Distal Rectoanal Excitatory Reflex: A Reliable Index of Pudendal Neuropathy?

Yash P. Sangwan, M.D., John A. Coller, M.D., Richard C. Barrett, M.S., John J. Murray, M.D., Patricia L. Roberts, M.D., David J. Schoetz, Jr., M.D.

From the Department of Colon and Rectal Surgery, Lahey Clinic, Burlington, Massachusetts

PURPOSE: Denervation of the extrinsic anal sphincter and pudendal neuropathy are confirmed by electrophysiologic or electromyographic testing, techniques that may not be available universally and require special equipment and training. A simple manometric test that is easy to perform and complements existing studies was performed to confirm pudendal neuropathy. METHODS: Fourteen patients with excessive defecatory straining and 30 patients with idiopathic fecal incontinence were studied by electrophysiology and balloon reflex manometry. Pudendal nerve terminal motor latency (PNTML) and rectoanal excitatory reflex were evaluated for abnormalities. Results were compared with 20 controls who had no anorectal complaints and who had similar testing performed. RESULTS: In controls, PNTML was normal in all but one person. Rectoanal excitatory reflex could be elicited in all controls with either 20 or 40 ml of air. Four different types of balloon reflex responses were observed in patient groups: diminutive excitation, delayed excitation, excitation at high volume of distention only, and absent excitation. Ten patients with fecal incontinence had normal PNTML but abnormal distal excitatory reflex, 5 patients had abnormal PNTML but normal distal excitatory reflex, and 15 patients had both PNTML and excitatory reflex that were abnormal. In patients with excessive defecatory straining, results of both tests were abnormal in six patients, and eight patients had abnormal excitatory reflex but normal PNTML. CONCLUSION: Pudendal neuropathy may result in abnormalities of excitatory reflex morphology or other characteristics. Abnormal distal excitatory reflex may complement electrophysiologic findings or may serve as a suitable alternative to confirm pudendal neuropathy in centers where facilities for formal testing are not available. [Key words: Pudendal neuropathy; Fecal incontinence; Manometry; Rectoanal excitatory reflex; Pudendal nerve terminal motor latency; Electromyography]

Sangwan YP, Coller JA, Barrett RC, Murray JJ, Roberts PL, Schoetz DJ Jr. Distal rectoanal excitatory reflex: a reliable index of pudendal neuropathy? Dis Colon Rectum 1995;38: 916-920.

Assessment of pudendal neuropathy in patients with idiopathic fecal incontinence involves determination of pudendal nerve terminal motor latency (PNTML).[1] This procedure is usually well tolerated, amounting to little more than a digital examination. However, it is not always possible to locate the pudendal nerves. Although no data are available in the literature on the exact incidence of unrecordable PNTML, in our experience, the figure is close to 10 to 15 percent. Whereas some of these instances of unrecordable PNTML may represent extensive damage to the pudendal nerve, rendering it incapable of responding to an electrical stimulus, a minority must represent inability to locate the nerves, particularly in patients with a long anal canal.

Pudendal neuropathy can also be confirmed by electromyography (EMG) of the external anal sphincter (EAS). Concentric needle EMG is usually applied to qualitative analysis of the neuropathic sphincter muscle.[2] Bartolo *et al.*[3] reported increased motor unit potential duration and decreased amplitude of fiber action potentials in the EAS, using EMG as a quantitative index of pudendal neuropathy. Single-fiber EMG is considered a reliable index of denervation and reinnervation, but the technique is prone to observer-dependent error.[4] Other EMG parameters, such as jitter and impulse blocking,[5, 6] have also been used to document neuropathic damage, but they have failed to gain widespread acceptance in coloproctology and are infrequently used. Regardless of the method used, EMG is a painful examination, necessitating multiple needle punctures and leading to understandably low patient acceptance.

Rectoanal excitatory reflex (RAER) is routinely elicited during anal manometry and depends on the integrity of the pudendal nerve for its execution. We hypothesized that injury to this nerve may lead to abnormal RAER characteristics reflected in its increased latency or altered morphology (diminished amplitude or total absence of the reflex). The demonstration of a correlation between abnormal RAER and pudendal nerve damage may permit the former to

Read in part at the meeting of the New England Society of Colon and Rectal Surgeons, Bolton Landing, New York, September 30 to October 1, 1994.

Address reprint requests to Dr. Coller: Department of Colon and Rectal Surgery, Lahey Clinic, 41 Mall Road, Burlington, Massachusetts 01805.

act as an indicator of pudendal neuropathy. Use of the distal RAER as an index of pudendal neuropathy has not been described before, and the present study was undertaken to explore the feasibility of using RAER as an alternative means of detecting pudendal neuropathy.

METHODS AND PATIENTS

In 30 patients with idiopathic fecal incontinence and 14 patients with excessive defecatory straining (obstructed defecation), PNTML and reflex response on balloon distention of rectum were studied, and results were compared with 20 controls. Mean age and range are given in Table 1.

Manometry

Manometry was performed using a computerized system (Narco Bio-Systems, Houston, Texas), and data were collected with menu-driven software. An eight-channel water-perfused flexible catheter, 5.5 mm in external diameter (Mui Scientific, Mississauga, Ontario, Canada), was used as a pressure probe. To facilitate analysis, graphic presentation, and generation of numeric reports of recorded data, the pressure recorder was interfaced with a microcomputer (Dynamic Pressure Analysis, John A. Coller, M.D., Lahey Clinic).[7] The protocol for performing manometry and acquiring data has been described previously.[7, 8] Resting and squeeze pressures were measured using a radial catheter with eight radially located ports at 45 degrees to each other. The balloon reflex was elicited using a spiral catheter with eight spirally located ports at 0.5-cm intervals and with an inflatable rectal balloon at its tip. Serial inflation volumes of 20, 40, 60, and 120 ml of air were used to elicit balloon reflex.

Resting pressure was calculated as mean maximum average resting pressure over three continuous pullout runs. Squeeze pressure was determined as mean maximum average squeeze pressure for two continuous pullout runs. Excitatory reflex was considered to be present when, on balloon inflation, an increase in pressure of two standard deviations above the preinflation resting pressure was noted. An attenuated or diminished excitatory response was defined as anal sphincter contraction at the expected time interval after balloon distention but failing to meet the criterion outlined earlier for excitatory response. The response was considered absent when no excitation could be observed in distal channels. The latency of distal excitatory response reflex was the time interval in seconds from onset of balloon distention to the onset of excitation. Pudendal nerve terminal motor latency was determined using the technique described by Kiff and Swash.[1]

Table 1.
Age and Sex Distribution

	Fecal Incontinence n = 30	Obstructed Defecation n = 14	Control Subjects n = 20
Mean age, years	63.1	44.1	41.2
Range	43 – 83	22 – 74	22 – 66

RESULTS

All controls revealed an excitatory response on balloon reflex testing with either 20 or 40 ml of rectal distention volume (Fig. 1). Pudendal nerve terminal motor latency was normal in all controls except one. Resting pressure was lower in both patient groups, but the difference between controls and patients with excessive defecatory straining was not statistically significant (Table 2). However, both patient groups revealed decreased squeeze pressure compared with controls (Table 2).

Four different types of abnormal reflex responses were identified in patients with idiopathic incontinence and excessive defecatory straining, namely, diminutive excitation, excitation only at high volumes (120 ml) of distention, delayed excitation (prolonged latency), or an absent response (Figs. 2–5) Ten patients with fecal incontinence had normal PNTML but had abnormal distal RAER. Five patients had abnormal PNTML but had normal distal RAER. In 15 patients, evidence of pudendal neuropathy was detected on both tests. In patients with excessive defecatory straining, results of both tests were abnor-

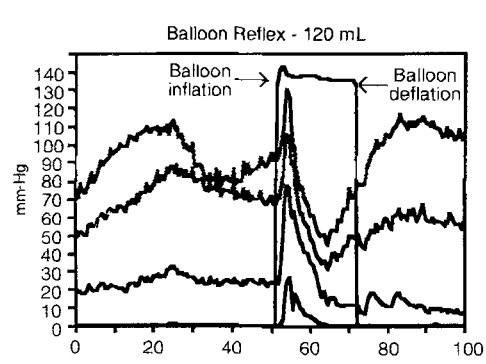

Figure 1. Normal distal rectoanal excitatory reflex.

Table 2.
Resting and Squeeze Pressure

	Fecal Incontinence n = 30	Obstructed Defecation n = 14	Control Subjects n = 20
Resting pressure			
Mean, mmHg	35.8	70.8	79.6
Range, mmHg	7.2 – 107	22.7 – 109.5	26.4 – 135.8
Squeeze pressure			
Mean, mmHg	45.8	81.2	132.3
Range, mmHg	12.6 – 102	39.6 – 140	86.2 – 210.9

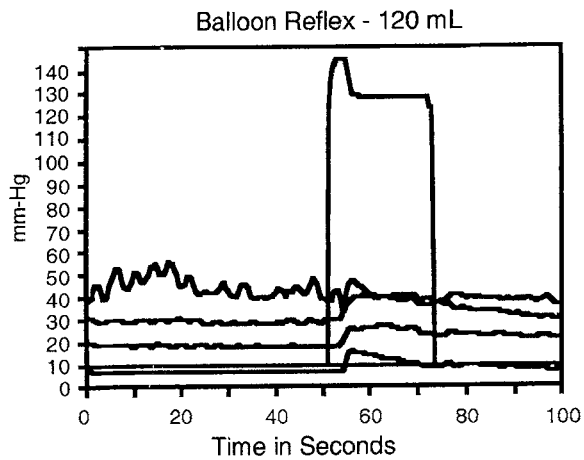

Figure 2. Diminutive distal rectoanal excitatory reflex but with normal latency.

mal in six patients, and eight patients had abnormal reflex but normal PNTML. No patient in this group had abnormal PNTML in the presence of a normal reflex response.

DISCUSSION

The impact of electrophysiologic testing in the management of pelvic floor disorders is uncertain. Although it is reassuring to document pudendal neuropathy by objective testing, its clinical use is limited.[9] The test is attractive because it is repeatable,[10] and being quantitative, it permits retrospective comparison and determination of progress of neuropathy.

However, in a proportion of patients, albeit small, PNTML is unobtainable because of the inability to locate the pudendal nerves and to deliver the stimulus. This may be the result of anatomic or technical reasons, *e.g.*, in patients with a long anal canal or a physician who is inexperienced in the testing procedures. In yet another minority, nerves may be damaged so extensively that they are incapable of responding to an electrical stimulus. Under these circumstances, it is difficult to know whether lack of response is the result of extensive nerve damage or of an inability to locate the nerve and deliver the stimulus. Obtaining objective evidence of pudendal neuropathy with balloon reflex testing is attractive because it is not necessary to locate the pudendal nerves, and special training and equipment are not required. Moreover, the simultaneous presence of inhibitory reflex in the upper anal canal is confirmatory evidence that an adequate stimulus has been delivered, and this knowledge serves as proof of delivery of the stimulus.

Patients with excessive defecatory straining who had normal resting but decreased squeeze pressure without fecal incontinence could be considered to have early pudendal neuropathy. Distal RAER was abnormal in eight of these patients, despite normal PNTML. These findings are interesting in that they seemingly suggest that distal RAER may be a more sensitive index of pudendal neuropathy. The reason for this may be that balloon reflex, which is elicited by distention of the rectum with air, may represent physiologic testing because it simulates more closely normal rectal distention by flatus. This is in contrast to an electrical or artificial stimulus applied directly to the nerve in the nerve stimulation technique. It is conceivable that a damaged nerve may respond to direct application of an electrical stimulus, whereas the same nerve may be unresponsive to a more physiologic, subtle, and indirect stimulus of rectal distention, accounting for the increased sensitivity of balloon reflex testing. This could also explain why an occasional patient with normal PNTML despite clinical disease may have abnormal results on manometry. Moreover, because the stimulus of rectal distention tests both afferent and efferent reflex pathways compared with testing of only the efferent arc by an electrical stimulus, results in the former may be abnormal more often, and this explains its heightened sensitivity.

It is not uncommon to encounter patients who have normal PNTML, despite compromised squeeze pres-

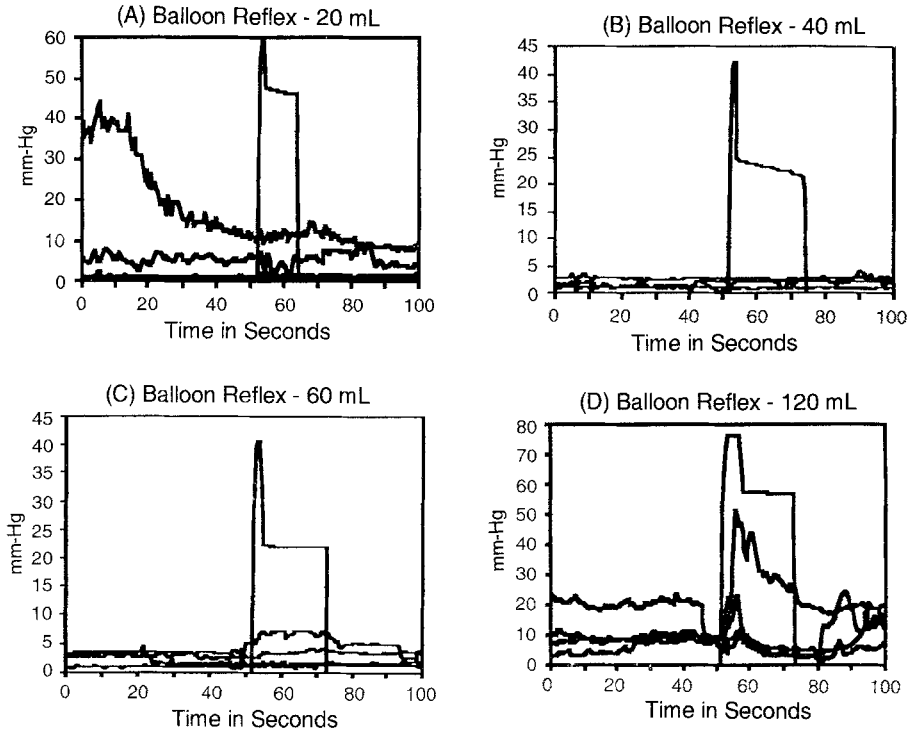

Figure 3. Rectoanal excitatory reflex elicited only at high volume (120 ml) of inflation.

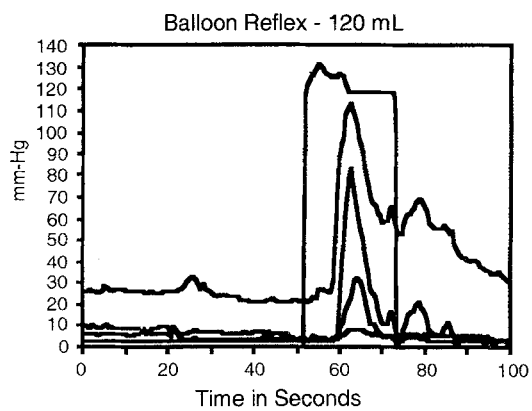

Figure 4. Delayed latency of distal rectoanal inhibitory reflex.

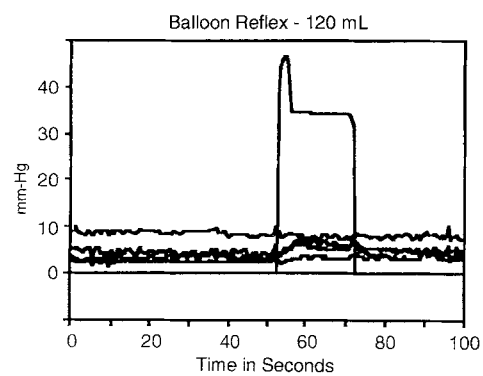

Figure 5. Absent distal rectoanal excitatory reflex.

sure, as noted in ten patients with fecal incontinence and eight patients with excessive defecatory straining in the present series. A test capable of confirming pudendal neuropathy in such patients may be a useful complementary addition to the armamentarium of coloproctologists. The finding that the RAER was abnormal in all of these 18 patients suggests that the RAER may prove to be such a test. Although it may be argued that normal PNTML in these 18 patients excludes pudendal neuropathy, the presence of clinical disease and low squeeze pressures suggests pudendal neuropathy. Comparison of PNTML and distal RAER testing with single-fiber EMG may resolve this issue. Conversely, the finding of increased PNTML and a normal reflex in five patients with fecal incontinence further confirms the mutual complementary role.

Use of the RAER as an index of pudendal neuropathy requires that preferably a more accurate computerized and not manual manometry system be used for analysis, graphic display of the reflex, and calculation of its latency. The single most important drawback of using reflex as an index of neuropathy is that lateralization of a lesion is not possible. The reported use of pudendal nerve decompression in treatment of erectile dysfunction[11] and the speculative future role of such a procedure in treatment of fecal incontinence or prevention of cumulative stretch-induced pudendal

nerve damage make split pelvic floor testing desirable.

We have found that excitation reflex is often present in the upper anal canal, even in the absence of a distal excitatory reflex response. Furthermore, in some patients with fecal incontinence, proximal excitatory and inhibitory responses may be transmitted to the distal anal canal because of lack of contraction of the distal EAS. This transmitted excitation should not be confused with the distal excitation reflex *per se*. We have observed that such a transmitted excitation is usually followed by an inhibitory response, even in the distal anal canal. On the other hand, a *bona fide* distal excitatory response should be the only response in the distal anal canal without a tagged inhibitory response.

CONCLUSIONS

The invasive nature of EMG, the inability to determine PNTML in some patients, and the lack of facilities for electrophysiologic testing in some centers call for a more universally available, relatively easily performed, supplementary method to document pudendal neuropathy. Results of the present study suggest that qualitative abnormalities of the distal RAER can provide evidence of pudendal neuropathy and serve as an alternative technique to document pudendal nerve damage. It is not the purpose of this article to advocate that RAER should replace PNTML determination as an index of pudendal neuropathy but to suggest that more careful scrutiny of RAER may serve as an addendum to existing electrophysiologic techniques used to document pudendal neuropathy.

REFERENCES

1. Kiff ES, Swash M. Slow conduction in pudendal nerves in idiopathic (neurogenic) faecal incontinence. Br J Surg 1984;71:614–6.
2. Kerremans R. Morphological and physiological aspects of anal incontinence and defaecation. Brussels: Arsica Uitgaven, 1969.
3. Bartolo DC, Jarrat JA, Read NW. The use of conventional electromyography to assess external sphincter neurology in man. J Neurol Neurosurg Psychiatry 1983; 46:1115–8.
4. Swash M, Schwartz MS. Implications of longitudinal fiber splitting in neurogenic and myopathic disorders. London: Springer-Verlag, 1984:350.
5. Ekstedt J. Human single muscle fiber action potentials: extracellular recording during voluntary and chemical activation. With some comments on end-plate physiology and on the fiber arrangements of the motor unit. Acta Physiol Scand 1964;61(Suppl 226):1–96.
6. Stalberg E, Trontelj JV. Single fibre electromyography. Old Woking, England: Mirvalle, 1979.
7. Coller JA. Clinical application of anorectal manometry. Gastroenterol Clin North Am 1987;16:17–33.
8. Roberts PL. Principles of manometry. Semin Colon Rectal Surg 1992;3:64–7.
9. Speakman CT, Henry MM. The work of an anorectal physiology laboratory. Baillieres Clin Gastroenterol 1992;6:59–73.
10. Rogers J, Laurberg S, Misiewicz JJ, Henry MM, Swash M. Anorectal physiology validated: a repeatability study of the motor and sensory tests of anorectal function. Br J Surg 1989;76:607–9.
11. Shafik A. Pudendal canal decompression in the treatment of erectile dysfunction. Arch Androl 1994;32: 141–9.