ORIGINAL ARTICLE

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Does Water-Perfused Catheter Overdiagnose Anismus Compared to Balloon Probe?

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Savoye G, Leroi AM, Bertot-Sassigneux P, Touchais JY, Devroede G, Denis P. Does water-perfused catheter overdiagnose anismus compared to balloon probe? Scand J Gastroenterol 2002;37:1411–1416.

Background: The purpose of this study was to compare the manometric assessment of straining effort as if to defecate and rectoanal inhibitory reflex obtained with a rectosphincteric balloon probe and with a water-perfused catheter in the same subject. **Methods:** Twelve healthy volunteers underwent two manometric assessments of anal sphincter function and electromyographic (EMG) surface recordings, one with a rectosphincteric balloon and one with a water-perfused catheter, 7 days apart in random order. **Results:** Increased EMG activity in the external anal sphincter in the midst of the rectoanal inhibitory reflex ($P < 0.001$) and during straining for defecation ($P < 0.001$) was more frequently observed with the perfused system than with the balloon probe. There was a discrepancy between the EMG activity of the external anal sphincter and the anal pressures during straining recorded with the perfused system. Duration of the reflex elicited by rectal distension with 10 and 20 ml of air was significantly greater with the rectosphincteric balloon than with the perfused catheter ($P = 0.02$ and $P = 0.05$, respectively). **Conclusion:** Water instilled in the anal canal by the perfused system induces artifacts in EMG recording and active anal contractions. These artifacts and induced contractions could lead to an erroneous diagnosis of anismus, particularly if pelvic floor EMG is only taken into account for the diagnosis of anismus.

Key words: anismus; anorectal manometry

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Anismus, characterized by paradoxical contraction or failure to relax the pelvic floor during attempts to defecate, is a common mechanism of outlet obstruction (1). Anismus can be demonstrated by recording electromyographic (EMG) activity from the pelvic floor muscles or by recording pressures from the anal canal during simulated defecation (2). An abnormality associated with anismus is related not to straining, but to rectal distension: occasionally, in the midst of the rectoanal inhibitory reflex, it is possible to record an external anal sphincter contraction (3).

The diagnosis of anismus may be done in several ways using anorectal manometry and perineal EMG. To perform this assessment, two recording devices are commonly used: the sphincteric balloon (4, 5) and the water-perfused catheter assembly (6). Despite the extensive use of manometric assessment of anal sphincter function and at least two reports of expert guidelines (7, 8), only a few prospective comparisons of these two devices are available (9–11). Moreover, these comparisons only focused on anal canal resting tone (9–11) and maximal voluntary contraction (11). It has been suggested, but not confirmed, that infusion of fluid due to the outflow from a perfused catheter may induce artifacts in EMG surface recordings and induced anal contractions (8, 12). These artifacts and contractions could be a source of error for anorectal function assessment during the rectoanal inhibitory reflex or when subjects strain as if to defecate.

The purpose of this study was to compare the manometric assessment of straining effort as if to defecate and rectoanal inhibitory reflex (RAIR) by rectosphincteric balloon probe and water-perfused catheter.

Subjects and Methods

Subjects

Twelve healthy volunteers (5 M and 7 F, mean age 33.1; range 24–52 years) participated in the study. None suffered from fecal incontinence or constipation and all denied any prior history of anorectal disease. All subjects gave informed consent to undergo the two consecutive anorectal manometric assessments with the two devices. The study was approved by the local ethics committee in accordance with local rules.

Method

Apparatus

The water-perfused system included a 4 lumen anal probe with an external diameter of 3.5 mm and an inflatable balloon. When correctly positioned, the manometric side holes were

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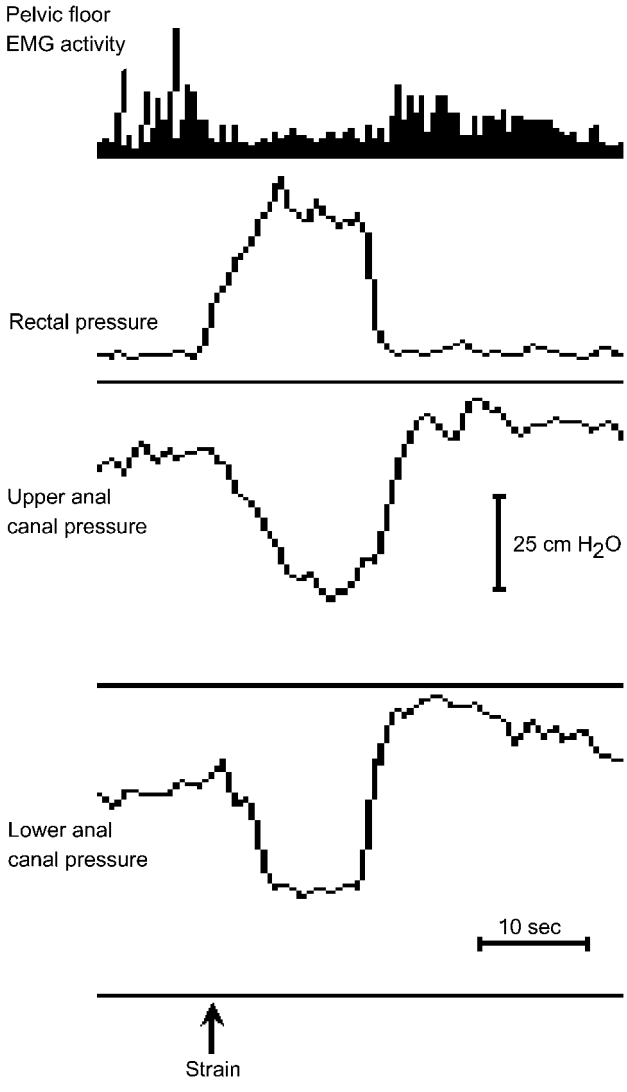

Fig. 1. During the act of defecation, electromyographic activity of the external anal sphincter and recording pressures from the upper and lower parts of the anal canal normally decrease.

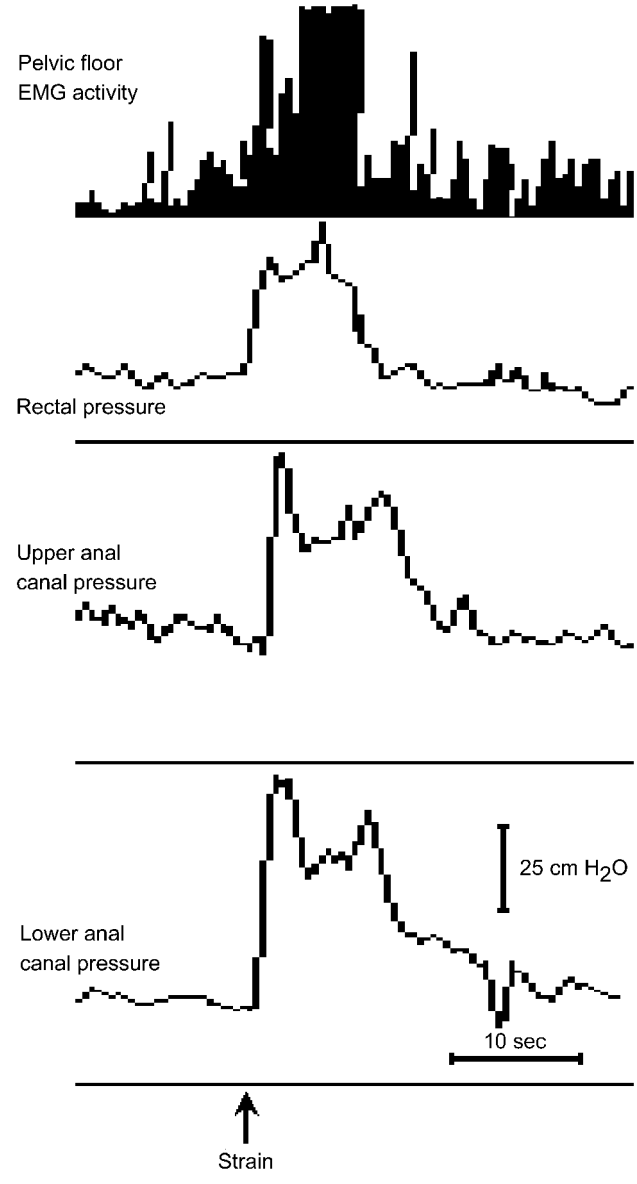

Fig. 2. In some subjects, during straining recorded with a perfused catheter, we observed an increase in the electromyographic activity of the external anal sphincter and an absence of relaxation of the pressures at the upper and lower parts of the anal canal. These subjects were considered to have an anismus.

located in the anal canal approximately 0.5 cm and 2.5 cm from the anal verge and in the rectum 5.5 cm from the anal verge. The anal pole of the balloon was located 7.5 cm from the anal margin.

The rectosphincteric balloon probe used was previously described by Arhan (5). The probe includes three balloons, one rectal distending balloon and two others, filled with water, located in the anal canal 1 cm apart. Rectal pressure was recorded with a perfused catheter with a hole under the rectal balloon. The external diameter of the probe was 7 mm. The probe was inserted so that the distal tip of the lowest balloon was barely visible at the anal margin, and so that pressure could be recorded in the rectal lumen and the upper and lower anal canals.

Catheters in both systems were perfused with distilled water at a rate of 0.5 ml/min with a low compliance pneumohydraulic capillary infusion system (13). External pressure transducers (Statham P23XL) recorded pressures that were then collected, stored and analysed on a computerized system. The devices were connected to the same transducers to avoid differences in the measurement lines.

Surface EMG of the external anal sphincter was performed with a commercially available Nikomed 4610 placed on both sides of the anal margin.

Study protocol

All volunteers underwent two manometric studies in random order, one with a rectosphincteric balloon and one with the water perfused catheter assembly, 7 days apart. Half of the subjects received the balloon probe first and half

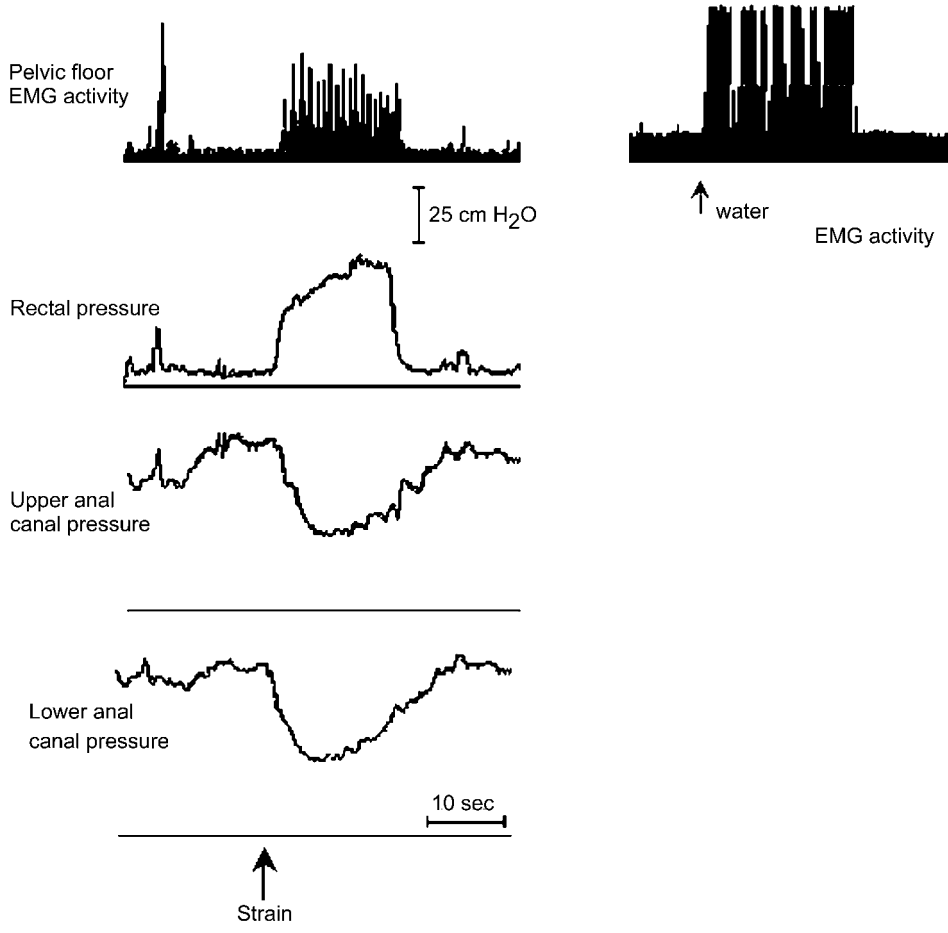

Fig. 3. Left: In some subjects, during straining recorded with a perfused system the anal pressures decreased and the electromyographic activity of the pelvic floor increased, showing saturation of the electromyographic signal. Right: During the EMG recording, some water was put on electrodes, leading to a recording artifact.

received the perfused catheter first, to control for any potential order effect (11). Each subject was studied in the left lateral decubitus position. The position of the probe was checked regularly during all recordings.

After insertion and placement of the probe, pressures were recorded in the rectum and in the upper and lower anal canal. After pressures equilibration, the rectal balloon was inflated with 50 ml of air and a simulated defecation was asked in order to check for anismus. Normally, during the act of defecation, the puborectalis sling muscle and the external anal sphincter relax to permit defecation. This can be demonstrated by recording EMG activity from the external anal sphincter and/or by recording pressures from the anal canal during simulated defecation (Fig. 1) (2). Subjects were considered to have anismus when we observed an increased or unchanged activity of the perineal EMG with a rise or absence of relaxation in pressures recorded at the upper and lower part of the anal canal (Fig. 2).

After the simulated defecation had been registered, the rectoanal inhibitory reflex (RAIR) was elicited by distending the rectal balloon for 3 s with 10, 20, 30, 40 and 50 ml of air at 1-min intervals. The speed of distention used was approximately 10 ml/s. The threshold distending volume necessary to induce visible relaxation in the upper anal canal was noted, as well as the conscious rectal sensitivity threshold. RAIR components, which can be more effectively evaluated in the upper anal canal, were also measured (i.e. maximal amplitude and total duration of the reflex). When the rectum is distended for a short period of time, a transient initial increase in pressure of the lower anal canal occurs. This is the rectoanal contractile reflex (12), which is secondary to the contraction of the external anal sphincter and, for this reason, is associated with increased EMG activity of the sphincter. Following rectal distensions, the presence or absence of a rectoanal contractile reflex was noted and the EMG activity of the external anal sphincter was assessed.

Statistical analysis was performed with the non-parametric Wilcoxon rank test for paired data. The chi-squared test with Yates correction was used to determine the differences between the two devices in relation to the presence or

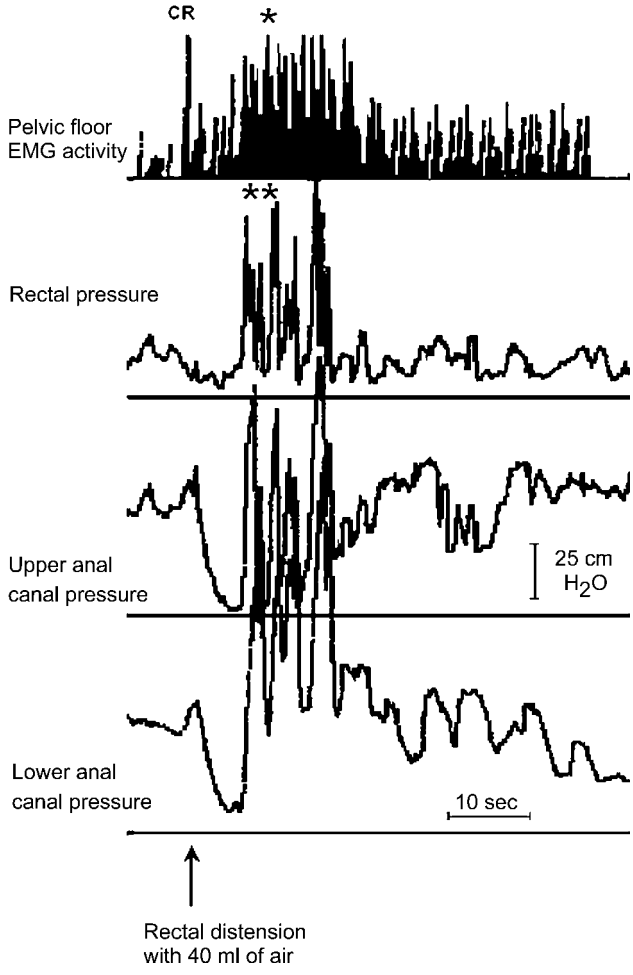

Fig. 4. In some subjects, during straining recorded with a perfused catheter the electromyographic activity increased and the anal pressures decreased and increased during relaxation. * Increased in the electromyographic activity of the external anal sphincter; ** increased anal pressures in the midst of the relaxation.

absence of an increase or decrease in EMG activity and of anal pressures during the rectoanal inhibitory reflex and straining. A probability value of $P < 0.05$ was considered to be significant after Bonferroni's correction.

Results

Electromyographic activity and anal pressures during straining

The presence of an increase in EMG activity in the external anal sphincter during straining as if to defecate was observed in 10 cases out of 12 with the perfused system and in 1 case out of 12 with the balloon probe ($P < 0.001$). In the case recorded with the balloon probe, the increase in EMG activity was associated with an increase in anal pressure in the upper and lower part of the anal canal. With the perfused system, the increase in EMG activity was associated with an absence of relaxation of anal pressure in 3 cases out of 10 (Fig. 2); with a decrease in anal pressure in 4 cases out of 10 (Fig. 3); and with a decrease in anal pressure with a secondary increase during relaxation in 3 cases out of 10 (Fig. 4). In these four subjects, anal pressures decreased and pelvic floor EMG activity increased during straining measured with a perfused system, showing artifacts in saturation of EMG activity similar to that observed in artifacts in EMG recordings due to contact with water (Fig. 3). If only anal pressures are taken into account, a lack of decrease in anal pressure was found in 6 subjects out of 12 with the perfused catheter compared to one subject out of 12 with the balloon probe (NS, $P = 0.07$).

Anorectal responses to rectal distension

The threshold distending volume necessary to elicit a RAIR ranged from 10 to 20 ml and was not different with the two devices (10 ± 10 ml with the balloon probe versus 11.7 ± 3.2 ml with the perfused system, NS), nor was the threshold of perceived rectal distension (Table I). A comparison of the components of the RAIR recorded with the rectosphincteric

Table I. Comparisons of the different characteristics of the rectoanal inhibitory reflex according to the probe

Rectal distension (ml)	10	20	30	40	50
Amplitude (cmH_2O)					
Perfused catheter	50.0 ± 31.7	66.9 ± 23.9	71.3 ± 20.9	70.1 ± 29.1	75.2 ± 21.1
	$P = 0.7$	$P = 0.7$	$P = 0.8$	$P = 1.0$	$P = 0.8$
Balloon probe	55.8 ± 17.5	65 ± 16.4	70.2 ± 14.2	73.2 ± 11.9	73.6 ± 12.3
Duration (s)					
Perfused catheter	6.5 ± 5.0	8.7 ± 4.2	10.9 ± 3.2	10.5 ± 4.3	15.2 ± 5.4
	$P = 0.02$	$P = 0.05$	$P = 0.08$	$P = 0.06$	$P = 0.5$
Balloon probe	10.3 ± 2.1	12.6 ± 4.2	15.2 ± 6.6	14.7 ± 5.4	16.5 ± 6.1
Rectal sensitivity threshold (no. of subjects)					
Perfused catheter	6/12	12/12	12/12	12/12	12/12
	$P = 0.07$	$P = 1.0$	$P = 1.0$	$P = 1.0$	$P = 1.0$
Balloon probe	11/12	12/12	12/12	12/12	12/12
Increase in EMG activity during RAIR (no. of subjects)					
Perfused catheter	6/12	8/12	7/12	5/12	5/12
	$P = 0.07$	$P < 0.001$	$P < 0.01$	$P < 0.05$	$P < 0.05$
Balloon probe	1/12	0/12	0/12	0/12	0/12

Mean $\pm$ *s* (standard deviation).

balloon and with the perfused catheter is given in Table I. The duration of the reflex elicited by rectal distension with 10 and 20 ml of air was significantly greater with the rectosphincteric balloon than with the perfused catheter. There was no statistical difference with the other volumes of rectal distension between the two devices (Table I).

An increase in the EMG activity of the external anal sphincter in the midst of the RAIR was observed following 31 out of 60 balloon inflations with the perfused system and in 1 out of 60 inflations with the balloon probe ($P < 0.001$) (Table I). This transient increase in EMG activity was associated with an increase in anal pressure in the midst of the reflex in 12 cases out of 31 (Fig. 5). It was not related to a greater threshold of rectal perception of distension or to absence of a rectoanal contractile reflex. All of the 31 reflexes recorded with an increase in EMG activity in the midst of the RAIR corresponded to rectal distension which was perceived by the subjects versus 27 out of 29 reflexes without this EMG activity (NS). Twenty reflexes out of 31 recorded with an increase in EMG activity in the midst of RAIR were associated with a rectoanal contractile reflex compared to 18 reflexes out of 29 without this EMG activity of the external anal sphincter in the midst of the RAIR (NS).

Discussion

In our study, EMG evidence of pelvic floor contraction with failure to decrease anal canal pressures during straining was more frequently observed with the perfused system than with the balloon probe. Recordings of external anal sphincter contraction during RAIR sometimes associated with a transient increase in anal pressure, occurred almost exclusively with the water-perfused probe. In addition, the RAIR elicited by rectal distension with a small volume of air and the perfused probe was shorter than with the balloon catheter. All these features are part of the definition or have been reported to be related to anismus (2). Our results suggest that water-perfused catheter could overdiagnose animus in healthy subjects. But results may be different in patients with anismus, in whom reflux control and sensation can vary from healthy controls. Anismus is a common mechanism of outlet obstruction defined as a paradoxical contraction or failure to relax the pelvic floor during defecation (1). External anal sphincter contraction in the midst of the RAIR has been found in 45% of encopretic children who also exhibit external anal sphincter contraction during expulsion that is thought to contribute to constipation (14). Previous studies have shown that contraction of the pelvic floor modifies the RAIR in sexually abused women with anismus (3, 15). Thus, pelvic floor contraction might explain the shorter duration of the reflex with the smallest volume of rectal distension as observed in the present study.

Anecdotal reports have shown that subjects contract the pelvic floor to avoid water leakage with a perfused system of anorectal manometry, thus decreasing the amplitude of the rectoanal inhibitory reflex (12). The present study confirms these reports. Water instilled in the anal canal could be the source of artifacts leading to an erroneous diagnosis of anismus, especially if anismus is defined as an increase in external anal sphincter EMG activity. Our subjects reacted instinctively to anal incontinence due to perfused fluids and

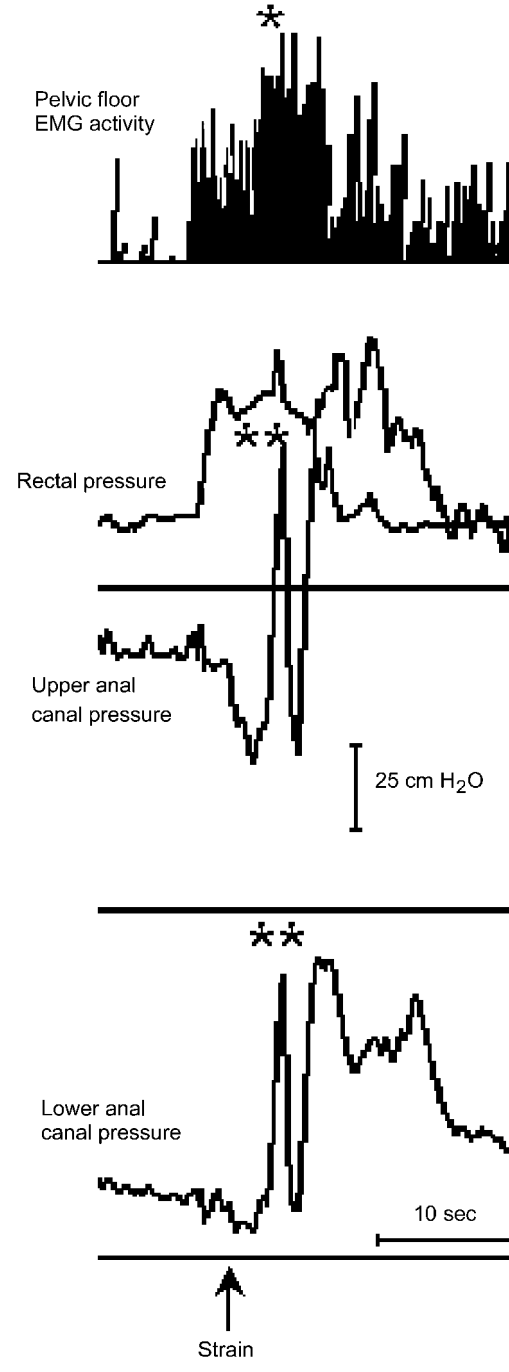

Fig. 5. An example of an increase in anal pressure during the RAIR with the water-perfused catheter associated with an increase in the pelvic floor EMG activity. CR: rectoanal contractile reflex; * increased in electromyographic activity of the EAS; ** increased anal pressure during the RAIR.

contracted their external anal sphincter when continence was most precarious (i.e. during relaxation of the internal anal sphincter and during straining). However, there was a discrepancy between the EMG activity of the external anal sphincter and the anal pressures during straining recorded with the perfused system. Approximately two-thirds of the subjects had an increased electromyographic activity of the external anal sphincter associated with relaxation of anal pressures during straining recorded with the perfused system. Half of these subjects had a secondary increase in anal pressures during relaxation. This increase in pressure was probably due to external anal sphincter contraction induced by the feeling of liquid leakage during straining. For others there was no certain explanation for this discrepancy. However, the increase in electromyographic activity was similar to that observed in artifacts from the contact of water on the surface electrodes. Artifacts of electromyographic activity may have occurred by water leakage.

Besides irritation due to water leakage, the two catheter systems have quite different diameters, measurement locations and sensitivities in measuring non-circumferential changes in pressure. This last point could explain the quantitative difference in the duration of the RAIR observed in the present study. For the other manometric criteria used to diagnose anismus the importance of different diameters, measurement locations and sensitivities in measuring non-circumferential changes in pressure appears less important. Strength imposed on a measuring system in the anal sphincter is usually lower when the diameter of the probe is smaller (5, 6). But, paradoxically, we observed a lack of relaxation in anal pressure during straining more frequently with the probe with the smaller diameter. The perfused catheter, which had the larger interval between measurement locations, was also possibly able to move more easily out of the high-pressure area of the anal sphincter, especially in women with shorter anal canal. To avoid the consequences of these movements, the position of the probe was checked regularly during the experiment. Moreover, in our study the lack of relaxation during straining was more frequently observed with the perfused catheter, suggesting indirectly a correct position of the probe at least during this part of the experiment.

It is particularly important to recognize a diagnosis of anismus in constipated patients, because this is associated with idiopathic chronic constipation that can be cured with biofeedback therapy (16). Biofeedback therapy can be performed with external anal sphincter EMG or manometry as a feedback signal for the patient. Our results emphasize the importance of the choice of probe. If our results can be extrapolated to constipated patients, perfused catheters should not be recommended for assessing these constipated patients and for performing biofeedback therapy for constipation. If perfused catheters are used, it can be recommended taking into account anal pressures during straining, which are much more reliable than a pelvic floor EMG in the diagnosis of anismus.

Received 8 April 2002
Accepted 25 September 2002

References

1. Preston DM, Lennard-Jones JE. Anismus in chronic constipation. Dig Dis Sci 1985;30:413–8.
2. Devroede G. Constipation. In: Sleisenger MH, Fordtran JS, editors. Gastrointestinal disease: pathophysiology, diagnosis, management. Philadelphia, London, Toronto, Montreal, Sydney, Tokyo: W. B. Saunders; 1993. p. 837–87.
3. Devroede G. La constipation: du symptôme à la personne. Psychol Med 1985;17:1515–24.
4. Arhan P, Faverdin C. Une sonde à ballonnets pour l'étude de la mécanique anorectale. Pathol Biol 1972;20:191–4.
5. Arhan P, Faverdin C, Persoz B, Devroede G, Dubois F, Dornic C, et al. Relationship between viscoelastic properties of the rectum and anal pressure in man. J Appl Physiol 1976;41:677–82.
6. Hill JR, Kelley ML, Schlegel JF. Pressure profile of the rectum and anus of healthy persons. Dis Colon Rectum 1960;3:203–9.
7. Keighley MR, Henry MM, Bartolo DC, Mortensen NJ. Anorectal physiology measurement: report of a working party. Br J Surg 1989;76:356–7.
8. Meunier P. Anorectal manometry. A collective international experience. Gastroenterol Clin Biol 1991;15:697–702.
9. Hancock BD. Measurement of anal pressure and motility. Gut 1976;17:645–51.
10. Miller R, Bartolo DCC, James D, McMortensen NJ. Air-filled microballoon manometry for use in anorectal physiology. Br J Surg 1989;76:72–5.
11. Allen ML, Zamani S, DiMarino AJ, Sodhi S, Miranda LA, Nusbaum M. Manometric measurement of anal canal resting tone. Comparison of a rectosphincteric balloon probe with a water-perfused catheter assembly. Dig Dis Sci 1998;43:1411–5.
12. Devroede G, Hemond M. Anorectal manometry: small balloon tube. In Smith LE, editor. Practical guide to anorectal testing. New York: Igaku-Shoin Medical Publishers; 1990. p. 55–64.
13. Andorfer RC, Steff JJ, Dodds WJ, Linehan JH, Hogan WJ. Improved infusion system for intraluminal esophageal manometry. Gastroenterology 1977;73:23–7.
14. Wald A, Chandra R, Chiponis D, Gabel S. Anorectal function and continence mechanisms in childhood encopresis. J Pediatr Gastroenterol Nutr 1986;5:346–51.
15. Leroi AM, Berkelmans I, Denis P, Hémond M, Devroede G. Anismus as a marker of sexual abuse. Consequence of abuse on anorectal motility. Dig Dis Sci 1995;40:1411–6.
16. Enck P. Biofeedback training in disordered defecation. A critical review. Dig Dis Sci 1993;38:1953–60.

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