Chapter 2.2
Rectoanal Inhibition

Patricia L. Roberts

Introduction

The rectoanal inhibitory reflex is defined as transient relaxation of the internal anal sphincter in response to rectal distention. It was first described by Gowers in 1877 (1) and confirmed by Denny-Brown and Robertson (2) in 1935. A consensus statement of definitions for anorectal physiology has defined the rectoanal inhibitory reflex as "the transient decrease in resting anal pressure by ≥25% of basal pressure in response to rapid inflation of a rectal balloon with subsequent return to baseline." (3) While the exact role of the rectoanal inhibitory reflex is unknown, it has been postulated to serve as a "sampling reflex" and is felt to be a factor in the maintenance of continence (4,5). Thus, the upper anal canal is able to discriminate between flatus and fecal material.

Physiology

This reflex is believed to be mediated through the intramural neuronal plexus (6). It is present following spinal cord injury and cauda equina syndrome, and it can remain intact after full rectal mobilization or presacral blockade. It is absent in Hirschsprung's disease and absent initially after low anterior resection and ileoanal pouch procedure. Regeneration of the reflex may occur after hand-sewn coloanal anastomosis and after low stapled anastomosis (7–10), in some cases clinically correlating with less-reported nocturnal fecal urgency. A false-negative reflex may be obtained if the resting pressure is extremely low and if the patient has a hyposensitive rectum, as frequently is seen in patients with megarectum. Failure to elicit such a reflex in some patients with full-thickness rectal prolapse may mitigate against a perineal approach to repair. In such patients, large inflation volumes may be necessary to elicit a recognizable reflex.

The role of nitric oxide, an endogenous bioactive substance and important inhibitory neurotransmitter in the gastrointestinal tract, in the media-

tion of the rectoanal inhibitory reflex also has been examined (11). Nitric oxide is a mediator of internal anal sphincter relaxation in response to nonadrenergic, noncholinergic nerve stimulation (12) (see Chapter 4).

Methods

There are a variety of methods for the performance of anal manometry and eliciting the rectoanal inhibitory reflex, although none has been standardized. Various catheter and balloon systems have been used, including semiconductor strain-gauge catheters, air-filled or water-filled balloons, and water-perfused catheters. The following describes the method of eliciting the rectoanal inhibitory reflex in our unit.

In our laboratory, anal manometry is performed with an eight-channel water-perfused catheter with an external diameter of 5.5 millimeters (Mui Scientific, Mississauga, Ontario, Canada). A computerized system with menu-driven software developed by Dr. John Coller is used. Analysis of data, graphic presentation, and generation of reports is facilitated by interfacing the pressure recorder with a computer. The protocol for eliciting the reflex has been described previously and is detailed here in brief (13,14). A Coller type B catheter, which is a spiral catheter (Figure 2.2.1) is used for eliciting the rectoanal inhibitory reflex. A 100-second run is performed, and at 50 seconds, the balloon is inflated with 60 cubic centimeters of air that allows it to attain a preset trigger pressure signaling the onset of balloon distention to the computer. Pressure events during the first 20 seconds after balloon distention indicate the reflex response (Figure 2.2.2). Rectoanal inhibitory and excitatory responses are considered present when pressure increases or decreases within two standard deviations below or above the resting pressure. The degree of relaxation varies in the proximal, middle, and distal sphincter, with the greatest degree of relaxation in the proximal internal anal sphincter. Latency of the rectoanal inhibitory (RAIR) or rectoanal excitatory (RAER) reflex is measured in seconds from the start of balloon inflation to the onset of the RAIR or RAER as defined by the computer setting.

Although some laboratories have reported the rectoanal inhibitory reflex as a discrete variable, that is, being either "present" or "absent," other units, such as ours, have looked at the significance of various parameters of the rectoanal inhibitory reflex, including the latency, the duration of the reflex, and the amplitude of the reflex in the proximal and distal portion of the sphincter (15,16).

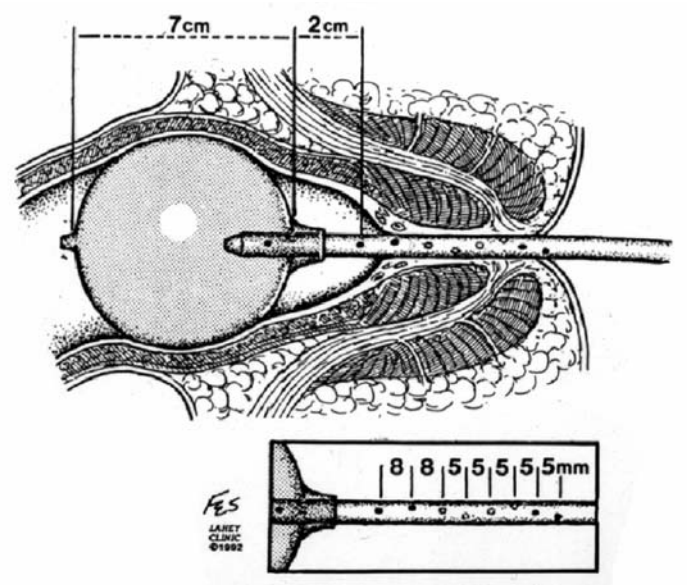

FIGURE 2.2.1. The Coller type B catheter, a balloon, and side-perfused multiple port catheter is used to elicit the rectoanal inhibitory reflex. The spacing of the ports is depicted in the inset. One port measures the intraluminal pressure of the rectum, one measures pressures in the balloon, and the others take measurements along the anal canal. (Reprinted with permission of the Lahey Clinic)

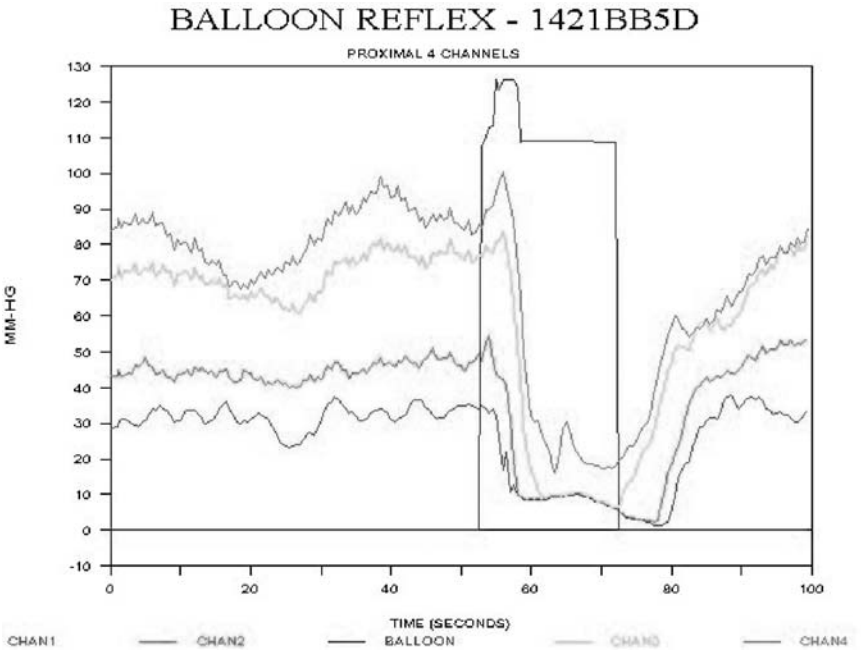

FIGURE 2.2.2. The normal rectoanal inhibitory reflex.

Rectoanal Reflex in Incontinence

Abnormalities of the rectoanal inhibitory and excitatory reflex have been well described in patients with fecal incontinence. These abnormalities may reflect the anatomic defects of the internal and external sphincter muscle associated with incontinence.

We have noted five different types of reflex patterns in patients with fecal incontinence. We have previously compared 43 patients with idiopathic or traumatic incontinence with 29 control subjects who had no anorectal complaints (17). In this study, control subjects had normal reflex patterns. Normal reflex patterns consisted of normal initial excitation followed by inhibition in the proximal anal canal and an excitatory response in the distal anal canal. Patients with discrete sphincter defects such as those patients with obstetric injuries had no distal excitation, but had normal proximal inhibition. Patients with idiopathic incontinence had normal proximal response, but an inhibitory instead of an excitatory response in the distal anal canal. An additional group had a normal reflex pattern while the remaining two groups, including one group with iatrogenic trauma, had no excitatory response in the proximal or distal anal canal, but had a normal inhibitory reflex. One group with idiopathic incontinence had excitatory response in the entire anal canal, but no inhibition. Patients with fecal incontinence and normal rectoanal inhibitory and excitatory reflexes may be a subgroup of patients with incontinence with the best preserved sphincter function and the least sphincter damage. Abnormalities of the rectoanal reflexes in patients who are incontinent may be the result of masking of the underlying influence of one of the sphincter muscles.

Absence of the rectoanal inhibitory reflex has been noted by other investigators. Sun et al. (18) reported an absence of the rectoanal inhibitory reflex in patients with incontinence and suggested that higher inflation volumes were necessary in such patients. These higher volumes resulted in a rebound increase of pressure on deflation and a positive reflex.

In addition, in patients with fecal incontinence, pudendal neuropathy also appears to result in abnormalities of the rectoanal excitatory reflex. We have studied 15 patients, specifically examining pudendal nerve terminal motor latency (PNTML), abnormalities in the rectoanal excitatory reflex and single fiber density as makers for pudendal neuropathy (19). Pudendal nerve terminal motor latency (PNTML) was prolonged in 10 patients and normal in five patients while increased single fiber density indicated neuropathy in 12 patients and was normal in two patients. The distal RAER was abnormal in 13 patients and normal in two. The three diagnostic modalities were in agreement in ten patients, confirming neuropathy in nine and excluding it in one patient. Ten patients with fecal incontinence had a normal PNTML, but an abnormal distal excitatory reflex; five patients had an abnormal PNTML, but a normal distal excitatory reflex and 15 patients had both PNTML and excitatory reflex that were abnormal. Thus, an abnor-

mal rectoanal excitatory reflex appears to correlate well with neurophysiologic tests used to diagnose pudendal neuropathy.

Assessment of other parameters of the rectoanal inhibitory reflex may yield further information in patients with incontinence. Kaur and colleagues (20,21) found that significantly greater sphincter relaxation was seen at each volume of rectal distention in incontinent patients compared with constipated and healthy control subjects. Similarly, Zbar (22) and colleagues compared parameters of the rectoanal inhibitory reflex in 42 patients with fecal incontinence and with chronic constipation. Excitatory and inhibitory latencies, maximum excitatory and inhibitory pressure, amplitude and slope of inhibition, slope and time or pressure recovery, and area under the inhibitory curve were all measured. The recovery time under the inhibitory curve differed at various sphincter levels and among the patient groups; however, incontinent patients had the most rapid recovery. It was concluded that continence may rely in part on some of these characteristics of rectoanal inhibition and that there may be some parameters that would predict functional results following low anastomosis.

Rectoanal Reflex and Constipation

The rectoanal inhibitory reflex has been studied in patients with constipation and incontinence and compared with healthy control subjects. Kaur et al. (20) studied 55 constipated subjects and 99 incontinent patients. A variety of parameters of the rectoanal inhibitory reflex were studied, including the percentage of sphincter relaxation at each volume. There was no difference in the three groups in the volume of distension required to elicit the rectoanal inhibitory reflex. Greater sphincteric relaxation was seen at each volume in incontinent patients compared with constipated patients. Similarly, other studies have not found significant differences among patients with incontinence, constipation, and normal control subjects with respect to the rectoanal inhibitory reflex. The main role of eliciting the reflex in patients with constipation is to identify those patients with Hirschsprung's disease, which represent a minority of adult patients with chronic constipation.

Hirschsprung's disease is characterized by an absence of ganglion cells in the mucosal and submucosal plexuses. The aganglionic segment may occur for a variable length, at times including the entire colon and rectum. Absence of the RAIR may be the only reliable way of establishing a diagnosis of Hirschsprung's disease, especially in patients with short segment disease (Figure 2.2.3).

In patients with megarectum, sufficient inflation volumes are necessary to elicit the RAIR. In our laboratory, inflation volumes of 180 cubic centimeters are often necessary to elicit the reflex in patients with megarectum. A false-negative reflex may be obtained with low inflation volumes.

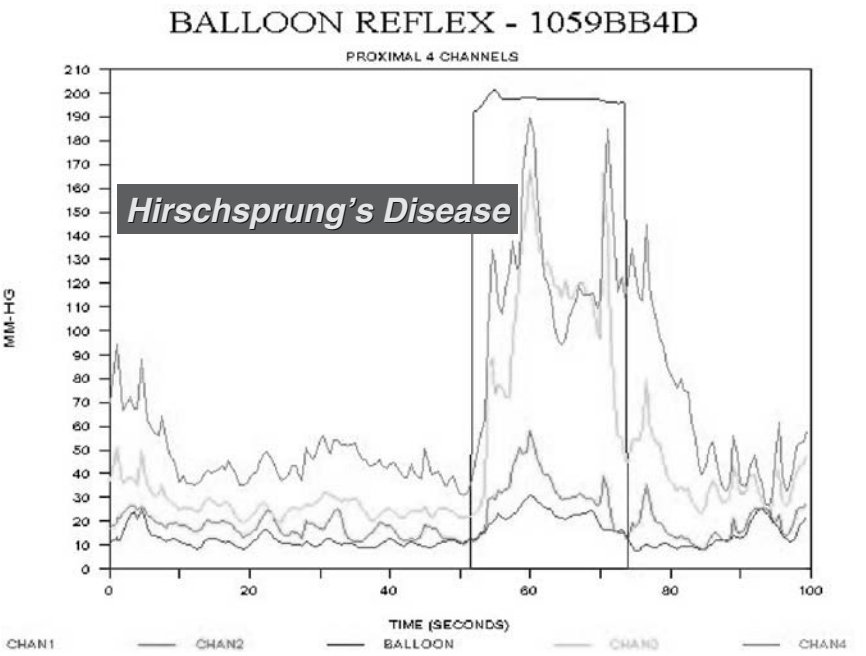

FIGURE 2.2.3. Absence of the RAIR in a patient with Hirschsprung's disease.

RAIR After Pelvic Surgery

The RAIR is generally absent after low anterior resection, coloanal anastomosis, and after ileoanal pouch procedure. Regeneration of the reflex has been demonstrated after both a hand-sewn and stapled anastomosis (7,10). In a study of 46 patients who underwent low anterior resection with stapled anastomosis for carcinoma of the rectum, the reflex was present in 43 preoperatively, but only in eight of 45 patients on the tenth postoperative day (10). Six of 29 patients (21%) studied between six and 12 months after surgery had a RAIR, and the reflex was demonstrated in 17 of 20 patients (85%) studied two years postoperatively. Recovery of anal function after low anterior resection or coloanal anastomosis seems to correlate with recovery of the RAIR. Similarly, in patients who have undergone an ileoanal pouch procedure, the reflex does return with time after operation, and this correlates with the patient's ability to discriminate between feces and flatus (23). In children, the RAIR and continence have been studied in patients with anorectal malformations, particularly high and intermediate imperforate anus, and the presence of the reflex appears to correlate with postoperative continence (24).

Conclusions

The RAIR is a record for the diagnosis of juvenile Hirschprung's disease. Recent analysis of this internal anal sphincter function has shown inherent parametric differences that may subgroup for some patients with fecal incontinence and constipation and that broadly correlates with postoperative functional deficit following low coloanal hand-sutured and stapled anastomosis. At present, it is unknown whether innate differences in preoperative rectoanal inhibition may encode for patients who fare worse following straight coloanal anastomosis and whether these patients may benefit in the short term from colonic pouch reconstruction or coloplasty (25). At present, it also would appear that attempts to use recorded variations in preoperative rectoanal inhibition to assist in decision making and to predict functional outcome in rectal surgery for evacuatory dysfunction have been unsuccessful (26).

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Editorial Commentary

The presence of a rectoanal inhibitory reflex (RAIR) has been the hallmark for the exclusion of the diagnosis of Hirschsprung's disease but there is clear evidence that it functions as a subtle anorectal sampling mechanism for flatus/feces differentiation. In this respect, its postoperative return in some discernable form appears to correlate with reported functional improvement after low anterior resection. Moroever, parameter differentiation of its form in some cases, (namely its latency, extent and mode of

recovery as well as the presence of rectoanal excitation), although technique dependent, appears to be somewhat disease specific and to offer an explanation for continence maintenance in patients who exhibit sphincter defects. It is unknown at present whether these parameters can preoperatively predict for patients likely to fare badly after procedures which involve prolonged endoanal distraction, deliberate internal anal sphincterotomy (or sphincter ablation) or after straight coloanal anastomosis. What is clear is that there is a recentralization of the importance of the internal anal sphincter in continence maintenance and for its protection where possible in endoanal surgery.

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