Ulcerative Colitis: The Fate of the Retained Rectum

Adam Juviler, M.D.¹ and Neil Hyman, M.D.¹

ABSTRACT

Ileal pouch-anal anastomosis has clearly diminished the role of colectomy and ileorectal anastomosis (IRA) in the management of patients with ulcerative colitis. Nonetheless, IRA probably still has an appropriate place in highly selected patients, and many others maintain an “out of circuit” rectal remnant after subtotal colectomy. Although symptomatic proctitis is the most common reason for completion proctectomy, these patients are also at a significant risk to develop rectal cancer. Routine surveillance appears to be warranted.

KEYWORDS: Ulcerative colitis, proctitis, ileorectal anastomosis

Objectives: Upon completion of this article, the reader should be able to discuss the fate of the retained rectum in patients with ulcerative colitis.

Total proctocolectomy with ileal pouch-anal anastomosis (IPAA) is now firmly established as the restorative procedure of choice in most patients requiring surgery for ulcerative colitis (UC).¹⁻³ Nonetheless, there remain several circumstances in which patients with UC retain a rectal remnant, often indefinitely, after subtotal colectomy. These include patients who have undergone an urgent or emergent subtotal colectomy with ileostomy for severe, complicated colitis. Often, they enjoy a good quality of life with their stoma and will not require completion proctectomy or request conversion to a pelvic pouch.⁴⁻⁷ Alternatively, medical comorbidities, sphincter dysfunction, or concerns about a possible diagnosis of Crohn's disease may make further surgery inadvisable.^{2,3,8-10}

Highly selected patients with UC and minimal rectal involvement, or those with clinically indeterminate colitis, may still be appropriately treated with a colectomy and ileorectal anastomosis (IRA). Further,

there remains a significant cohort of patients who underwent an ileorectal anastomosis in decades past who require follow-up. Despite the documented safety of a true double-stapled IPAA, there appear to be several patients who have undergone an ileal pouch-rectal anastomosis instead of IPAA and retain at least a partial segment of their rectal remnant.¹¹ In all of these patients, the long-term fate of the retained rectum must be considered.

Key questions include: What is the risk of subsequent proctitis that will eventuate in the need for completion proctectomy? More ominously, what is the long-term risk of cancer in the retained rectal segment?

HISTORY

For much of the twentieth century, surgery for UC was fraught with considerable hazard and often resulted in an intolerable quality of life. In the first half of the century,

Ulcerative Colitis; Editor in Chief, David E. Beck, M.D.; Guest Editor, Bruce G. Wolff, M.D. *Clinics in Colon and Rectal Surgery*, volume 17, number 1, 2004. Address for correspondence and reprint requests: Neil Hyman, M.D., Fletcher 301, MCHV Campus, Department of Surgery, University of Vermont, College of Medicine, Burlington, VT 05401, E-mail: Neil.Hyman@vtmednet.org. ¹Department of Surgery, University of Vermont College of Medicine, Burlington, Vermont. Copyright © 2004 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662. 1531-0043,p;2004,17,01,029,034,ftx,en;ccrs00158x.

mortality was unacceptably high even for a diverting ileostomy. By the 1950s, total proctocolectomy with ileostomy became clearly established as the procedure of choice for elective cases. However, prior to the work of Brooke and Turnbull, the ileostomy commonly became stenotic and was difficult to manage, while proctectomy continued to be a dangerous undertaking with a mortality rate as high as 15% into the 1960s.¹²

As early as the 1940s, there were reports of subtotal colectomy with ileorectal anastomosis as a solution to the complications and lifestyle alterations associated with total proctocolectomy.¹³ Aylett, in the 1950s and 1960s, was perhaps the most widely published proponent of this procedure, writing "...panproctocolectomy with the formation of a permanent ileostomy is an unnecessary disability to inflict ... for the cure of UC."¹⁴ He performed ileorectal anastomosis in over 90% of his UC cases and consistently reported excellent functional results. Into the 1980s, groups continued to perform ileorectal anastomosis in the majority of cases,^{6,15-17} although the advocacy of ileorectal anastomosis clearly began to wane with the advent of pelvic-pouch surgery.

Over the past 20 years, controversy over the role of ileorectal anastomosis for UC has largely been quelled by the advent and improvements in IPAA. By the 1980s, IPAA was performed in at least one half of cases of UC.^{4,18} In Stockholm, for example, the proportion of the ileorectal anastomoses created for UC decreased from 27% until 1985 to less than 10% 5 years later.¹² Today, IPAA is clearly the elective surgery of choice in virtually all referral centers.

That being said, restorative proctocolectomy is not appropriate for all patients with UC who require surgery. When urgent surgery is required (e.g., toxic megacolon, colonic hemorrhage), subtotal colectomy with ileostomy remains the procedure of choice^{12,19-22} because it has half the mortality rate of emergent proctocolectomy⁹ and avoids the risk of pelvic sepsis in an already compromised patient.⁴ Subtotal colectomy is often followed months later by proctectomy with either ileostomy or ileal-pouch anastomosis. However, many of these patients are quite satisfied with their ileostomy and do not wish to expose themselves to the risks of a pelvic dissection and/or the potential complications of an ileal pouch. This may be particularly true in patients with clinically indeterminate colitis and/or those with clinical features suspicious for Crohn's disease. Retrospective studies of colectomy specimens have shown that 3 to 23% of patients undergoing surgery for presumed UC will ultimately be diagnosed with Crohn's disease.^{1,2,23-28} This risk is particularly increased in patients who undergo urgent surgery for toxic colitis or megacolon since many of the histopathologic features that distinguish UC from Crohn's disease are somewhat unreliable in this setting.²⁹

OUTCOMES

Some have reported that a large majority of patients undergoing IRA are able to have good long-term outcomes with an intact rectum. However, it also seems clear that a substantial proportion of patients with a retained rectum will eventually come to unplanned proctectomy. The primary reason for rectal excision is typically proctitis and/or diarrhea in most cases, and dysplasia or overt cancer in others.

RISK OF MALIGNANCY

The risk of malignancy is the single most important determinant of long-term mortality in UC patients.³⁰⁻³⁵ The reported rates of colitis-associated malignancy are variable because of differences among the patient population being studied (e.g., a referral center vs population based) and possibly from one country to another.¹⁰⁻¹³ Nonetheless, it seems quite clear that patients who have UC for greater than 8 to 10 years begin to accrue an increased risk of malignancy compared with age-matched controls.^{20,23,36,37} Further, it seems clear that the risk of malignancy is associated with distribution of disease; patients with pancolitis have a much greater long-term risk of malignancy than those with primarily left-sided disease.^{20,23,36,38} Proctitis alone appears to confer minimal or no increased lifetime risk.^{33,37,39} Many studies imply a colorectal cancer risk of 5 to 12% after 20 years of colitis and 1% per year risk increases thereafter.^{20,23,24,32-34,36,40,41} Mir-Madjlessi and colleagues inferred that one in three patients with pancolitis would develop a colitis-associated malignancy at 40 years of disease.³⁶ Lennard-Jones et al found the rate of cancer tripled from the second to the third decade of pancolitis; they reported the risk increased from 0.5% per year between 10 and 20 years of disease to 1.7% per year between 20 and 30 years, for a total malignancy rate of 20% at 30 years.⁴²

Particular concern about rectal cancer is well-founded in UC; between 24% and 38% of malignancies in this setting occur in the rectum.^{23,33,36,41} Therefore, if we assume the overall risk of colorectal cancer at 30 years of disease to be 15 to 20%, the risk of rectal cancer should approximate 5 to 10% over that time if the rectal remnant is maintained. In fact, the literature is supportive of this assumption, and the actual risk may be even higher after subtotal colectomy.

There are several large retrospective studies of patients with pancolitis treated with subtotal colectomy (Table 1). Outcomes vary among studies, but in general, the reported incidence of cancer in the retained rectum is in line with the aforementioned figures. Rectal cancer rates are clearly influenced by the extent and length of follow-up, the incidence and indications for completion proctectomy, and by the level of aggressiveness in searching for and treating rectal dysplasia. The risk of

Table 1 Fate of the Retained Rectum in Ulcerative Colitis

Series	Period	n	Mortality	F/U (years)	Proctitis	Cancer	Completion Proctectomy
Farnell ⁵⁵	1961–1973	63	3.2%	—	33.3%	0%	24%
Binder ²⁵	1953–1974	29	—	1–14	67.3%	—	72.4%
Baker ²⁰	1952–1976	374	2.7%	—	—	5.9%	11.0%
Baker ⁴⁴	1951–1979	59	0%	15	20.3%	5.1%	22.0%
Johnson ¹⁶	1950–1981	286	8.7%	0.25–40	38.1%	3.8%	—
Oakley ⁷	1960–1982	288	4.2%	—	41%	3.1%	55%
Hawley ⁵⁴	1953–1984	125	0.8%	—	15.2%	4.0%	28%
Leijonmarck ¹	1955–1984	51	4%	13	45.1%	0%	57%
Khubchandani ¹⁷	1959–1986	53	—	—	18.9%	5.7%	12%
Pastore ²	1974–1990	48	0%	6.5	54%	2%	17%
Melville ⁴	1976–1990	95	0%	—	8.2%	—	18%

cancer in the retained rectum appears to be between 0% and 25%.^{1,6,7,16,20,43–45} However, even in the largest studies with the longest follow-up, total cancer numbers are small and confidence intervals are necessarily quite large.

Because of the small absolute number of rectal cancers, rates are typically inferred but appear to be consistent over several studies. Baker and associates looked at Aylett's series of ileorectal anastomoses done over a 25-year period from the 1950s to the 1970s.²⁰ They found the rate of rectal cancer at 20 years to be 4 to 8%, with an increase of ~1% annually thereafter, for a rate of 13 to 23% at 35 years. Johnson and colleagues retrospectively reviewed a 30-year experience with the retained rectum and found the risk of cancer to be 14 to 20% at 27 years.¹⁶ Grundfest and group estimated the risk of rectal cancer to be 13% at greater than 25 years of follow-up.⁴³ To the contrary, Leijonmarck et al, in a population-based study of Stockholm County, found a 5% dysplasia rate requiring resection, but no rectal cancers over a 30-year time-period.¹ Similarly, Pastore and associates reported rectal cancer in just 1 out of 48 retained rectums, although this study had relatively short mean follow-up.²

Irrespective of the precise incidence, cancer in the retained rectum appears to be more lethal than de novo cancer. In Baker's study, 4% of Aylett's patients died over 20 years as a result of rectal disease, most of them owing to cancer. Of those who developed rectal cancer, 62% had died within 3 years of diagnosis.²⁰ Baker and colleagues reported that 2 out of the 3 patients with rectal cancer died from their malignancy.⁴⁴ Johnson and associates reported a total of 10 rectal cancers, 8 of which had either nodal or distant metastases.⁶ The patients in the series reported by Oakley and colleagues fared better, with just 2 of 9 patients with rectal cancer dying over a 22-year time period.⁷

A third factor, in addition to duration and extent of disease, that clearly has an influence on the chance of

subsequent rectal cancer is the finding of dysplasia in the resected colon. Oakley and researchers reported on five surviving patients who had cancer in their colonic specimens; three of the five were found on follow-up to have cancer or severe dysplasia in the rectal remnant.⁴⁵ Grundfest et al described nine patients with a colitis-associated colon cancer or severe dysplasia who underwent subtotal colectomy, eight of whom survived; of the eight, five developed severe dysplasia or cancer in the retained rectum.⁴³ Similar findings have been described in patients undergoing restorative proctocolectomy; there appears to be a higher risk of anal transition-zone dysplasia if there is concomitant dysplasia or cancer found in the colon.^{11,31,46–49}

The presence of dysplasia or cancer in the resected colon should cause particular concern about the fate of the remaining rectum. This is not only true of patients treated with IRA, but also of those who undergo subtotal rectal resection at the time of pelvic-pouch surgery. Leaving a retained rectal segment in patients with upstream cancer or dysplasia is potentially fraught with danger; such patients clearly require careful surveillance for dysplasia and subsequent frank carcinoma.¹¹

SURVEILLANCE

Since colitis-associated malignancies typically arise from dysplastic epithelium, surveillance strategies have been advocated to identify dysplasia with a goal of preventing malignancy or at least detecting lesions in an earlier, presymptomatic stage. In one study of patients with UC and colorectal cancer, 5-year survival was 77.2% in patients identified through surveillance, versus 36.3% in a symptomatic group of patients.⁵⁰ However, a critical look at surveillance strategies casts considerable doubt on their efficacy. In some studies, advanced malignancies were identified despite routine periodic screening.^{38,50,51} In others, the incidence of cancer was so low that the value of screening was doubtful.^{31,38,51,52} Axon critically

analyzed 12 studies of colonoscopic surveillance in 1916 patients with UC. Of 92 carcinomas identified, only 11 were felt to be truly attributable to surveillance colonoscopy.⁵¹

Nonetheless, it seems intuitive that dysplasia screening would be of particular benefit in patients with a retained rectum. First, patients with an "out of circuit" rectum after subtotal colectomy with ileostomy are unlikely to have a malignancy diagnosed until quite late in the course. The vast majority of these patients have intermittent rectal bleeding on an ongoing basis and the presence of an ileostomy would obviate the change in bowel habits typically seen with a rectal cancer. As such, the presentation would likely include advanced signs and symptoms from pelvic extension.

Second, there is only a short segment to survey, facilitating more extensive sampling and lower cost. The finding of high-grade dysplasia or a dysplasia-associated lesion or mass (DALM) appears to be a clear indication for completion proctectomy.^{6,20,27,43} However, even low-grade dysplasia has been associated with a 16 to 29% progression rate to a DALM, high-grade dysplasia, or overt carcinoma.⁵¹

In addition to the finding of dysplasia, local topography is an important consideration in surveillance. The feasibility of safe surveillance in patients with extensive pseudopolyps or other elevated lesions can be markedly complicated.^{31,38,52} Further, many patients with a retained rectum that is out of circuit often develop narrowing or overt strictures, making it difficult or impossible to survey the entire retained rectum.^{53,54} Strong consideration should be given to completion proctectomy in these scenarios.

PROCTITIS

Almost by definition, all patients with UC have rectal involvement. However, particularly in years past, patients with minimal rectal disease who maintain adequate compliance of their native rectal reservoir were considered candidates for IRA.^{2,4,16,25,45} However, such patients are certainly at risk for symptoms of proctitis that can impair functional outcome and ultimately lead to proctectomy. The risk of proctitis after subtotal colectomy in these patients is quite substantial. Khubchandani and group reported a 22% postoperative rate of proctitis in patients who had "grossly normal" rectal mucosa at the time of their original procedure. In this subgroup of patients, there was an eventual 11% rate of proctectomy in long-term follow-up.²⁷

There appears to be a general trend in the literature toward high rates of recurrent or persistent disease in the retained rectum, but relatively low rates of reoperation for symptomatic proctitis. The risk of completion proctectomy purely for proctitis and/or diarrhea is typically between 8 and 53%.^{1,2,4,5,7,10,15-17,26-28,45,54}

Table 2 The Retained Rectum: Quality of Life Measurements

Series	Failures	Average BM/day	Antidiarrheal Medications	Steroids
Farnell ⁵⁵	24%	—	—	6%
Oakley ⁴⁵	23%	4.3	23%	8%
Leijonmarck ¹	57%	4.0	25%	—
Khubchandani ¹⁷	12%	1.4	82%	—
Pastore ²	17%	6	—	—
Elton ⁵⁶	11%	3	25%	—

BM, bowel movements.

However, proctectomy rates as high as 78%²⁵ and as low as 3%¹⁵ have been reported as well. Pastore and associates reported that more than half of the Mayo Clinic patients who had undergone subtotal colectomy for UC over a 15-year period developed proctitis, but fewer than one fifth of these patients required surgery.² Similar results from the Cleveland Clinic were reported by Oakley and researchers.^{7,45}

Despite the high rate of proctitis postoperatively, many patients clearly do attain a good quality of life (Table 2^{1,2,17,45,55,56}). Baker and colleagues, reporting on the 25-year experience of Aylett and associates, found that 83% of survivors and 68% of patients overall were "alive and well" with the retained rectum.²⁰ However, the experience at St. Mark's Hospital with subtotal colectomy revealed only a minority of patients living "normal healthy lives."¹³

CONCLUSIONS

IPAA has dramatically diminished the role of IRA in patients with UC. Nonetheless, there may be highly selective patients with very mild rectal involvement, significant medical comorbidities, or clinically indeterminate colitis who may be appropriately treated with an ileorectal anastomosis. Further, many patients are satisfied with their ileostomy after urgent subtotal colectomy and do not wish to undergo completion proctectomy or pelvic-pouch surgery. The risk of cancer in these rectal remnants is quite real; surveillance programs for dysplasia seem appropriate. A subset of these patients will clearly require completion proctectomy for symptomatic disease. Further, others may develop a stricture or extensive pseudopolyps or otherwise develop a rectum that cannot be surveyed; strong consideration should be given to proctectomy in these cases.

REFERENCES

1. Leijonmarck C-E, Lofberg R, Ost A, Hellers G. Long-term results of ileorectal anastomosis in ulcerative colitis in Stockholm County. *Dis Colon Rectum* 1990;33:195-200

2. Pastore RLO, Wolff BG, Hodge D. Total abdominal colectomy and ileorectal anastomosis for inflammatory bowel disease. *Dis Colon Rectum* 1997;40:1455-1464
3. Soravia C, O'Connor BI, Berk T, McLeod RS, Cohen Z. Functional outcome of conversion of ileorectal anastomosis to ileal pouch-anal anastomosis in patients with familial adenomatous polyposis and ulcerative colitis. *Dis Colon Rectum* 1999;42:903-908
4. Melville DM, Ritchie JK, Nicholls RJ, Hawley PR. Surgery for ulcerative colitis in the era of the pouch: the St. Mark's Hospital experience. *Gut* 1994;35:1076-1080
5. Watts JM, Hughes SR. Ulcerative colitis and Crohn's disease: results after colectomy and ileorectal anastomosis. *Br J Surg* 1977;64:77-83
6. Johnson WR, McDermott FT, Hughes ESR, Pihl EA, Milne BJ, Price AB. The risk of rectal carcinoma following colectomy in ulcerative colitis. *Dis Colon Rectum* 1983;26:44-46
7. Oakley JR, Lavery IC, Fazio VW, Jagelman DG, Weakley FL, Easley K. The fate of the rectal stump after subtotal colectomy for ulcerative colitis. *Dis Colon Rectum* 1985;28:394-396
8. Hyman NH, Fazio VW, Tuckson WB, Lavery IC. Consequences of ileal pouch-anal anastomosis for Crohn's colitis. *Dis Colon Rectum* 1991;34:653-657
9. Becker JM. Surgical therapy for ulcerative colitis and Crohn's disease. *Gastroenterol Clin North Am* 1999;28:371-390
10. Hawley PR. Ileorectal anastomosis. *Br J Surg* 1985;72:S75-S82
11. Hyman N. Rectal cancer as a complication of stapled IPAA. *Inflamm Bowel Dis* 2002;8:43-45
12. Leijonmarck C-E, Brostrom O, Monsen U, Hellers G. Surgical treatment of ulcerative colitis in Stockholm County, 1955 to 1984. *Dis Colon Rectum* 1989;32:918-926
13. Baker WNW. The results of ileorectal anastomosis at St. Mark's Hospital from 1953 to 1968. *Gut* 1970;11:235-239
14. Aylett SO. Three hundred cases of diffuse ulcerative colitis treated by total colectomy and ileorectal anastomosis. *BMJ* 1966;5494:1001-1005
15. Khubchandani IT, Trimpi HD, Sheets JA, Stasik JJ, Kleckner FS. Ileorectal anastomosis for ulcerative colitis and Crohn's colitis. *Am J Surg* 1978;135:751-756
16. Johnson WR, Hughes ESR, McDermott FT, Pihl EA, Katrivessis H. The outcome of patients with ulcerative colitis managed by subtotal colectomy. *Surg Gynecol Obstet* 1986;162:421-425
17. Khubchandani IT, Sanfort MR, Rosen L, Sheets JA, Stasik JJ, Riether RD. Current status of ileorectal anastomosis for inflammatory bowel disease. *Dis Colon Rectum* 1989;32:400-403
18. Goudet P, Dozois RR, Kelly KA, Melton J, Ilstrup DM, Phillips SF. Changing referral patterns for surgical treatment of ulcerative colitis. *Mayo Clin Proc* 1996;71:743-747
19. Berg DF, Bahadursingh AM, Kaminski DL, Longo WE. Acute surgical emergencies in inflammatory bowel disease. *Am J Surg* 2002;184:45-51
20. Baker WNW, Glass RE, Ritchie JK, Aylett SO. Cancer of the rectum following colectomy and ileorectal anastomosis for ulcerative colitis. *Br J Surg* 1978;65:862-868
21. Carter FM, McLeod RS, Cohen Z. Subtotal colectomy for ulcerative colitis: complications related to the rectal remnant. *Dis Colon Rectum* 1991;34:1005-1009
22. Marcello PW, Milsom JW, Wong SK, Brady K, Goormastic M, Fazio VW. Laparoscopic total colectomy for acute colitis: a case control study. *Dis Colon Rectum* 2001;44:1441-1445
23. Gyde SN, Prior P, Allan RN, et al. Colorectal cancer in ulcerative colitis: a cohort study of primary referrals from three centers. *Gut* 1988;29:206-217
24. Wandall EP, Damkier P, Pedersen FM, Wilson B, de Muckadell OBS. Survival and incidence of colorectal cancer in patients with ulcerative colitis in Funen County diagnosed between 1973 and 1993. *Scand J Gastroenterol* 2000;35:312-317
25. Binder SC, Miller HH, Deterling RA. Fate of the retained rectum after subtotal colectomy for inflammatory disease of the colon. *Am J Surg* 1976;131:201-203
26. Jones PF, Bevan PG, Hawley PR. Ileostomy or ileorectal anastomosis for ulcerative colitis? *BMJ* 1978;1:1459-1463
27. Khubchandani IT, Stasik JJ, Nedwick A. Prospective surveillance by rectal biopsy following ileorectal anastomosis for inflammatory disease. *Dis Colon Rectum* 1982;25:343-347
28. Lofberg R, Leijonmarck C-E, Brostrom O, Hellers G, Tribukait B, Ost A. Mucosal dysplasia and DNA content in ulcerative colitis patients with ileorectal anastomosis: follow-up study in defined patient group. *Dis Colon Rectum* 1991;34:566-571
29. Fazio VW. Toxic megacolon in ulcerative colitis and Crohn's colitis. *Clin Gastroenterol* 1980;9:389-407
30. Karlen P, Kornfeld D, Brostrom O, Lofberg R, Persson P-G, Ekblom A. Is colonoscopic surveillance reducing colorectal cancer mortality in ulcerative colitis?: a population based case control study. *Gut* 1998;42:711-714
31. Hyman N. Treating the malignant complications of inflammatory bowel disease. *Semin Colon Rectal Surg* 2001;12:55-59
32. Lennard-Jones JE, Melville DM, Morson BC, Ritchie JK, Williams CB. Precancer and cancer in extensive ulcerative colitis: findings among 401 patients over 22 years. *Gut* 1990;31:800-806
33. Ekblom A, Helmick C, Zack M, Adami H-O. Ulcerative colitis and colorectal cancer: a population-based study. *N Engl J Med* 1990;323:1228-1233
34. Levin B. Inflammatory bowel disease and colon cancer. *Cancer* 1992;70:1313-1316
35. Langholz E, Munkholm P, Davidsen M, Binder V. Colorectal cancer risk and mortality in patients with ulcerative colitis. *Gastroenterology* 1992;103:1444-1451
36. Mir-Madjlessi SH, Farmer RG, Easley KA, Beck GJ. Colorectal and extracolonic malignancy in ulcerative colitis. *Cancer* 1986;58:1569-1574
37. Lennard-Jones JE. Cancer risk in ulcerative colitis: surveillance or surgery. *Br J Surg* 1985;72:S84-S86
38. Connell WR, Lennard-Jones JE, Williams CB, Talbot IC, Price AB, Wilkinson KH. Factors affecting the outcome of endoscopic surveillance for cancer in ulcerative colitis. *Gastroenterology* 1994;107:934-944
39. Kornbluth A, Sachar DB. Ulcerative colitis practice guidelines in adults. *Am J Gastroenterol* 1997;92:204-211
40. Collins RH, Feldman M, Fordtran JS. Colon cancer dysplasia, and surveillance in patients with ulcerative colitis: a critical review. *N Engl J Med* 1987;316:1654-1658
41. Gillen CD, Walmsley RS, Prior P, Andrews HA, Allan RN. Ulcerative colitis and Crohn's disease: a comparison of the colorectal cancer risk in extensive colitis. *Gut* 1994;35:1590-1592
42. Lennard-Jones JE, Morson BC, Ritchie JK, Shove DC, Williams CB. Cancer in colitis: assessment of the individual

- risk by clinical and histological criteria. *Gastroenterology* 1977;73:1280-1289
43. Grundfest SF, Fazio V, Weiss RA, et al. The risk of cancer following colectomy and ileorectal anastomosis for extensive mucosal ulcerative colitis. *Ann Surg* 1981;193:9-14
44. Backer O, Hjortrup A, Kjaergaard J. Evaluation of ileorectal anastomosis for the treatment of ulcerative colitis. *J R Soc Med* 1988;81:210-211
45. Oakley JR, Jagelman DG, Fazio VW, et al. Complications and quality of life after ileorectal anastomosis for ulcerative colitis. *Am J Surg* 1985;149:23-30
46. Coull DB, Lee FD, Henderson AP, Anderson JH, McKee RF, Finlay IG. Risk of dysplasia in the columnar cuff after stapled restorative proctocolectomy. *Br J Surg* 2003;90:72-75
47. Stern H, Walfisch S, Mullen B, McLeod R, Cohen Z. Cancer in an ileoanal reservoir: a new late complication? *Gut* 1990;31:473-475
48. Puthu D, Rajan N, Rao R, Rao L, Venugopal P. Carcinoma of the rectal pouch following restorative proctocolectomy: report of a case. *Dis Colon Rectum* 1992;35:257-260
49. Ziv Y, Fazio VW, Sirimarco MT, Lavery IC, Goldblum JR, Petras RE. Incidence, risk factors, and treatment of dysplasia in the anal transition zone after ileal pouch-anal anastomosis. *Dis Colon Rectum* 1994;37:1281-1285
50. Choi PM, Nugent FW, Schoetz DJ Jr, Silverman ML, Haggitt RC. Colonoscopic surveillance reduces mortality from colorectal cancer in ulcerative colitis. *Gastroenterology* 1993;105:418-424
51. Axon ATR. Cancer surveillance in ulcerative colitis—a time for reappraisal. *Gut* 1994;35:587-589
52. Bernstein CN, Shanahan F, Winstein WM. Are we telling patients the truth about surveillance colonoscopy in ulcerative colitis? *Lancet* 1994;343:71-74
53. Greenstein AJ. Cancer in inflammatory bowel disease. *Mt Sinai J Med* 2000;67:227-240
54. Johnson WR, McDermott FT, Pihl E, Hughes ESR. Mucosal dysplasia: a major predictor of cancer following ileorectal anastomosis. *Dis Colon Rectum* 1983;26:697-700
55. Farnell MB, Van Heerden JA, Beart RW, Weiland LH. Rectal preservation in nonspecific inflammatory disease of the colon. *Ann Surg* 1980;192:249-253
56. Elton C, Makin G, Hitos K, Cohen CRG. Mortality, morbidity and functional outcome after ileorectal anastomosis. *Br J Surg* 2003;90:59-65