Decrease in the Anorectal Pressure Gradient After Low Anterior Resection of the Rectum

A Study Using Continuous Ambulatory Manometry

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PURPOSE: Changes in anorectal function after low anterior resection of the rectum (LAR) often lead to symptoms of urgency and frequency of defecation, the anterior resection syndrome. It has been reported that preservation of part of the rectum improves clinical results, but why this should be remains unclear. METHODS: We have carried out continuous ambulatory manometric studies in two groups of patients: 11 patients, a median of 11 (range, 5-96) months after LAR, in whom the median anastomotic level above the anal high-pressure zone was 0 (range, 0-2) cm; 9 patients, a median of 6 (range, 3-12) months after sigmoid colectomy, in whom the rectum remained *in situ* and who acted as controls. RESULTS: Comparing the LAR group with controls, resting anal pressures were lower, median 68 (range 27-102) cm H_2O *vs.* 95 (45-116) cm H_2O ($P < 0.05$), and neorectal pressures were higher, 25 (0-48) cm H_2O *vs.* 10 (0-10) cm H_2O ($P < 0.01$). Thus the anorectal pressure gradients were less, 34 (0-74) cm H_2O *vs.* 81 (35-113) cm H_2O ($P < 0.01$). Slow-wave activity in the anal sphincter was present in six patients (55 percent) after coloanal anastomosis and eight patients (89 percent) after sigmoid colectomy. Sampling episodes were seen in only two patients (18 percent) after coloanal anastomosis and five patients (56 percent) after sigmoid colectomy. When clinical endpoints were compared (LAR *vs.* controls), bowel frequency in 24 hours was higher, 5 (3-8) *vs.* 2 (1-3) ($P < 0.01$); fecal leakage was more common, affecting seven patients (64 percent) *vs.* one patient (11 percent) ($P < 0.05$), and urgency of defecation was also more common. CONCLUSIONS: The inferior clinical results observed after LAR compared with the results after sigmoid colectomy are thus in part because of higher neorectal pressure acting on a weakened sphincter mechanism. These observations lend support to the idea that neorectal capacity should be increased in patients who undergo low anterior resection. [Key words: Low anterior resection; Rectal carcinoma; Anorectal physiology; Continuous ambulatory manometry]

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Following the abandonment of the "5 cm rule" for the safe margin of resection in rectal carcinoma,[1-3] low rectal tumors have increasingly been treated by sphincter-saving low anterior resection (LAR), in preference to abdominoperineal excision. It has become apparent, however, that many patients pay a price for avoidance of a colostomy.[4, 5] The "anterior resection syndrome" is characterized by frequent bowel action, urgent defecation, and even incontinence. The proportion of patients who suffer from this syndrome seems to increase as the level of anastomosis approaches the anal sphincter. For example, Karanjia *et al.*[4] found that urgency and leakage were significantly more common in patients who had an anastomosis 3 cm from the anal verge than in patients whose anastomosis was 6 cm or more from the anal verge. In an earlier study, we compared groups of patients who had either good or poor anorectal function after low anterior resection and found that anastomoses situated 4 cm or more above the physiologic high-pressure zone were associated with significantly better function than anastomoses sited below that level.[5] It is not clear why this small amount of distal rectum can apparently make the difference between an acceptable clinical outcome and a poor one. The aim of this study was to use continuous ambulatory manometry to try to identify any dynamic changes in anorectal pressure and coordination that might explain the problems that patients experience after LAR. Our hypothesis was that the physiologic behavior of the neorectum created from a descending colon differs significantly from the behavior of a normal rectum.

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PATIENTS AND METHODS

Twenty patients were studied, 11 of whom had undergone potentially curative resection for low rectal carcinoma (median anastomotic level above the physiologic high-pressure zone, 0 (range, 0–2) cm, and 9 of whom had undergone potentially curative resection of left colonic and sigmoid tumors with high colorectal anastomoses (minimum distance above physiologic high-pressure zone, 7 cm), who acted as controls. The study group will be referred to as "coloanal anastomosis" and the control group as "sigmoid colectomy." The median ages (and ranges) and the male to female ratio in the two groups did not differ significantly, 69 (range, 59–81) years in the LAR group and 63 (range, 57–86) years in the control group.

Tests were carried out a median of 11 (range, 5–96) months after operation in the LAR group and a median of 6 (range, 3–12) months after sigmoid colectomy. The level of anastomosis was measured by means of rigid sigmoidoscopy, and the anal high-pressure zone was defined by microballoon and the station pull-through technique.

Measurements were made by *continuous ambulatory manometry*, a 2 megabite digitrapper (Synectics, Stockholm, Sweden) recording from a microtip catheter (Gaeltec, Isle of Skye, UK) equipped with two transducers. The transducers were placed 6 cm apart, the caudal one lying in the middle of the anal high-pressure zone and the other in the rectum or neorectum. Recordings were made in the morning over a three-hour period, between breakfast and lunch. Patients were free to move around, although they usually sat in a chair for most of the time.

Information obtained was retrieved by means of a dedicated computer software program (Gastrosoft, Irving, TX) and printed out in full for analysis. All grouped data were expressed as median and range. Data were analyzed using the Mann-Whitney *U* test and nominal data using Fisher's exact test.

RESULTS

Continuous Ambulatory Manometry

Resting anal pressures over the three-hour recording period were significantly lower after LAR (median, 68 (range, 27–102) cm H_2O) than after sigmoid colectomy (median, 95 (range, 45–116) cm H_2O) ($P < 0.05$). In contrast, neorectal pressures were significantly higher after LAR (median, 25 (range, 0–45) cm H_2O) than after sigmoid colectomy (median, 10 (range, 0–10) cmH_2O) ($P < 0.01$). Hence, the anorectal pressure gradient, the difference between (neo) rectal and resting anal pressure, was much less after LAR (median, 34 (range, 0–74) cm H_2O) than after sigmoid colectomy (median, 81 (range, 35–113) cm H_2O) ($P < 0.01$) (Fig. 1).

Slow-wave activity in the anal sphincter was present in six patients (55 percent) after coloanal anastomosis and eight patients (89 percent) after sigmoid colectomy. Sampling episodes were seen in only two patients (18 percent) after coloanal anastomosis and five patients (56 percent) after sigmoid colectomy.

Clinical Outcome

Clinical anorectal function was significantly worse in patients who had undergone LAR than in patients who had undergone sigmoid colectomy. Bowel frequency was significantly greater after LAR; median, five (range, 3–8) times in 24 hours compared with two (range, 1–3) in controls ($P < 0.01$). The length of time for which patients could defer defecation after they perceived the call to stool was also deficient after LAR; median, 15 (range, 0–30) minutes compared with 60 (range, 30–120) minutes in controls ($P < 0.01$). Eight of 11 patients were able to defer defecation for less than 15 minutes after LAR, and 3 of these could defer for less than 5 minutes, whereas none of the control

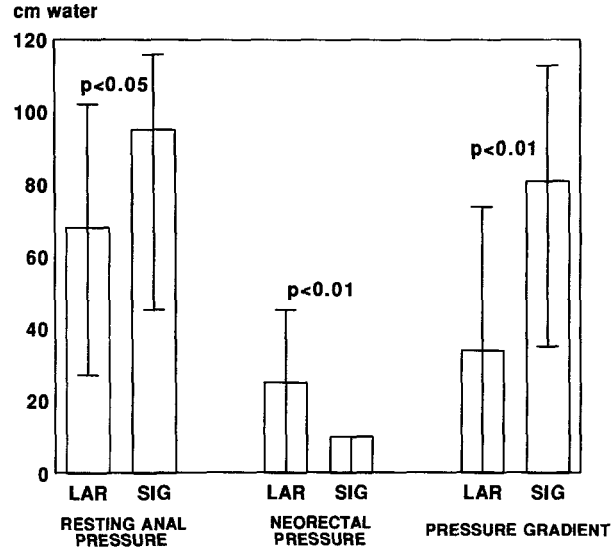

Figure 1. Resting anal pressure in the anal high-pressure zone, pressure in the neorectum/rectum (neorectal pressure), and the anoneorectal pressure gradient (pressure gradient) after low anterior resection and coloanal anastomosis (*LAR*) or sigmoid colectomy (*SIG*). Medians and ranges are shown.

patients was unable to defer defecation for less than 30 minutes. Seven patients experienced minor fecal leakage after LAR (64 percent), whereas only one patient experienced such leakage after sigmoid colectomy (11 percent) ($P < 0.05$).

DISCUSSION

Continuous ambulatory manometry has certain potential advantages over more conventional methods of pressure measurement. It allows the monitoring of dynamic variations in pressure over prolonged periods of time in individuals who can be in a more normal environment and who are not restricted to the left lateral position and are presumably, therefore, more at ease. By using a combination of transducers, it is possible to monitor coordinated activity between the anus and rectum, and also rectal substitutes, perhaps important in the fine control of continence.

Sphincter-preserving operative procedures have been used increasingly in recent years in the treatment of a number of conditions that would previously have been dealt with by ano-proctectomy and a permanent stoma. This is true for the treatment both of benign diseases such as ulcerative colitis and familial polyposis[6] and of rectal carcinoma. For middle and lower third rectal cancer, when the mesorectum has been totally excised,[7] provided there is an adequate margin of disease-free tissue distal to the tumor, then the descending colon may well be anastomosed to the anal sphincter itself, even to the level of the dentate line. Unfortunately, as the level of anastomosis becomes lower and the amount of residual anorectum becomes less, so the patient's quality of life, in terms of bowel function, tends to become poorer.[4, 5] Nevertheless, the outcome may still be preferable to life with a permanent abdominal stoma.

In the past it was assumed that the only prerequisite for continence after low anterior resection was the presence of an intact, normally functioning anal sphincter.[8] It is now apparent that as the level of anastomosis becomes lower, bowel frequency increases, defecation becomes more urgent, and the likelihood of fecal leakage increases.[4, 5] If one makes the assumption that patients' ages and sphincter pressures are constant, the critical level for the anastomosis, above which function is usually acceptable and below which it tends to be poor, appears to be about 4 cm above the anal high-pressure zone.[5]

The reason why this relatively short length of distal rectum is so important is not clear. It is well known that anal sphincter pressure decreases after low rectal transection, perhaps caused by transection of intramural nerves or stretching of the anal sphincter.[9, 10] A controlled study in dogs suggested that both of these factors may be important.[11] Deleterious effects of such a decrease on resting anal pressure may be compounded by the fact that the rectal substitute, created from mobilized descending colon, is much less capacious and compliant than normal rectum.

By use of continuous ambulatory manometry, we confirmed that anal sphincter pressure decreases significantly after low anterior resection. In addition, we observed that this weakened sphincter is subjected to greater stress from neorectal content, which is presented to it under higher pressure and may also be looser in consistency than normal stool. The rectum, which was preserved in control subjects who had undergone sigmoid colectomy, contains its contents at lower pressure. A small amount of retained rectum, perhaps as little as 4 cm above the anal high-pressure zone,[5] may exert its effect by modulating and diminishing high-pressures in the colonic neorectum and so provide a more satisfactory clinical outcome.

Slow-wave activity and sampling episodes occur in normal sphincters.[12] One-half of the patients who had undergone sigmoid colectomy showed sampling episodes, whereas only one-fifth of the patients who had undergone coloanal anastomosis exhibited them. Nearly all patients showed slow-wave activity after sigmoid colectomy, whereas only one-half of those patients who had undergone coloanal anastomosis showed such activity. These apparently large differences in the activity of the anal sphincter between the two groups might well have reached significance if the statistical power of our study had been greater. It would appear that the fine control of the anal sphincter is lost in most patients after very low anterior resection but is usually preserved after sigmoid colectomy, in which the rectum remains intact. Exactly why only one-half of the patients in the control group showed sampling episodes is difficult to explain, but it does appear that there is some loss of fine tuning of the anal sphincter even after a relatively high rectosigmoid transection, although this does not appear to translate into poorer clinical function.

These observations of high neorectal pressure and a reduced anoneorectal pressure gradient and of a weakened, malfunctioning anal sphincter lend support to the idea that some patients, who undergo low anterior resection with coloanal anastomosis, might benefit from the construction of a more capacious and

compliant rectal substitute, with a lower intraluminal pressure, above the anastomosis. Such a reservoir could be created by colonic myotomy or myectomy[13–15] or by the use of a colonic pouch.[16, 17] Such techniques may, of course, create problems of their own.

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