Ann R Coll Surg Engl 1999; **81**: 105–108

Controlled intraoperative water testing of left-sided colorectal anastomoses: are ileostomies avoidable?

J M D Wheeler FRCS
Specialist Registrar

J M Gilbert MS FRCS
Consultant Surgeon

Department of Surgery, Wexham Park Hospital, Slough, Berkshire

Key words: Colorectal anastomoses; Testing; Ileostomies

Anastomotic leakage is a major problem in colorectal surgery, and previous studies have suggested that intraoperative identification of leaks allows repair at the time of surgery. This study examined whether testing allowed a defunctioning ileostomy to be safely omitted.

A series of 102 consecutive patients underwent left-sided colorectal resection, 52 males and 50 females, mean age 65.7 years (range 16–89 years). After completion of the anastomosis, its integrity was tested by running saline into the rectum, using a manometer, to a maximum distending pressure of 30 cmH_2O. Any leaks were repaired and the anastomosis retested. A defunctioning ileostomy was only performed if the anastomosis could not be shown to be leak-proof on testing. Patients underwent a contrast enema on the 8th postoperative day.

Twenty-one (20.6%) patients failed the initial leakage test and 3 (3%) patients failed a second test. Two of these 21 patients went on to have a clinical leak, both of which were treated conservatively. Two defunctioning ileostomies were performed at the time of surgery. Sixteen (16.2%) had a leak on radiological testing, and there was clinical evidence of a leak in 5 (4.9%) patients. There were 3 (2.9%) deaths, but none of these had a leak on radiological testing.

Incomplete anastomoses were successfully corrected intraoperatively. A defunctioning ileostomy was avoided in 98% of cases. Intraoperative testing to a pressure of 30 cmH_2O is helpful in anterior resection, but does not guarantee that an intact anastomosis will remain intact postoperatively.

Correspondence to: Mr J M D Wheeler FRCS, Research Fellow, ICRF Laboratory, Institute of Molecular Medicine, John Radcliffe Hospital, Oxford OX3 9DU

Anastomotic leakage is a major cause of morbidity and mortality in colorectal surgery. Leak rates are higher after anterior resection than after colonic resection *(1)*. The leak rate will vary depending on how it is sought, with radiological leakage rates being higher than clinical leakage rates *(2,3)*. Surgical technique appears to be the major cause of anastomotic leak, and two previous studies have shown that intraoperative testing of anastomoses may allow repair of any defects at the time of surgery with assumed lower leakage rates *(1,4)*. Some authors consider it prudent to defunction low anterior resections *(5)*, while others have previously questioned whether this should still be performed routinely *(6)*. Supporters of defunctioning argue that it is difficult to predict which anastomoses will leak. However, as only a small proportion of anastomoses will leak, it would be advantageous to identify those that are likely to do so at the time of surgery, so that selective defunctioning may be achieved. This study examined whether controlled intraoperative water testing of left-sided colorectal anastomoses could determine in which patients a defunctioning ileostomy could be safely omitted.

Patients and methods

A series of 102 consecutive patients undergoing elective left-sided colorectal anastomosis were studied prospectively. There were 52 men and 50 women with a mean age of 66 years (range 16–89 years). Anterior resection was performed in 94 (92%) patients and in 26 of these patients a low anastomosis was situated less than 6 cm from the anal verge (Table I). Total mesorectal excision was used for resection of all rectal carcinomas situated in the mid or lower third of the rectum. In all, 91 (89%) operations were performed for elective resection of a carcinoma, 8

Table I. Details of left-sided colorectal anastomoses performed

Operation	*n*	*(%)*
Anterior resection	94	92
(Low anterior resection)	(26)	(25)
Sigmoid coloectomy	4	4
Total colectomy	3	3
Reversal of Hartmann's	1	1

(8%) operations for diverticular disease and one each for recurrent sigmoid volvulus, familial adenomatous polyposis, and reversal of a previous Hartmann's procedure. Picolax was used for bowel preparation and antibiotic prophylaxis given to all patients. All operative decisions were left to the operating surgeon with a consultant (JMG) being present in all cases. For anterior resection, the splenic flexure was mobilised and an end-to-end anastomosis performed with randomisation to either staples or sutures. There were 50 (49%) anastomoses stapled and 52 (51%) sutured with single layer interrupted seromuscular inverting 2/0 Nurolon® sutures as described by Matheson and Irving *(7)*.

After completion of the anastomosis, a soft clamp was placed across the bowel above the anastomosis. Saline was run in through a size 30G Foley balloon catheter placed in the anus and pulled down against the anal sphincters. The saline was run into the rectum and the bowel seen to distend up to a pressure of 30 cmH_2O, as previously described *(4)*. If a leak occurred it was repaired and the anastomosis tested a second time. If the anastomosis was seen to be intact, no stoma was performed, although in two patients a tube caecostomy was inserted. If a second leak occurred, the patient was defunctioned with either a loop ileostomy or tube caecostomy depending on the degree of risk perceived. A tube caecostomy was used if the anastomosis was believed to be less than perfect, but no localised defect could be identified. Postoperatively, evidence of an anastomotic leak was looked for clinically and radiologically, with a water-soluble contrast enema performed on the 8th postoperative day.

Results

All of the 102 patients in the study underwent controlled intraoperative water testing. Only 99 underwent a water-soluble contrast enema, as there was one death before the radiography, one accidental omission and one patient was unable to undergo an enema having suffered a fractured neck of the femur postoperatively.

There were 5 (4.9%) clinical leaks and two late clinical leaks (more than 14 days postoperatively), giving an overall clinical leakage rate of seven (6.9%—four handsewn, three stapled) (Table II). Three of these clinical leaks were from a low anastomosis, giving an overall clinical leak rate of 11.5% for low anastomoses.

In all, 21 (20.6%—ten handsewn, 11 stapled) patients failed the initial water test (Fig. 1) and underwent strengthening of the anastomosis. However, only two of these patients went on to have a clinical leak (one patient with a low anastomosis), and these settled with conservative management. Nineteen patients were re-tested and, of the three patients who failed the second water test, two underwent formation of a loop ileostomy (one patient with a low anastomosis) and one patient was given a tube caecostomy.

There were 16 (16.2%—eight handsewn, eight stapled) leaks identified on water-soluble contrast enema (Fig. 2). Of these, eight were from a low anastomosis, giving an overall radiological leakage rate of 30.8% for low anastomoses. Only three were clinically significant (two with a low anastomosis), but all were treated conservatively and no stomas were performed.

Six (5.9%) patients underwent formation of a stoma at surgery. There were four tube caecostomies and two loop ileostomies (Fig. 1). Therefore, only 2 (2%) patients (one

Table II. Details of patients who suffered a clinical leak

	Sex	*Age*	*Anastomosis*	*Operation*	*Water test*	*Contrast enema*	*Treatment*	*Alive at 30 days*
Clinical leaks								
1	M	80	Handsewn	Anterior resection	Passed 1st	No leak	Transverse colostomy	No
2	M	74	Stapled	Anterior resection	Passed 1st	No leak	Hartmann's	No
3	F	61	Handsewn	Low anterior resection	Passed 1st	Leak	Conservative	Yes
4	M	68	Stapled	Low anterior resection and caecostomy	Passed 2nd	Leak	Conservative	Yes
5	M	84	Handsewn	Anterior resection	Failed 1st (no 2nd test)	Leak	Conservative	Yes
Late clinical leaks								
6	M	61	Stapled	Low anterior resection	Passed 1st	No leak	Transverse colostomy	Yes
7	M	66	Handsewn	Anterior resection	Passed 1st	No leak	Loop ileostomy	Yes

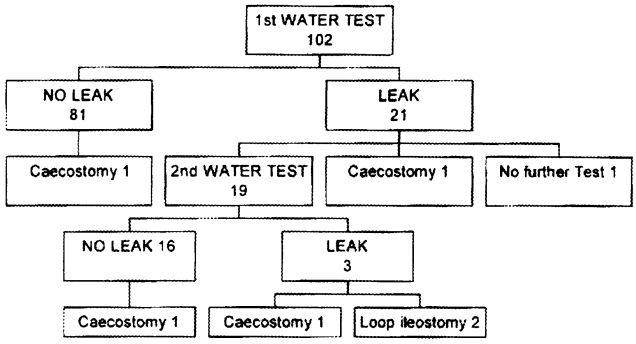

Figure 1. Controlled intraoperative water testing. Ileostomies and tube caecostomies all performed at the time of initial surgery.

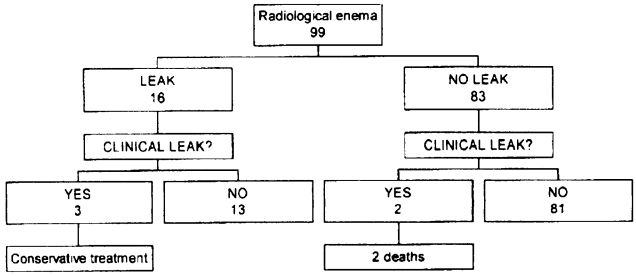

Figure 2. Postoperative water-soluble contrast enemas.

with a low anastomosis) underwent formation of a true stoma at surgery. Of 26 patients undergoing low anterior resection, 25 (96%) did not have a defunctioning stoma performed at the time of surgery. Both stomas have been closed at follow-up.

There were three deaths in this series (2.9%—one handsewn, two stapled). An 80-year-old male who had undergone an anterior resection for a Dukes' C adenocarcinoma developed bronchopneumonia on the 4th postoperative day. On the 9th postoperative day he suffered a 200 ml fresh rectal bleed. Although he did not have a radiological leak, he deteriorated and underwent a transverse colostomy and drainage of a pelvic abscess on the 16th postoperative day. He died of respiratory failure after his second laparotomy. A 74-year-old male underwent an anterior resection for a Dukes' C adenocarcinoma. At the time of surgery an obstructed right ureter was anastomosed to the left ureter. On the 5th postoperative day he underwent a laparotomy and oversewing of the uretero-ureteric anastomosis for a leak demonstrated on intravenous urography. On the 9th postoperative day he developed peritonitis, despite a normal contrast enema, and underwent a Hartmann's procedure for presumed anastomotic dehiscence. He died of respiratory failure. A 68-year-old male underwent an anterior resection for stenosing diverticular disease. He died on the 3rd postoperative day from a left basal pneumonia.

Discussion

Many factors have been implicated in anastomotic failure *(8)*, including bowel preparation, vascularity of the bowel, bacterial contamination, anastomotic tension, drains, level of anastomosis and, perhaps most importantly, surgical technique *(9–11)*. This was highlighted by Fielding *et al. (9)* who reviewed 1466 patients undergoing large bowel resection and anastomosis. Twenty-eight consultants had a clinical leakage rate that varied from 0.5% to 30%. Leak rates as high as 69% have been demonstrated *(2)* for anterior resection, and this seems to be higher if patients are examined closely, especially by use of contrast enemas. Our clinical leakage rate of 4.9% (11.5% for low anastomosis) compares favourably with published clinical leakage rates *(3,6)*. A water-tight anastomosis was only achieved primarily in 79% of patients as shown by the first leakage test, and in 95% of patients after additional sutures, as shown by the second leakage test. There was no relation to the height of the anastomosis in those patients who failed the water test. Only two of 21 patients who failed the first water test went on to suffer a clinical leak and both of these settled with conservative management. However, the four patients who required further surgery after a clinical leak had passed the water test and did not exhibit a leak on the contrast enema. This indicates that an anastomosis may break down more than 1 week postoperatively, after appearing to be intact.

In all, 21 (20.6%) patients failed the first water test, and this is presumably a technical failure. Could it be supposed that these patients would have gone on to have a clinical leak, if the anastomoses had not been reinforced? Beard *et al. (12)* reported a prospective randomised trial of intraoperative air testing of 145 consecutive colorectal anastomoses. They concluded that intraoperative air testing significantly reduces the incidence of postoperative clinical and radiological leaks. We believe that the exact site of leakage is better identified with water rather than air, and that the theoretical risk of anastomotic disruption should be avoided with the controlled introduction of water. A maximum distending pressure of 30 cmH_2O was used on the basis of the results of a previous study *(4)*. This is less than pressures that have been found physiologically within the rectal lumen *(13)*, but increasing the pressure would have increased the risk of disrupting the anastomosis. The postoperative contrast enema is potentially dangerous and primarily a research tool *(14)*, and Beard *et al. (12)* believed that it may have caused anastomotic failure in two of their patients. A subsequent study of postoperative contrast radiology of colorectal anastomoses demonstrated a 1.3% rate of clinically apparent 'anastomotic complication' attributed to the radiological investigation itself *(15)*.

Mealy *et al. (6)* have questioned whether anterior resection should be routinely defunctioned. They studied 114 consecutive patients undergoing anterior resection without defunctioning colostomy, and reported a clinical leak rate of 5.3%. In contrast, Karanjia *et al. (5)* still consider it wise to defunction a low anterior resection. They reported a major clinical leakage rate of 8% for defunctioned low anterior resection, and 18% if the anastomosis is not defunctioned. In the present series, 25 of 26 (96%) patients undergoing low anterior resection did not have a defunctioning stoma performed at surgery,

with a resulting clinical leak in three patients (11.5%). Only one of these patients required further surgery. The perceived advantage of lower leakage rates with a covering stoma, needs to be weighed against the morbidity of subsequently closing the stoma. A defunctioning stoma does not prevent an anastomotic leak *(6,8,12)*, but it does prevent the most serious consequence of a leak, peritonitis.

Which patients should be defunctioned? The aim of this study was to see if water testing of a left-sided colorectal anastomosis would identify these patients, and it appears to have done so. Only 2% of patients overall, and 4% of low anterior resections, were given a loop ileostomy at the time of surgery, and those who subsequently required a stoma were not identifiable either by intraoperative or radiological testing.

The water test is easily carried out and adds approximately 5 min to the operation time. The exact site of leakage is more easily identified than if air is insufflated into a pelvis full of water. It also provides a useful guide to the surgeon for demonstrating errors in surgical technique *(4)*. Although the water test will highlight those patients who have a technically imperfect anastomosis at the time of surgery, it will not avoid anastomotic leaks altogether. Those patients who suffered a leak despite a normal water test will presumably have other factors involved such as height of the anastomosis or bowel vascularity.

In conclusion, controlled water testing of left-sided colorectal anastomoses at the time of surgery allowed incomplete anastomoses to be corrected intraoperatively. A defunctioning ileostomy was avoided in 98% of patients, and in 25 of 26 (96%) of low anastomoses. Intraoperative testing to a pressure of 30 cmH_2O is helpful in anterior resection, but does not guarantee that an intact anastomosis will remain intact postoperatively.

References

1 Davies AH, Bartolo DCC, Richards AEM, Johnson CD, Mortensen NJMc. Intraoperative air testing: an audit on rectal anastomosis. *Ann R Coll Surg Engl* 1988; **70**: 345–7.

2 Goligher JC, Graham NG, De Dombal FT. Anastomotic dehiscence after anterior resection of rectum and sigmoid. *Br J Surg* 1970; **57**: 109–18.

3 McGinn FP, Gartell PC, Clifford PC, Brunton FJ. Staples or sutures for low colorectal anastomoses: a prospective randomised trial. *Br J Surg* 1985; **72**: 603–5.

4 Gilbert JM, Trapnell JE. Intraoperative testing of the integrity of left-sided colorectal anastomoses: a technique of value to the surgeon in training. *Ann R Coll Surg Engl* 1988; **70**: 158–60.

5 Karanjia ND, Corder AP, Bearn AP, Heald RJ. Leakage from stapled low anastomosis after total mesorectal excision for carcinoma of the rectum. *Br J Surg* 1994; **81**: 1224–6.

6 Mealy K, Burke P, Hyland J. Anterior resection without a defunctioning colostomy: questions of safety. *Br J Surg* 1992; **79**: 305–7.

7 Matheson NA, Irving AD. Single layer anastomosis after rectosigmoid resection. *Br J Surg* 1975; **62**: 239–42.

8 Vignali A, Fazio VW, Lavery IC *et al.* Factors associated with the occurrence of leaks in stapled rectal anastomoses: a review of 1014 patients. *J Am Coll Surg* 1997; **185**: 105–13.

9 Fielding LP, Stewart-Brown S, Blesovsky L, Kearny G. Anastomotic integrity after operations for large bowel cancer: a multicentre study. *BMJ* 1980; **2**: 411–14.

10 Khoury GA, Waxman BP. Lower bowel anastomoses. 1. The healing process and sutured anastomoses. A review. *Br J Surg* 1983; **70**: 61–3.

11 Rullier E, Laurent C, Garrelon JL, Michel P, Saric J, Parneix M. Risk factors for anastomotic leakage after resection of rectal cancer. *Br J Surg* 1998; **85**: 355–8.

12 Beard JD, Nicholson ML, Sayers RD, Lloyd D, Everson NW. Intraoperative air testing of colorectal anastomoses: a prospective, randomized trial. *Br J Surg* 1990; **77**: 1095–7.

13 Gillespie IE. In: Ledingham IMcA, MacKay C, eds. *Jamieson & Kay's Textbook of Surgical Physiology*, 3rd Edition. Edinburgh: Churchill Livingstone, 1978: 252–3.

14 Shorthouse AJ, Bartram CI, Eyers AA, Thomson JPS. The water-soluble contrast enema after rectal anastomosis. *Br J Surg* 1982; **69**: 714–17.

15 Akyol AM, McGregor JR, Galloway DJ, George WD. Early postoperative contrast radiology in the assessment of colorectal anastomotic integrity. *Int J Colorectal Dis* 1992; **7**: 141–3.

Received 23 September 1998