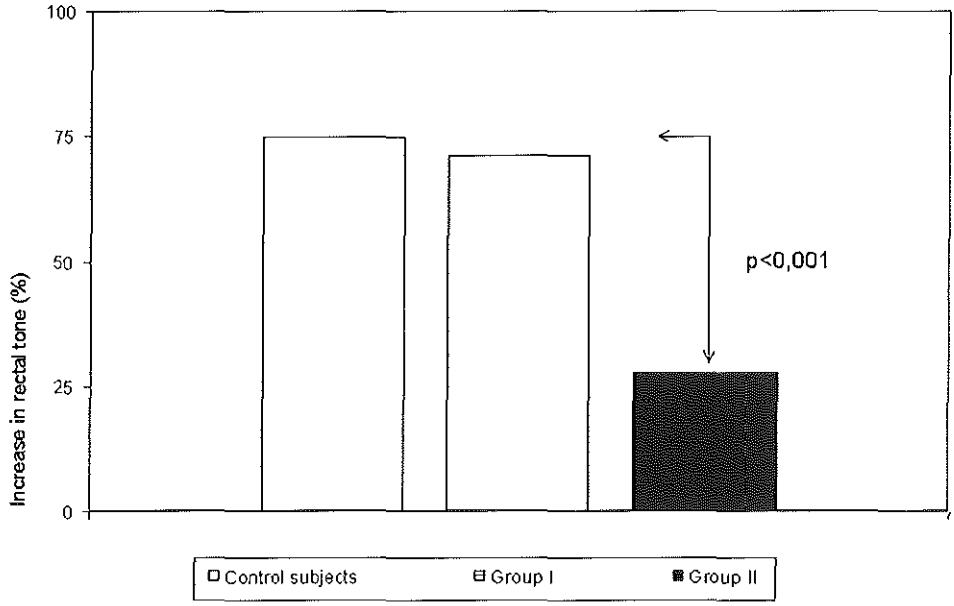

Figure 2. Increase in rectal tone following a meal in controls and women with obstructed defecation with normal and prolonged TCTT. Increase in rectal tone is expressed as percentage change from the baseline volume.

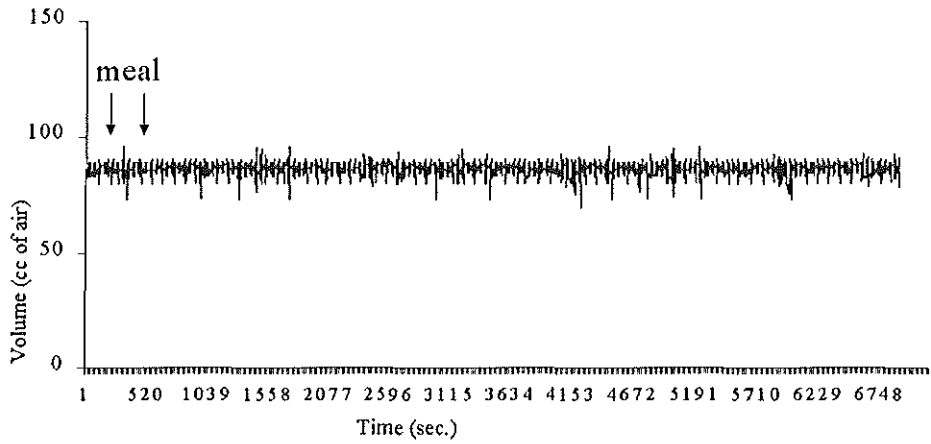

Figure 3. Rectal tone in response to a meal in a patient with prolonged colonic transit time. No increase in rectal tone is observed.

In group II, the median was threshold to evoke an urge to defecate was 40,1 mm Hg (range: 18-65). Five of these patients felt no urge to defecate at all.

In none of the recordings, there was a difference in outcome between patients with and without previous pelvic surgery or between patients with or without previous pregnancy. Results observed in older subjects (>60 years) were similar to those found in younger subjects (<60 years).

DISCUSSION

The increase in colonic activity in response to a meal was first described in 1913 by Hertz et al, and referred to as the 'gastrocolic reflex' (18). The mechanisms mediating the colonic response to a meal are still unclear. Putative mechanisms are both neuronal and hormonal.

Based on the results of the present study, and the observations of others, it is clear that there also exists a 'gastrorectal reflex'. There is some evidence that this reflex is a local reflex, rather than a component of an extended, propagating reflex. It has been shown that the 'high amplitude propagated contractions' (HAPC's) of the colon descend along the whole colon, but do not migrate beyond the distal sigmoid colon (19-22).

The physiological significance of the gastrorectal reflex is obscure. It has been suggested that this reflex contributes to postprandial defecation. Following a meal, the number of HAPC's of the colon increase (3,19-25). These contractions may propagate a fecal mass via the sigmoid into the rectum. At that moment, rectal tone is increased due to the gastrorectal reflex. This results in a greater incremental pressure from the fecal mass on the rectal wall, providing a heightened sensation, resulting in an urge to defecate (17). This is confirmed by the observation that distension volumes needed to elicit an urge to defecate are significantly reduced following a meal (26). This suggests that the increased tension in the rectal wall following a meal results in a change in the set point at which receptors in the wall are stimulated (19,27). In the present study, 67% of the control subjects experienced a slight urge to defecate during the first minutes after increase of rectal tone, compared to only 37% of the

patients in group II. In these patients, the impaired increase in rectal tone might result in less intense rectal filling sensations, and probably a blunted stimulus for rectal contraction.

The present study reveals that rectal tone increases significantly after a meal. In patients with obstructed defecation in whom colonic transit time is normal (group I), a similar response was observed. In patients with a prolonged transit time (group II), this response was absent or significantly blunted. This latter observation is in accordance to that reported by Grotz et al (16).

Patients with a normal colonic transit time (group I) had a normal rectal response to a meal, despite the impaired sensorimotor function of their rectum. Since there is growing evidence that rectal sensorimotor function is regulated by the extrinsic parasympathetic sacral nerves, this finding indicates that the postprandial response is independent of these nerves. This assumption is supported by the finding that patients with a cauda equina syndrome, who suffer from obstructed defecation also, show a completely normal rectal response to a meal (15).

In patients with prolonged transit time (slow transit constipation), the neuron density of the myenteric plexus in the colonic wall is lower compared to controls (28,29). This observation suggests that a diminished responsiveness of the intrinsic nervous system of the rectal wall to the yet unknown stimulus underlying the gastrorectal reflex may be responsible for the impaired gastrorectal reflex in these patients.

The mechanisms underlying the gastrorectal reflex are unclear. It has been suggested that the vagal nerve, the sympathetic nervous system, as well as gastrointestinal hormones contribute to this reflex. The vagal nerve acts via the cholinergic system. Although one author has reported that vagal innervation extends to the distal part of the colon and rectum in some individuals (30), later studies have not been able to confirm this observation (31-33). Therefore, it seems unlikely that the vagal nerve contributes to the gastrorectal reflex. Acetylcholine is known to increase rectal tone, since intravenous administration of neostigmine, an acetylcholine agonist, increases rectal tone (16,17). Moreover, administration of an anticholinergic drug inhibited the increase in distal colonic motility after a meal (34). This finding indicates that the response to food is cholinergically mediated.

Based on the findings of the present study, it seems unlikely that the extrinsic parasympathetic sacral nerves play a role in the gastrorectal reflex. It is more likely that the cholinergic component of the intramural nerve plexus mediates this reflex.

A second possible pathway is the sympathetic nervous system. This system has an inhibiting effect on bowel motor function (35,36). According to Christensen the postprandial colonic response is due to a transitory block of the sympathetic inhibitory effect on colonic motility (37). A similar transitory block of the sympathetic inhibitory influence on rectal tone might also play a role in the gastrorectal reflex (35).

A third pathway which might stimulate the intrinsic nerve plexus is non-neurogenic. In this pathway hormones are involved. Three hormones that are frequently described to have a stimulating influence on colonic motility are gastrin, motilin, and cholecystokinin. Although the levels of gastrin, motilin and cholecystokinin increase following a meal (9,38-43), the exact role of these hormones is unclear.

In conclusion, rectal tone increases significantly after a meal in controls, as well as in patients with obstructed defecation in whom colonic transit time is normal. This tonic response is absent or significantly blunted in patients with a prolonged transit time. The tonic response of the rectum to an evoked urge to defecate, as well as rectal sensory perception are significantly impaired both in patients with a normal, and patients with a prolonged transit time. Since there is growing evidence that this impaired sensorimotor function of the rectum is due to an extrinsic parasympathetic sacral nerve deficit, it is unlikely that the gastrorectal reflex is mediated by these nerves.

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Chapter 6

Rectal Tone in Response to Topical Bisacodyl in Women with Obstructed Defecation

For love of God do take some laxative;
Upon my soul that's the advice to give

Pertelote, The Nun's Priest's Tale, Canterbury Tales

M.J. Gosselink and W.R. Schouten

Adapted from manuscript, International Journal of Colorectal Disease, accepted for publication.

ABSTRACT

The aim of this study was to investigate the tonic response of the rectum to topical application of bisacodyl in women with obstructed defecation. Forty-five women with obstructed defecation, and 15 female controls were studied. Total colonic transit time was normal in 35 patients, and prolonged in ten. For the purpose of this study, an 'infinitely' compliant polyethylene bag was inserted into the rectum. Rectal tone was assessed by measuring variations in bag volume with a computerized electromechanical air injection system. After an adaptation period of 30 minutes, a suppository containing 10 mg bisacodyl was inserted into the rectum. Recording was continued for 90 minutes. In a second recording session, rectal tone in response to an evoked urge to defecate was assessed. In a third session we investigated rectal sensory perception. After a mean time interval of 30±15 minutes following intrarectal application of bisacodyl, all controls showed a significant increase in rectal tone (mean value: 68,2±12%). In patients with a normal transit time, a similar increase was observed. In patients with prolonged transit time, the tonic response of the rectum to bisacodyl was significantly lower (mean value: 21,1±11%, $p<0,001$). Five of these patients showed no response at all. In the second recording session, all controls showed an increase in rectal tone during an evoked urge to defecate (mean value: 36,3±7%). In both patientgroups this tonic response was absent, or significantly blunted (mean value: 19,2±6%, $p<0,001$). In both patientgroups rectal sensory perception was impaired significantly. In conclusion, rectal tone increases significantly after topical application of bisacodyl in controls as well as in patients with obstructed defecation in whom transit time is normal. This tonic response is absent or significantly blunted in patients with a prolonged transit time. The tonic response of the rectum to an evoked urge to defecate, as well as rectal sensory perception are significantly impaired in both patients with a normal and with a prolonged transit time.

INTRODUCTION

Normal rectal evacuation requires adequate intrarectal pressure, which can be raised by increasing intrapelvic pressure, achieved by voluntary contraction of the diaphragm and abdominal wall muscles. Furthermore, increase of rectal tone proximal to the fecal mass, as well as normal sensory perception, contribute to normal rectal evacuation also. In patients with obstructed defecation, rectal sensorimotor function is significantly impaired. Based on former data, it has been suggested that an extrinsic parasympathetic sacral nerve deficit is a major contributing factor to the impaired sensorimotor function of the rectum in women with obstructed defecation. This assumption is supported by the observation that injury to these nerves results in obstructed defecation (1-7). Bisacodyl (4,4-diacetyl-bis-hydroxyphenyl-pyridyl (2)-methan), is frequently used by patients with obstructed defecation. Despite the frequent utilization of this drug and the approval by the FDA in 1957 (8), the exact mechanism of its action is still not clear. It is supposed that its mechanism of action lies in direct stimulation of the intrinsic gastrointestinal nerve plexus (9-11). After we found that the tonic response of the rectum to an evoked urge to defecate is impaired in women with obstructed defecation, we were interested in the tonic response of the rectum to topical application of bisacodyl in those patients.

PATIENTS AND METHODS

Patients

Between September 1998 and September 1999, 45 women with obstructed defecation (median age: 40, range: 18-71 years) entered the study. Obstructed defecation was diagnosed when two or more of the following symptoms were present: prolonged and unsuccessful straining at stool, feeling of incomplete evacuation, manual assistance and the regular use of laxatives and enemas. Thirty-three patients reported symptoms had started following pelvic surgery (hysterectomy: 29, other: 4). None of the patients had a history of bowel surgery or rectocele repair. Thirty-seven patients had children (mean: 2, range 1-4), (vaginal deliveries in 34, caesarian section in 2).

In all patients, total colonic transit time was assessed according to Dorval (chapter 2). Total colonic transit time was normal in 35 women and prolonged in 10.

For comparison, fifteen female controls (mean age: 38, range: 21-67 years) were also studied. Twelve women were healthy volunteers and 3 were recruited from those awaiting surgery for familial adenomatous polyposis coli, not affecting the rectum. None of the control subjects had symptoms or signs of rectal disease. All were continent and all had a normal defecation pattern. None of them complained of abdominal pain. None of the control subjects had undergone abdominal or pelvic surgery previously. None of the controls was taking medications, except oral contraceptives (N= 3). All women of childbearing potential had a negative urine pregnancy test before participation in the study. The study was approved by the local ethical committee. All women gave written informed consent.

All patients and controls were asked to attempt to empty their rectum and bladder before the recording session.

Methods

Recording session I - Rectal tone in response to topical application of bisacodyl

Rectal wall tone was assessed with the help of an 'infinitely' compliant polyethylene bag and a strain gauge with a computer-controlled air injection system, as described in detail in chapter 5. Rectal tone was assessed by measuring the variations in bag volume. These variations were expressed as percentage change from the baseline volume.

After an adaptation period of 30 minutes, a suppository consisting of 10 mg bisacodyl (Centrafarm Services B.V, Etten-Leur, The Netherlands) was inserted into the rectum, at a distance of 5-7 cm from the anal canal. The recording was continued for 90 minutes. Intra-bag volume variations due to moving, talking, laughing, and coughing were continuously monitored. Individuals were instructed to signal feelings of an urge to defecate during the recording session.

Recording session II - Rectal tone in response to an evoked urge to defecate

This recording was performed as described in detail in chapter 2. An 'infinitely' compliant

polyethylene bag was inserted over a guide wire into the proximal part of the rectum, under radiological control. Additionally, a latex balloon was introduced into the distal part of the rectum. This latex balloon was inflated until an urge to defecate was experienced. The tonic response of the rectum to this evoked urge to defecate was recorded.

Recording session III - Rectal sensory perception

Rectal sensory perception was assessed as described in detail in chapter 4. During this session an 'infinitely' compliant polyethylene bag in the rectum was inflated with air at a rate of approximately 40 cc of air per minute. Subjects were instructed to report when they experienced an urge to defecate.

Statistical Analysis

Results of recording sessions I and II are given as mean value ± standard deviation. Results of session III are given as median and range. Data of patients and control subjects were compared using the Mann-Whitney U-test for unpaired data. The limit of statistical significance was set at p=0,05 (two-sided).

RESULTS

Results of the three recording sessions are outlined in the Table, printed on page 106.

Recording session I

After a mean time interval of 30±15 minutes following intrarectal application of bisacodyl, all controls showed a significant increase in rectal tone (mean value: 68,2±12 %). Three individuals showed a sustained increase in rectal tone following bisacodyl (Figure 1), whereas 12 showed a more wave-like pattern (Figure 2). This response lasted for at least 40 minutes (range: 40- still present at the end of the recording). All controls experienced a call to stool at the beginning of this response. In patients with a normal total colonic transit time, a similar increase in rectal tone was observed (mean value: 64,1±14%). A sustained increase in rectal tone was observed in 7 patients, and a more wave-like pattern in 28. The median

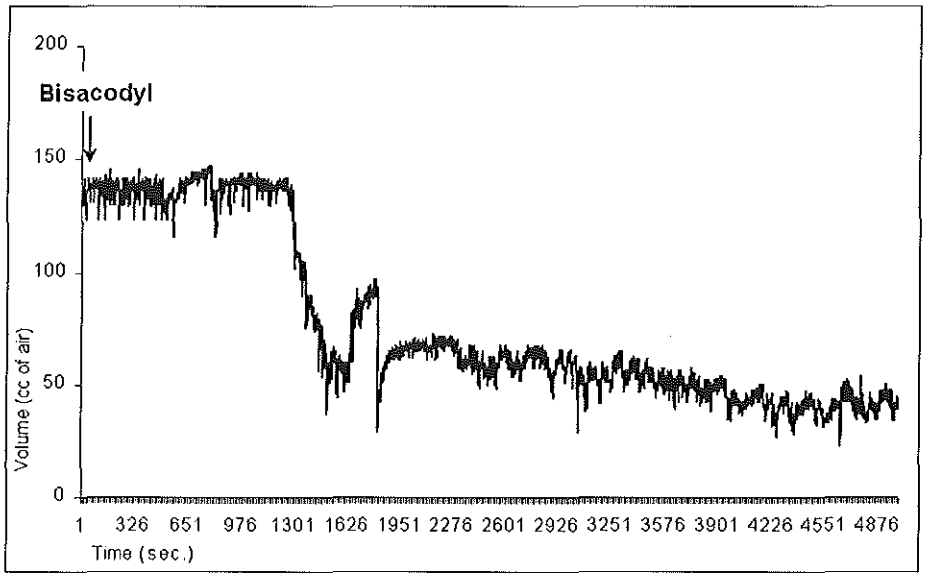

Figure 1. Recording of rectal tone in response to topical application of bisacodyl in a female control. A sustained tonic response is observed.

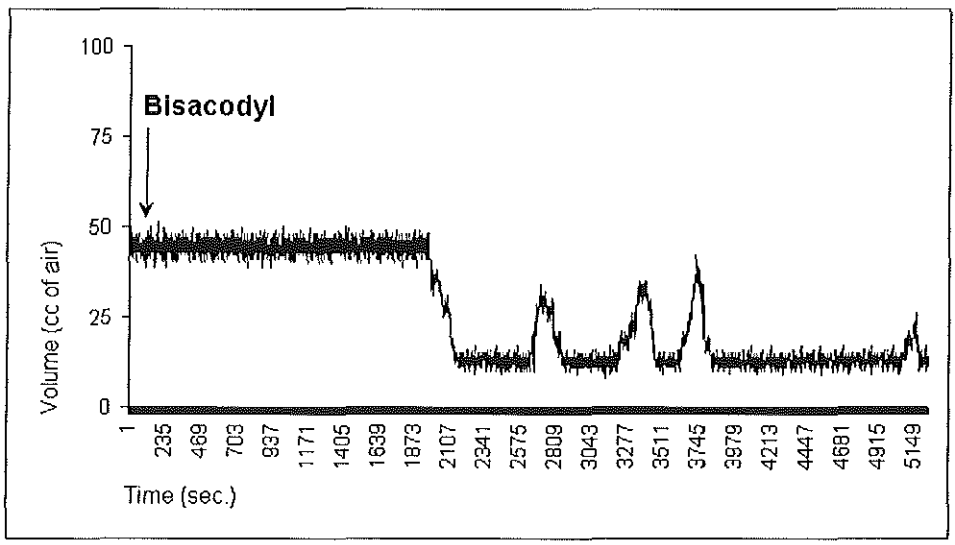

Figure 2. Recording of rectal tone in response to topical application of bisacodyl in a female control. A more wave-like pattern is observed.

duration of the response was similar to that found in controls. Thirty-three patients (94%) also experienced a call to stool at the onset of the response. In patients with prolonged transit time, the tonic response of the rectum to topical bisacodyl was significantly lower (mean value: 21,1±11%). In five of these patients, the rectum showed no response at all (Figure 3). The other 5 patients with an impaired tonic response, did report a call to stool during this response. Figure 3 represents the increase in rectal tone in all three study groups.

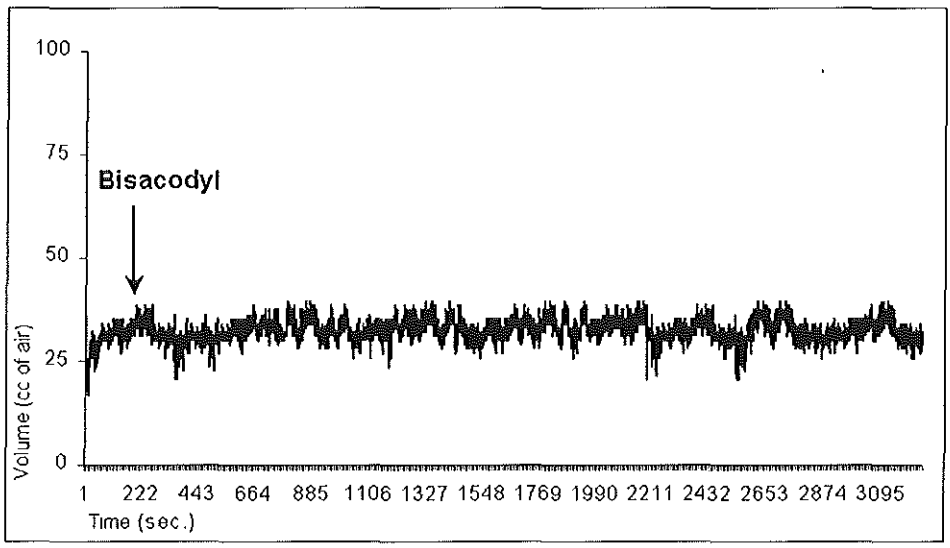

Figure 3. Recording of rectal tone in response to application of bisacodyl in a woman with obstructed defecation and prolonged transit time. No change in rectal tone is observed.

Recording session II

All controls showed an increase in rectal tone during an evoked urge to defecate (mean value: 36,3±7%). In all patients with obstructed defecation, this tonic response was significantly lower (mean value: 19,2±6%, $p<0,001$). In 4 patients with a normal colonic transit time, and in 2 patients with prolonged transit, this response was completely absent.

Recording session III

All control subjects experienced rectal filling sensations in the range between 0 and 65 mm Hg. The median pressure threshold for the earliest urge to defecate in the control

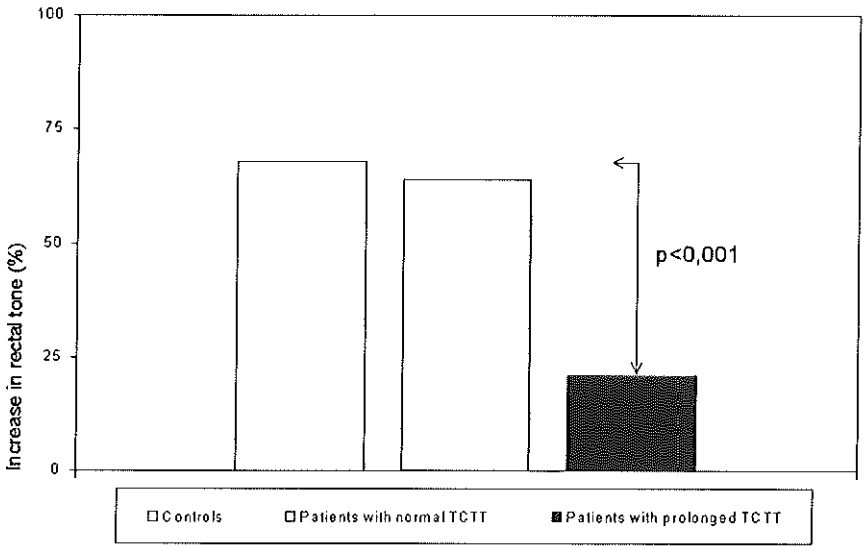

Figure 4. Representation of mean values of the increase in rectal tone in response to topical application of bisacodyl in all three study groups.

	Tonic response of the rectum to: (%, mean±standard deviation)		**Pressure threshold to evoke an urge to defecate** (mm Hg, median, range)
	Bisacodyl	**An evoked urge to defecate**	
Female controls	68,2±12	36,3±7	24,4 (13-32)
Patients with normal transit time	64,1±14	20,3±6*	44,2 (18-65)*
Patients with prolonged transit time	21,1±11*	19,1±5*	42,8 (18-65)*

*p<0,001

Table. Results of the three recording sessions

group was 24,4 (range: 13-32) mm Hg. In patients with obstructed defecation, the pressure thresholds for rectal filling sensations were significantly higher than those observed in controls (median: 43,7 (range: 18-65) mm Hg, $p<0,001$). Seven patients with a normal colonic transit time, and 2 with a prolonged transit, experienced no sensation at all in the pressure range between 0 and 65 mm Hg.

DISCUSSION

Intraluminal pressure recordings have revealed that intracolonic application of bisacodyl elicits high amplitude propagated contractions (HAPC's) in the colon (3,10,12-15). This response is blunted or absent in patients with slow transit constipation (9,12,14). Considering the fact that many patients with constipation or obstructed defecation apply suppositories containing bisacodyl, it is remarkable that, to our knowledge, the effect of intrarectal bisacodyl has not been studied yet. It has been shown that HAPC's do not migrate beyond the distal sigmoid colon (16-19). Despite this finding, it might be possible that these propagating contractions induce a change in rectal tone. It has however been shown that intraluminal pressure recordings do not demonstrate changes in tone (20-22). Barostat recordings have been stated to provide more information regarding the contractile state of the colon and rectum (23). Therefore we utilized the electromechanical barostat system in order to evaluate the rectal response to topical bisacodyl. The present study reveals that in female controls, rectal tone increases significantly after intrarectal application of bisacodyl. In patients with obstructed defecation in whom total colonic transit time is normal, a similar response was observed. In patients with a prolonged transit time this response was absent or significantly blunted. In both patientgroups, the sensorimotor function of the rectum was impaired. Despite this impaired sensorimotor function, patients with obstructed defecation and a normal colonic transit time showed a normal rectal response to bisacodyl. This finding indicates that the tonic response of the rectum to topical bisacodyl is independent of the extrinsic parasympathetic sacral nerves. Although the exact mechanism of its action is unknown, it has been suggested that bisacodyl has a direct effect on the intramural nerve plexus of the

colon and the rectum (9-11). This has been supported by the observation that the HAPC's, elicited by intracolonic application of bisacodyl, can be blocked by intraluminal installation of intraluminal lignocaine (a local anaesthetic that blocks the initiation and propagation of action potentials, 11). It has been established that in patients with slow transit constipation, the neuron density of the myenteric plexus in the colonic wall is lower compared to controls (24,25,26). This deficit of intrinsic neurons might be the reason why patients with prolonged total colonic transit time showed no, or only a significantly blunted response to bisacodyl.

In conclusion, rectal tone increases significantly after topical application of bisacodyl in controls as well as in patients with obstructed defecation in whom total colonic transit time is normal. This tonic response is absent or significantly blunted in patients with a prolonged transit time. Rectal sensorimotor function was significantly impaired both in patients with a normal and in those with a prolonged colonic transit time. Since there is growing evidence that the impaired sensorimotor function of the rectum is due to an extrinsic parasympathetic sacral nerve deficit, it is unlikely that the response of the rectum to bisacodyl is mediated by these nerves.

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Chapter 7

The Perineo-rectal Reflex

Too often we underestimate the power of a touch

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ABSTRACT

Many women with obstructed defecation apply digital pressure upon their perineum in order to facilitate defecation. Aim of this study was to investigate the impact of this manoeuvre on rectal tone. Forty-five female patients with obstructed defecation were studied. Thirty-four patients (76%) regularly applied digital pressure upon their perineum in order to facilitate defecation. Total colonic transit time was normal in 32 patients and prolonged in 13. For comparison, 17 female controls were studied. With the subject in left lateral position, a thin 'infinitely' compliant polyethylene bag was inserted into the rectum, at 10 cm from the anal canal. Rectal tone was assessed by measuring variations in bag volume with a computer-controlled electromechanical air injection system. After an adaptation period of 15 minutes, digital pressure was applied to the perineum by one of the authors (WRS). In a second recording session, the tonic response of the rectum to an evoked urge to defecate was examined. During the application of perineal pressure, all controls showed an increase in rectal tone (mean value: 52,8±19%). In the whole patientgroup, this response was significantly lower (mean value: 24,2±19%, $p<0,001$). Eight of these patients (18%) showed no response at all. None of them applied perineal pressure. In the remaining 37 patients (72%), the perineo-rectal reflex was present, but significantly lower (mean value: 29,8±17%, $p<0,001$). Thirty-four of these women (92%) told that they applied perineal pressure on a regular base in order to facilitate their defecation. All controls showed an increase in rectal tone during an evoked urge to defecate (mean value: 37,8±8%). In the patients, this response was significantly lower (16,7±6%). Eight of these patients showed no increase in rectal tone at all. These patients were the same subjects in whom the perineal-rectal reflex was absent. Regarding the tonic response of the rectum to perineal pressure, no difference was found between patients with a normal, and those with a prolonged colonic transit time.

In conclusion, digital pressure, applied upon the perineum, results in an increase in rectal tone. This perineo-rectal reflex is present, though significantly lower in the majority of women with obstructed defecation. This observation might explain why women with obstructed defecation frequently apply perineal pressure in order to facilitate their defecation.

INTRODUCTION

Many women with obstructed defecation report the need of manual assistance in order to facilitate their defecation (1,2). Some women can only expel feces if they open their anal canal with a finger (3). Others insert a finger into the vagina to support the rectovaginal septum during evacuation. Vaginal assistance is frequently reported by women with a large rectocele (2,4). Another manoeuvre is the application of digital pressure upon the perineum (5). Preston et al. have suggested that the puborectalis muscle is pushed upward by this manoeuvre. This might straighten the anorectal angle, enhancing the alignment between rectum and anal canal (1). This effect of digital pressure upon the perineum has not been confirmed by evacuation proctography.

The present study was conducted to investigate the impact of digital pressure upon the perineum on rectal tone.

PATIENTS AND METHODS

Patients

Between September 1998 and September 1999, 45 female patients (median age: 49, range: 18-64 years) with obstructed defecation entered the study. Obstructed defecation was diagnosed when two or more of the following symptoms were present: prolonged and unsuccessful straining at stool, feeling of incomplete evacuation, manual assistance during attempted evacuation, and the regular use of laxatives and enemas. Thirty-four of the patients applied digital pressure upon their perineum on a regular base in order to facilitate their defecation. In all patients, total colonic transit time was assessed according to Dorval, using a single type of radiopaque marker, ingested once a day during six days, and one abdominal X-ray performed on the seventh day (see chapter 2). Total colonic transit time was normal in 32 women and prolonged in 13.

For comparison, seventeen female controls (mean age: 38, range: 18-67 years) were studied. Twelve controls were normal healthy volunteers and 3 were recruited from those awaiting surgery for familial adenomatous polyposis coli, not affecting the rectum. Two had a small perianal fistula. None of the control subjects had symptoms or signs of rectal disease. All

were continent and all had a normal defecation pattern. None of them complained of abdominal pain. None of the control subjects had undergone abdominal or pelvic surgery previously. None of the controls was taking medications, except oral contraceptives (N= 4). All female controls of childbearing potential had a negative urine pregnancy test before entering the study. The study was approved by the local ethical committee. All subjects gave written informed consent.

Methods

Recording session I – Tonic response of the rectum to perineal pressure

A thin, 'infinitely' compliant polyethylene sandwich bag and a strain gauge with a computer-controlled air injection system were used, as described in chapter 2. After insertion of the bag into the rectum, the computer-controlled air injection system keeps a constant intra-bag pressure. When rectal tone decreases, air is injected into the bag, to maintain the constant pressure within the bag. Conversely, when rectal tone increases, air is withdrawn from the bag. Rectal wall tone is assessed by measuring the variations in bag volume. These variations are expressed as percentage change from the baseline volume.

After an adaptation period of 15 minutes, digital pressure was applied upon the perineum of the patient, by one of the authors (WRS).

Recording session II – Tonic response of the rectum to an evoked urge to defecate

This recording was performed as described in chapter 2. Under radiological control an 'infinitely' compliant polyethylene bag was inserted over a guide wire into the proximal part of the rectum. Additionally, a latex balloon was introduced into the distal part of the rectum. This latex balloon was inflated until an urge to defecate was experienced. Simultaneously, rectal wall tone was assessed by measuring the variations in volume in the proximal bag, as described above.

Statistical Analysis

Results are given as mean value ± standard deviation. Data of patients and control patients were compared using the Mann-Whitney U-test for unpaired data. Statistical significance was assigned to any probability value of less than 0,05 (two sided).

RESULTS

Recording session I

During application of digital pressure upon the perineum, rectal tone increased in all control subjects (mean value: 52,8±19%) (Table). Figure 1 shows a recording tracing of this perineo-rectal reflex.

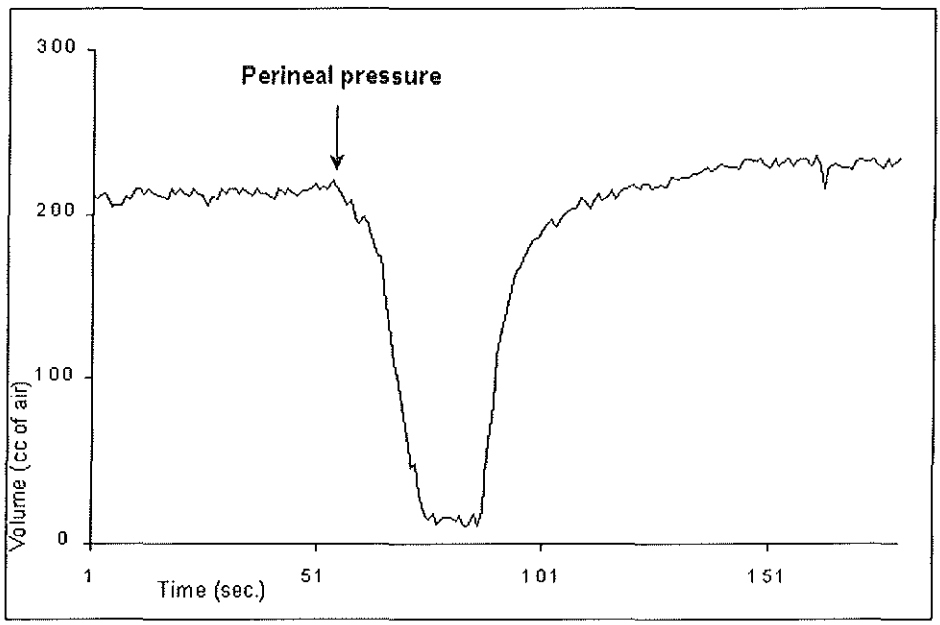

Figure 1. Recording of a female control, showing a pronounced increase in rectal tone in response to digital pressure upon the perineum

In the whole patientgroup this reflex was significantly lower (mean value: 24,2±19%, $p<0,001$) (Figure 2). Eight of these patients (18%) showed no response at all. None of them

applied perineal pressure. Figure 3 shows a recording tracing obtained in one of these patients. In the remaining 37 patients, the reflex was present, but significantly lower (mean value: 29,8±17, $p<0,001$). Thirty-four of these women (92%) reported that they frequently applied pressure upon the perineum in order to facilitate their defecation. Regarding the perineo-rectal reflex, no differences were observed between patients with a normal, and those with a prolonged colonic transit time.

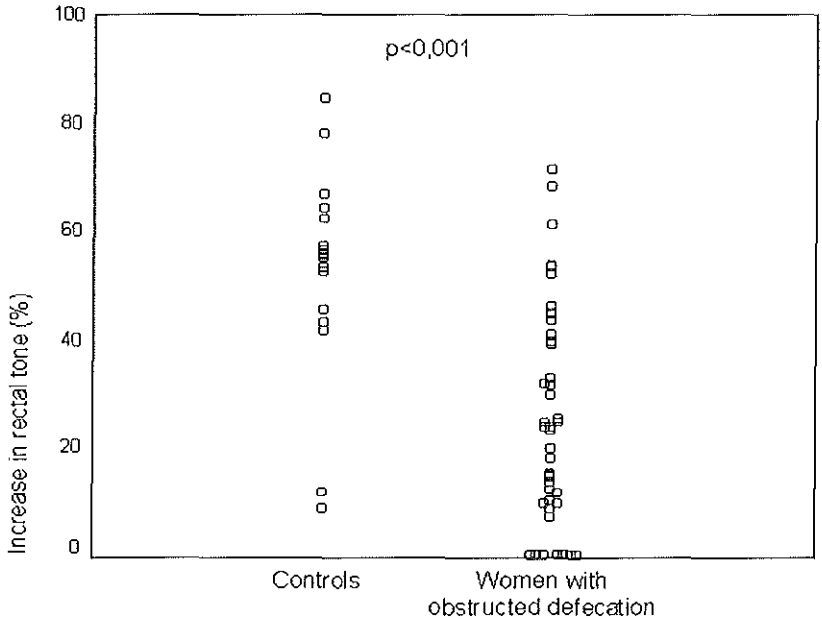

Figure 2. Comparison of the response of the rectum (in percentage change from baseline volume) of female controls and women with obstructed defecation.

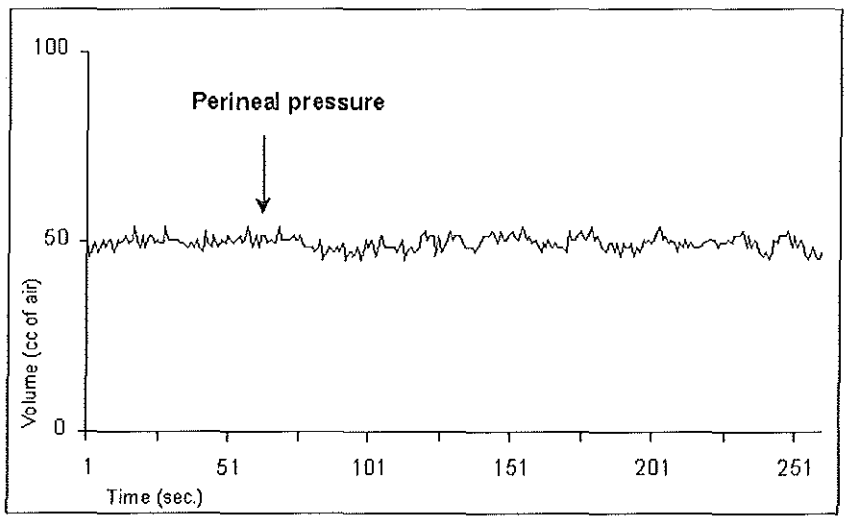

Figure 3. Recording of a woman with obstructed defecation. No increase in rectal tone during pressure upon the perineum is observed.

Recording session II

In all control subjects the evocation of an urge to defecate induced an increase in rectal tone (mean value: 37,8±8%), proximal to the distal stimulating balloon (Table).

In women with obstructed defecation, this tonic response of the rectum was significantly lower (mean value: 16,7±6%, p<0,001). Eight of these patients showed no response at all. These patients were the same subjects in whom the perineo-rectal reflex was absent.

Regarding the tonic response of the rectum to an evoked urge to defecate, no significant difference was found between patients with a normal and those with a prolonged colonic transit time.

	Female controls N=17	**Women with obstructed defecation N=45**
Tonic response of the rectum to perineal pressure (%, mean value ± standard deviation)	52,8±19	24,2±19*
Tonic response of the rectum to an evoked urge to defecate (%, mean value ± standard deviation)	37,8±8	16,7±6*

*p<0,001

Table. Outcome of recording sessions I and II.

DISCUSSION

The present study clearly demonstrates that digital pressure upon the perineum induces an increase in rectal tone. The utility of this perineo-rectal reflex in healthy subjects is unknown. In mammals, maternal anogenital licking is known to stimulate defecation of the pup (6,7). It has been reported earlier that the bladder responds to perineal stimulation.

Pressure upon the perineum inhibits bladder contractions (8,9). It has been suggested that this inhibition of bladder contractions contributes to the suppression of the micturition reflex during sexual intercourse (10). It is well known that children frequently press their heels

upon their perineum in order to avoid micturition when they feel an urge to urinate while they are occupied with playing or watching TV (11).

The perineo-rectal reflex was present in 37 out of 45 women (82%) with obstructed defecation. However, compared to controls this tonic response of the rectum was significantly lower. Thirty-four of these women (92%) reported that they frequently applied pressure upon the perineum in order to facilitate their defecation. The perineo-rectal reflex was absent in 8 out of the 45 patients (18%). None of them applied digital pressure upon the perineum. None of these patients showed a tonic response of the rectum during an evoked urge to defecate. The mechanism underlying the perineo-rectal reflex is unknown. As described in chapter 2, rectal sensorimotor function is thought to be mediated by the extrinsic parasympathetic sacral nerves. There is growing evidence that the impaired sensorimotor function in women with obstructed defecation might be caused by a deficit of these extrinsic parasympathetic sacral nerves. The finding that the tonic response of the rectum to an evoked urge to defecate, as well as the perineo-rectal reflex are absent or blunted in patients with obstructed defecation, does suggest that the extrinsic parasympathetic sacral nerves also play a role in the mediation of the perineo-rectal reflex. This assumption is supported by the observation that digital pressure upon the perineum does not facilitate defecation in patients with a spinal cord injury at the sacral level, in whom the extrinsic parasympathetic sacral nerves are blocked (12).

It is well known that normal micturition is coordinated by a 'center of micturition', located in the anterior side of the pons cerebri. This center receives neural projections from the bladder as well as from the perineum. During stimulation of the perineum, the neurons of this pontine micturition center are inhibited (13-15). This observation illustrates the coordinating role of this pontine micturition center in the inhibiting perineo-vesical reflex. There is growing evidence that defecation, like micturition, is coordinated by a center in the pons cerebri (13,14). It has been shown that pontine neurons receive neural projections from the rectum. These neurons start to exhibit a stimulating firing pattern during perineal stimulation (14,16). Therefore, in our opinion it might be possible that the pons cerebri is also involved in the perineo-rectal reflex. The perineo-rectal reflex is characterized by an increase in rectal

tone, whereas the perineo-vesical reflex is characterized by inhibition of bladder contraction. It has been reported that micturition and defecation are alternating actions (17). Distension of the bladder or stimulation of nerves running from the bladder inhibits the defecation reflex (13,18). Conversely, distension of the rectum or stimulation of nerves running from the rectum, inhibits the micturition reflex (7,8,10,13,17,19-22).

In conclusion, digital pressure, applied upon the perineum, results in an increase in rectal tone. This perineo-rectal reflex is present, though significantly lower in the majority of women with obstructed defecation. This observation might explain why women with obstructed defecation frequently apply perineal pressure in order to facilitate their defecation.

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Chapter 8

Epilogue

Introduction

During the last two decades, paradoxical contraction of the pelvic floor during attempted defecation (anismus) has been considered as the principle cause of obstructed defecation. Considering the lack of agreement between the different diagnostic tests and the prevalence of anismus in healthy subjects, it is questionable if anismus is indeed a distinct pathologic entity or merely a coincidental finding with no clinical relevance. There is no doubt that a rectocele can give rise to obstructed defecation. Surgical correction of this anatomical abnormality is beneficial for 3 out of 4 patients (see chapter 1). There is growing evidence that rectal dysfunction contributes to obstructed defecation. The present study has revealed that the sensorimotor function of the rectum is impaired in women with obstructed defecation. There is some evidence that an extrinsic parasympathetic sacral nerve deficit contributes to the deterioration of rectal sensorimotor function. Women with obstructed defecation, in whom total colonic transit time is normal, show a normal tonic response of their rectum to topical application of bisacodyl as well as following a meal. These findings indicate that the rectal wall of these patients is not totally inert. In patients with prolonged colonic transit time however, the tonic response of the rectum to bisacodyl and following a meal is absent or significantly blunted. It has been reported that the intrinsic nerve system of their colon is altered (1-3). Based on this finding, it might be possible that in patients with delayed colonic transit time the intrinsic nerve system of the rectum is also altered. Until now, no studies have been performed aimed at evaluating the intrinsic nerve system of the rectal wall in women with obstructed defecation. Further studies regarding this aspect are warranted in order to answer the question why the tonic response of the rectum to topical application of bisacodyl and following a meal is absent or blunted in women with obstructed defecation in whom colonic transit time is prolonged.

Currently available therapeutic options

Women with obstructed defecation due to a large rectocele should be treated by surgical correction of this abnormality. Biofeedback training is advised for the treatment of women without a rectocele as well as for the treatment of patients with persistent symptoms of

obstructed defecation after adequate correction of their rectocele. Most experts believe that biofeedback therapy is the best treatment modality available at present.

Initially, biofeedback therapy was intended as a relearning process aimed at suppressing the inappropriate contraction of the pelvic floor (4-12). There is however, a great deal of controversy regarding the objective effect of biofeedback training on rectal function. It has been shown that many patients experience significant symptom relief at the end of the training program, despite continued anismus on objective testing. In other patients various parameters related to anismus change significantly at the end of the training period without any clinical improvement (8,13-15). These confusing observations suggest that other factors may be more important in the pathogenesis of obstructed defecation. The beneficial effects of biofeedback training in subjects with continued anismus suggest that the resolution of symptoms may be attributed to other factors such as the psychological affects of encouragement and positive verbal feedback. It has been noted that many patients use biofeedback-training sessions to discuss psychological problems. It might be possible that the behavioral and psychological aspects of the therapy are just as important for a successful outcome. Further research is warranted in order to evaluate these aspects of biofeedback therapy. In addition, it might be worthwhile to focus our attention on the impact of biofeedback therapy on rectal function.

If symptoms of obstructed defecation persist despite adequate biofeedback training, retrograde colorectal irrigation might be considered. Such a retrograde colorectal washout has been successfully applied in patients with fecal incontinence (16). For adequate irrigation, 500 to 1000 cc of warm water is installed into the rectum and descending colon. After several minutes, expulsion of the irrigation solution and bowel contents can take place. Antegrade colonic irrigation is another alternative for patients with obstructed defecation. For this type of irrigation a special conduit is necessary in order to gain access to the proximal colon (17). The results of antegrade colonic irrigation, reported so far, are quite promising (17-20).

If all conservative measurements have failed to relieve symptoms of obstructed defecation, surgical intervention might be considered. In patients with obstructed defecation in whom colonic transit time is normal, the creation of a left-sided colostomy can result in significant symptom relief. In patients in whom colonic transit time is prolonged, subtotal colectomy with the creation of an ileostomy is recommended.

Future therapeutic options

I. Prokinetics

Prokinetics drugs enhance gastrointestinal transit. Research to determine specific sites of action of prokinetic agents, and the electrophysiological response of neurons and smooth-muscle cells to them, is an evolving field. The action of a prokinetic drug can be due to a specific drug-receptor interaction, an action direct on the smooth muscle, or a combination of both. An alternative pathway is represented by an interference with the release of one or more mediators affecting gastrointestinal motility, or a central effect (21). At present no prokinetics are available for the improvement of rectal sensorimotor function.

II. Hormones

Many women report temporary symptoms of obstructed defecation in the period before onset of menstruation (22-24). Intestinal transit time is prolonged during the luteal phase, when the level of hormones is high (22-26). Addition of estrogen and progesterone in male rats prolongs bowel (27). In female rats, intestinal transit time decreases after ovariectomy (28). Both estrogen and progesterone receptors have been detected on the bowel wall (27,29). Hormones, which lower the level of gonadal hormones, such as GnRH-agonists, might have a beneficial effect on rectal function.

III. Sacral root electrostimulation

In 1976, the first sacral nerve stimulator was implanted in a patient with spinal cord injury by Brindley et al (30). During the last decades, sacral root stimulation has been applied frequently in patients with urinary problems in order to control continence and to facilitate

bladder emptying (31-33). Varma et al. studied the influence of sacral root stimulation on rectal contractility in 5 men with spinal cord injury, in whom the stimulators had been implanted to improve bladder emptying. It was remarkable that during repeated stimulation of the sacral nerves, colorectal contractions increased (34). Mac Donagh et al. described 12 subjects with spinal cord injury who also used the nerve stimulator to empty their bladder. They observed that 11 patients showed an improvement of rectal evacuation using the stimulator (35). The same observation was made by Chia et al (36). Based on these positive results it has been suggested that sacral root stimulation might provide a therapeutic option for women with obstructed defecation. Recently, it has been reported that some patients with constipation or obstructed defecation experience symptom relief during sacral root stimulation (37,38). Sacral root stimulation seems to be a promising avenue to improve rectal sensorimotor function. This futuristic therapeutical option remains to be further investigated and will hopefully offer a solution for obstructed defecation in this millennium.

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Chapter 9

Summary and Conclusions

Samenvatting en Conclusies

"I hav finally kum to the konklusion that a good reliable sett ov bowels iz wurthmore tu a man, than enny quantity ov brains"

Henry Wheeler Shaw

Summary

In our western society constipation and obstructed defecation are frequently reported complaints. In most patients, these problems can be relieved with dietary measurements, sufficient fluid intake, addition of bulk, regular physical exercise, and use of laxatives and stool softeners. There is a group of predominantly female patients, in whom these measurements are not successful, and in whom no causative disorder can be found. During the past 15 years anismus has been cited as the principle cause of obstructed defecation. Since a few years doubt has been raised upon the clinical significance of this syndrome. It has been suggested that altered rectal function might also contribute to obstructed defecation. The present studies were aimed at evaluating rectal wall properties in women with obstructed defecation.

Chapter 1 provides a general introduction to this thesis. In addition, the aims of the present studies are presented.

In chapter 2 the tonic response of the rectum to an evoked urge to defecate is described. For the purpose of this study an 'infinitely' compliant polyethylene bag was inserted over a guide wire into the proximal part of the rectum, under radiological control. Additionally, a latex balloon was introduced into the distal part of the rectum. This latex balloon was inflated with air until an urge to defecate was experienced. Simultaneously rectal wall tone was measured with the help of an electronic barostat system. This barostat system is programmed to maintain a constant intra-bag pressure. When rectal tone decreases, air is injected into the bag, to maintain the constant pressure within the bag. Conversely, when rectal tone increases, air is withdrawn from the bag. Changes in rectal wall tone were assessed by measuring the variations in bag volume. Forty female controls and 100 women with obstructed defecation were studied. In controls the evocation of an urge to defecate induced a pronounced increase in rectal wall tone. In women with obstructed defecation, the threshold for perception was significantly increased, whereas the tonic response of the rectum to an evoked urge to defecate was absent, or significantly blunted. In patients with a normal colonic transit time

this impairment of rectal sensorimotor function was similar to that observed in patients with a prolonged transit time.

In chapter 3, the results are presented of a study aimed at evaluating rectal compliance in women with obstructed defecation. Rectal compliance was measured with an 'infinitely' compliant polyethylene bag. This bag was inserted into the rectum and inflated with air to selected pressure-plateau's (range 0-60 mm Hg, in cumulative steps of 2 mm Hg, each with a duration of ten seconds) utilizing a computer-controlled electromechanical air injection system. Volumes needed to reach the different levels of distending pressures were recorded. The distending pressures, needed to evoke an urge to defecate were noted. Sixty female controls and 80 women with obstructed defecation were studied. In both controls and patients, the compliance curve had a characteristic tri-phasic (S-shaped) form. The mean compliance curve obtained from the patients was identical to that of the controls. In 14 patients the course of the compliance curve fell above the normal range. Evacuation proctography showed a large rectocele in 10 of these patients (71%). Such a rectocele was observed in only 5 patients (7,6%) with a normal compliance curve. Eighty percent of the controls experienced an urge to defecate during the second phase of the curve. In 75% of the patients, this occurred in the third phase. Regarding compliance curves and perception of an urge to defecate, no significant differences were found between patients with a normal and those with a prolonged colonic transit time. The results of this study illustrate that rectal compliance is normal in women with obstructed defecation.

In chapter 4, the results are presented of the study utilizing two different distension protocols for the evaluation of rectal sensory perception in women with obstructed defecation. The parasympathetic afferent nerves, running from the rectum to the spine, mediate the perception of rectal filling sensations. The role of the sympathetic afferent nerves is not clear. It had been reported that the parasympathetic afferent nerves are stimulated both by 'slow ramp' (cumulative) and 'fast phasic' (intermittent) distension of the rectum, whereas the sympathetic afferent nerves are only stimulated by 'fast phasic' distension. Therefore, we

utilized two distension protocols in order to differentiate between a parasympathetic or sympathetic afferent nerve deficit in women with obstructed defecation. Rectal sensory perception was assessed with an 'infinitely' compliant polyethylene bag and the computer-controlled air injection system. After positioning of the bag into the rectum, it was inflated with air to pre-selected pressure plateaus according to the two different distension protocols ('fast phasic' and 'slow ramp'), until the maximum pressure of 65 mm Hg was reached. The distending pressures, needed to evoke rectal filling sensations, were noted. Sixty control subjects and 100 women with obstructed defecation enrolled the study. In all controls rectal filling sensations could be evoked. In the patients rectal filling sensations were absent or blunted. In patients with a normal colonic transit time this impairment of sensory perception was similar to patients with a prolonged colonic transit time. In both distension protocols the pressure thresholds for perception were constantly the same. This finding indicates that it is not worthwhile to use two different distension protocols for the evaluation of rectal sensory perception.

Chapter 5 describes the tonic response of the rectum to a meal in women with obstructed defecation. With the help of an 'infinitely' compliant polyethylene bag, rectal tone was assessed in 15 female controls and in 60 women with obstructed defecation. Colonic transit time was normal in 30 of these patients, and prolonged in the remaining. After an over-night fasting, a baseline recording was obtained for 30 minutes. Then, all individuals consumed a 450-kcal liquid meal. Following this meal, rectal tone was recorded continuously for three hours. After a mean time interval of 28 minutes, all controls showed an increase in rectal tone. A similar gastrorectal reflex was observed in women with obstructed defecation in whom colonic transit time was normal. In the patients with a prolonged transit time, increase in rectal tone following a meal was absent, or significantly lower.

Chapter 6 describes the tonic response of the rectum to topical application of bisacodyl. After an adaptation period of 30 minutes, a suppository containing 10 mg bisacodyl was inserted into the rectum. Rectal tone was measured for 90 minutes, as described above. The

measurement was performed in 15 female controls and 45 women with obstructed defecation. Colonic transit time was normal in 35, and prolonged in 10 of these patients. All controls showed a significant increase in rectal tone in response to bisacodyl. In patients with a normal colonic transit time, the increase in rectal tone following the application of bisacodyl was similar. In patients with a prolonged colonic transit time, the increase in rectal tone in response to bisacodyl was absent, or significantly lower.

Chapter 7 presents the results of a study aimed at evaluating the impact of digital pressure upon the perineum on rectal tone. Rectal tone was measured as described above. After an adaptation period of 15 minutes, digital pressure was applied upon the perineum. Fifteen female controls and 45 women with obstructed defecation were included in the study. During the application of perineal pressure, all controls showed an increase in rectal tone. In the whole patientgroup, this response was significantly lower. Eight of these patients showed no response at all. None of them applied perineal pressure. In the remaining 37 patients, the perineo-rectal reflex was present, but significantly lower. Thirty-four of these women told that they applied perineal pressure on a regular base in order to facilitate their defecation. Regarding the tonic response of the rectum to perineal pressure, no difference was found between patients with a normal, and those with a prolonged colonic transit time.

Conclusions

1. Rectal distension evokes an urge to defecate and induces an increase in rectal tone proximal to the stimulating balloon. In women with obstructed defecation this aspect of rectal sensorimotor function is impaired.
2. In women with obstructed defecation, the compliance of the rectal wall is normal.
3. It is not useful to utilize different distension protocols in order to evaluate rectal sensory perception.
4. In women with obstructed defecation, in whom colonic transit time is not delayed, the gastrorectal reflex is normal. In patients with a prolonged transit time, this reflex is absent or blunted.

5. Topical application of bisacodyl produces an increase in rectal tone. In women with obstructed defecation in whom colonic transit time is not delayed, the tonic response of the rectum to topical application of bisacodyl is normal. In patients with a prolonged transit time, this tonic response is absent or significantly blunted.
6. Digital pressure, applied upon the perineum, results in an increase in rectal tone. This perineo-rectal reflex is present, though significantly lower in the majority of women with obstructed defecation. This observation might explain why women with obstructed defecation frequently apply perineal pressure in order to facilitate their defecation.
7. In women with obstructed defecation in whom colonic transit time is normal, the tonic response of the rectal wall after a meal and after application of bisacodyl is not altered. In patients with a prolonged transit time this tonic response is blunted (see following Table).

	Increase in rectal wall tone:					
Obstructed defecation	**during an evoked urge to defecate**	**after a meal**	**after application of bisacodyl**	**during perineal pressure**	**Rectal compliance**	**Rectal sensory perception**
Normal TCTT	↓	N	N	↓	N	↓
Prolonged TCTT	↓	↓	↓	↓	N	↓

TCTT = Total Colonic Transit Time
N = normal
↓ = absent or impaired

Samenvatting

In de westerse samenleving komen klachten van obstipatie en bemoeilijkte stoelgang veel voor. Bij de meeste patiënten kunnen deze aandoeningen adequaat worden behandeld met behulp van eenvoudige maatregelen, zoals aanpassing van het dieet, voldoende drinken, meer lichaamsbeweging en het gebruik van laxeermiddelen. Er zijn echter patiënten, voornamelijk vrouwen, bij wie deze maatregelen geen effect hebben en bij wie geen duidelijke onderliggende ziekte wordt gevonden. De afgelopen 15 jaar werd het spastisch bekken bodem syndroom, ook wel anismus genoemd, beschouwd als de belangrijkste oorzaak van bemoeilijkte stoelgang. De laatste jaren wordt de klinische betekenis van anismus in twijfel getrokken. Er zijn er steeds meer aanwijzingen dat het rectum een belangrijke rol speelt bij het ontstaan van een bemoeilijkte stoelgang. De onderzoeken die in dit proefschrift worden beschreven, hadden tot doel verschillende functionele aspecten van de rectumwand bij vrouwen met een therapieresistente bemoeilijkte stoelgang te bestuderen.

Hoofdstuk 1 bevat een algemene introductie. Tevens wordt in dit hoofdstuk het doel van de verschillende onderzoeken uiteengezet.

In hoofdstuk 2 wordt beschreven wat er met de tonus van het rectum gebeurt tijdens het opwekken van aandranggevoelens. Om dit te kunnen onderzoeken, werd onder röntgendoorlichting een 'oneindig' compliant (rekbaar) meetzakje van polyethyleen over een voerdraad in het proximale deel van het rectum geschoven. Vervolgens werd een latex ballon in het distale deel van het rectum gepositioneerd. Deze latex ballon werd met lucht gevuld, totdat de patiënt een gevoel van aandrang ervoer. Tegelijkertijd werd de tonus van de proximaal van de stimulatieballon gelegen rectumwand geregistreerd met behulp van een elektronisch barostat systeem. Dit apparaat is erop gericht de druk in het meetzakje constant te houden. Als de tonus van de rectumwand afneemt, pompt het apparaat lucht in het meetzakje, terwijl er lucht uit het zakje wordt gezogen als de tonus toeneemt. Variaties in het volume van het zakje zijn derhalve een maat voor veranderingen in de tonus van de rectumwand. Veertig vrouwelijke controle personen en 100 vrouwen met een bemoeilijkte

stoelgang werden onderzocht. Bij de controle personen ging het gevoel van aandrang gepaard met een uitgesproken toename van de tonus van de rectumwand. Bij vrouwen met een bemoeilijkte stoelgang moest de stimulatieballon met significant meer lucht worden gevuld om een gevoel van aandrang op te wekken. Bovendien bleek dat bij de patiënten de tonus van de rectumwand, gemeten proximaal van de stimulatieballon, niet of slechts minimaal toenam op het moment dat het gevoel van aandrang optrad. Bovengenoemde sensorimotore functie van de endeldarm was bij patiënten met een vertraagde colon passagetijd in gelijke mate gestoord als bij patienten met een normale colon passagetijd.

In hoofdstuk 3 worden de resultaten beschreven van het onderzoek dat erop gericht was de compliantie van rectum te bepalen bij vrouwen met een bemoeilijkte stoelgang. De compliantie van het rectum werd gemeten met behulp van een 'oneindig' compliant polyethyleen meetzakje. Nadat dit zakje in het rectum was gepositioneerd, werd het gevuld met lucht totdat vooraf vastgestelde druk niveaus werden bereikt (spreiding: 0-60 mm Hg, in oplopende stapjes van 2 mm Hg, elk met een duur van 10 seconden). Hierbij werd gebruik gemaakt van een elektronisch barostat systeem. De hoeveelheid lucht, nodig om de verschillende drukniveaus te bereiken, werd geregistreerd. Op het moment dat de patient gevoel van aandrang kreeg, werd de druk in het meetzakje geregistreerd. Zestig vrouwelijke controle personen en 80 vrouwen met een bemoeilijkte stoelgang werden onderzocht. Zowel bij de controle personen als bij de patiënten had de compliantiecurve een karakteristieke trifasische ('S-') vorm. Het gemiddelde van de compliantiecurves van alle patiënten was gelijk aan de gemiddelde curve van de controle personen. Bij 14 vrouwen met een bemoeilijkte stoelgang verliep de compliantiecurve in het gebied buiten de normale spreiding. Defaecografisch onderzoek bij deze patiënten bracht aan het licht dat 10 vrouwen (71%) een grote rectocele hadden. Bij patiënten met een normale compliantiecurve werd een dergelijk grote rectocele slechts in 5 gevallen (7,6%) aangetroffen. Tachtig procent van de controle personen kreeg gevoel van aandrang tijdens de tweede fase van de compliantiecurve. Bij de meeste patiënten (75%) trad dit gevoel op tijdens de derde fase van de curve. Ten aanzien van de compliantiecurve en het moment van optreden van gevoel van aandrang, waren er

geen verschillen tussen patiënten met een normale en patiënten met een vertraagde colon passagetijd. Uit deze studie blijkt dat de compliantie van het rectum bij vrouwen met een bemoeilijkte stoelgang normaal is.

In hoofdstuk 4 wordt het onderzoek beschreven betreffende de sensibiliteit van het rectum van vrouwen met een bemoeilijkte stoelgang. Voor de perceptie van gevoel van aandrang zijn de parasympathische afferente zenuwen, die vanaf de endeldarm naar het ruggenmerg lopen, onontbeerlijk. De rol van de sympathische afferente vezels is onduidelijk. Volgens sommige onderzoekers kunnen de parasympathische afferente zenuwen gestimuleerd worden door zowel 'slow ramp' (langzaam oplopende) en 'fast phasic' (snel intermitterend) distensie van het rectum, terwijl de sympathische afferente zenuwen alleen gestimuleerd kunnen worden door 'fast phasic' distensie. In het onderzoek dat in dit hoofdstuk wordt beschreven, werden beide distensieprotocollen gebruikt teneinde na te gaan of de verminderde sensibiliteit van het rectum bij vrouwen met een bemoeilijkte stoelgang het gevolg is van een afwijking in de parasympathische dan wel sympathische zenuwbanen. De sensibiliteit van het rectum werd bepaald met behulp van een 'oneindig' compliant polyethyleen meetzakje en het elektronisch barostat systeem. Na positionering in het rectum werd het meetzakje gevuld met lucht volgens de twee distensie protocollen ('fast phasic' en 'slow ramp'). Hierbij werd gebruik gemaakt van tevoren vastgestelde drukniveaus, totdat de maximale druk van 65 mm Hg was bereikt. Op het moment dat het gevoel van aandrang optrad, werd de bijbehorende druk in het meetzakje genoteerd. Zestig controle personen en 100 vrouwen met een bemoeilijkte stoelgang namen deel aan het onderzoek. Ook nu weer kon bij alle controle personen een gevoel van aandrang worden opgewekt. Bij vrouwen met een bemoeilijkte stoelgang was dit gevoel geheel afwezig of sterk verminderd, zowel bij vrouwen met een normale colon passagetijd als bij vrouwen met een vertraagde colon passagetijd. In beide distensieprotocollen trad gevoel van aandrang op bij vergelijkbare drukken. Op basis van deze bevindingen lijkt het niet zinvol om de twee verschillende distensieprotocollen te gebruiken bij de evaluatie van de sensibiliteit van het rectum. Voorts is het duidelijk dat bij de meerderheid van de patiënten met een bemoeilijkte stoelgang

aandrang gevoelens ontbreken of sterk verminderd zijn.

In hoofdstuk 5 worden de resultaten beschreven van het onderzoek naar de tonische respons van de rectumwand op een maaltijd bij vrouwen met een bemoeilijkte stoelgang. Met behulp van een 'oneindig' compliant polyethyleen meetzakje werd bij 15 vrouwelijke controle personen en 60 vrouwen met een bemoeilijkte stoelgang de tonus van de wand van het rectum gemeten. De colon passagetijd was normaal bij 30 van deze patiënten. Bij de andere helft van de groep was de colon passagetijd vertraagd. Allereerst werd de meting in nuchtere toestand verricht gedurende een periode van 30 minuten. Vervolgens consumeerden alle personen een vloeibare maaltijd van 450-kcal. Gedurende drie uur na deze maaltijd werd de tonus van de wand van het rectum continu gemeten. Gemiddeld 28 minuten na de maaltijd nam de tonus van de wand van het rectum bij alle controle personen toe. Een vergelijkbare gastrorectale reflex werd gevonden bij de patiënten bij wie de colon passagetijd normaal was. Bij patiënten met een vertraagde colon passagetijd bleek de tonus van de wand van het rectum in het geheel niet of significant minder toe te nemen.

In hoofdstuk 6 wordt de respons beschreven van het rectum op rectale toediening van een bisacodyl bevattende zetpil. Dertig minuten na inbrengen van het meetzakje werd een zetpil met daarin 10 mg bisacodyl in het rectum gebracht. De tonus van de wand van het rectum werd gedurende 90 minuten gemeten zoals hierboven reeds is beschreven. De meting werd verricht bij 15 vrouwelijke controle personen en 45 vrouwen met een bemoeilijkte stoelgang. De colon passagetijd was normaal bij 35 patiënten en vertraagd bij 10. Na toediening van bisacodyl nam de tonus van de wand van het rectum significant toe bij alle controle personen. Bij patiënten met een normale colon passagetijd werd een vergelijkbare reactie gevonden. Bij patiënten met een vertraagde passagetijd trad deze reactie niet of in veel mindere mate op.

In hoofdstuk 7 wordt getracht de vraag te beantwoorden waarom vrouwen met een bemoeilijkte stoelgang vaak op hun perineum duwen in een poging de stoelgang te

bevorderen. De tonus van de wand van het rectum werd gemeten op dezelfde wijze als hierboven is beschreven. Na een adaptatieperiode van 15 minuten werd het perineum met de hand omhoog geduwd. Vijftien vrouwelijke controle personen en 45 vrouwen met een bemoeilijkte stoelgang namen deel aan het onderzoek. Tijdens manuele druk op het perineum nam de tonus van de wand van het rectum toe bij alle controle personen. Bij de patiënten was deze tonische reactie van het rectum veel minder uitgesproken. Bij 8 patiënten was deze perineo-rectale reflex geheel afwezig. Geen van deze 8 patiënten paste manuele druk op het perineum toe om de defaecatie op te wekken. Hoewel de perineo-rectale reflex wel was op te wekken bij de andere 37 patiënten, bleek deze tonische reactie aanzienlijk geringer te zijn dan bij de controle personen. Binnen deze patientengroep gaven 34 vrouwen aan dat zij regelmatig perineale druk toepasten om de stoelgang op te wekken. Met betrekking tot de perineorectale reflex konden geen verschillen worden aangetoond tussen patiënten met een normale en patiënten met een vertraagde colon passagetijd.

Conclusies

1. Distensie van het rectum leidt tot gevoel van aandrang. Tijdens het opwekken van dit gevoel van aandrang neemt de tonus van de wand van het rectum proximaal van de stimulatieballon toe. Bij vrouwen met een bemoeilijkte stoelgang is dit aspect van de sensorimotore functie van het rectum gestoord.
2. Bij vrouwen met een bemoeilijkte stoelgang is de compliantie van het rectum normaal.
3. Het is niet zinvol verschillende distensieprotocollen te gebruiken bij de evaluatie van de sensibiliteit van het rectum.
4. Vrouwen met een bemoeilijkte stoelgang, bij wie de colon passagetijd normaal is, hebben een normale gastrorectale reflex. Bij patiënten met een vertraagde colon passagetijd is deze reflex afwezig of gestoord.
5. Rectale toediening van bisacodyl leidt tot een toename van de tonus van de wand van het rectum. Vrouwen met een bemoeilijkte stoelgang, bij wie de colon passagetijd

normaal is, vertonen een vergelijkbare toename van de tonus. Bij patiënten met een vertraagde colon passagetijd is deze respons afwezig of significant minder.

6. Druk op het perineum veroorzaakt een toename van de tonus van de wand van het rectum. Hoewel deze perineo-rectale reflex aanwezig is bij de meeste patiënten met een bemoeilijkte stoelgang, is deze reflex aanzienlijk geringer in vergelijking met de controlepersonen. De meeste vrouwen bij wie de perineo-rectale reflex op te wekken is, blijken regelmatig op hun perineum te drukken om hun stoelgang te bevorderen.
7. Bij patiënten met een bemoeilijkte stoelgang bij wie de colon passagetijd normaal is, is de tonische reactie van de rectumwand na een maaltijd en na toediening van bisacodyl niet afwijkend. Bij patiënten met een vertraagde colon passagetijd is deze tonische reactie wel afwijkend (zie onderstaande tabel).

Toename van de tonus van de rectumwand:

Bemoeilijkte stoelgang	tijdens opwekken van gevoel van aandrang	na een maal-tijd	na toediening van bisacodyl	tijdens druk op het perineum	Complian-tie van het rectum	Sensibiliteit van het rectum
Normale colon passagetijd	↓	N	N	↓	N	↓
Vertraagde colon passagetijd	↓	↓	↓	↓	N	↓

N = normaal

↓ = afwezig of gestoord

DANKWOORD

Een aantal personen wil ik graag een plekje in mijn proefschrift geven.

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Philippe. Ik hou van je.

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Maar achter deze hoek een werelddeel
Achter dit ogenblik een zee van tijd

Adriaan Morriën