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Risk of Rectal Cancer After Colectomy for Patients with Ulcerative Colitis—a National Cohort Study

Short Title: Rectal cancer after colectomy in ulcerative colitis

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Statistical Analysis: RA, MA

Abstract:

Background & Aims: Patients with ulcerative colitis (UC) have an increased risk of rectal cancer, so reconstruction with an ileal pouch anal anastomosis (IPAA) is generally preferred to an ileo-rectal anastomosis (IRA) after subtotal colectomy. Similarly, completion proctectomy is recommended for patients with ileostomy and diverted rectum, although this approach has been questioned because anti-inflammatory agents might reduce cancer risk. We performed a national cohort study in Sweden to assess the risk of rectal cancer in patients with UC who have an IRA, IPAA, or diverted rectum after subtotal colectomy.

Methods: We collected data from the Swedish National Patient Register for a cohort of 5886 patients with UC who underwent subtotal colectomy with an IRA, IPAA, or diverted rectum from 1964 through 2010. Patients who developed rectal cancer were identified from the Swedish National Cancer Register. Risk of rectal cancer was compared between this cohort and the general population by standardized incidence ratio analysis.

Results: Rectal cancer occurred in 20/1112 patients (1.8%) who received IRA, 1/1796 patients (0.06%) who received an IPAA, and 25/4358 patients (0.6 %) with a diverted rectum. Standardized incidence ratios for rectal cancer were 8.7 in patients with an IRA, 0.4 in patients with an IPAA, and 3.8 in patients with a diverted rectum. Risk factors for rectal cancer were primary sclerosing cholangitis in patients with an IRA (hazard ratio, 6.12), and colonic severe dysplasia or cancer prior to subtotal colectomy in patients with a diverted rectum (hazard ratio, 3.67).

Conclusion: In an analysis of Swedish National Patient Register, we found that risk for rectal cancer after colectomy in patients with UC is low, in relative and absolute terms, after reconstruction with an IPAA. IRA and diverted rectum are associated with an increased risk of rectal cancer, compared with the general population, but the absolute risk is low. Patients and their health care providers should consider these findings in making decisions to leave the rectum intact, perform complete proctectomy, or reconstruct the colon with an IRA or IPAA.

KEY WORDS: SIR, surgery, IBD treatment, patient management

Abbreviations

UC	Ulcerative Colitis
IBD	Inflammatory Bowel Disease
IRA	Ileo Rectal Anastomosis
IPAA	Ileal Pouch Anal Anastomosis
DR	Diverted Rectum
PSC	Primary Sclerosing Cholangitis
RC	Rectal Cancer
SC	Subtotal Colectomy
SIR	Standardized Incidence Ratio
ICD	International Classification of Diseases

Introduction

Ulcerative colitis (UC) is a chronic inflammatory bowel disease (IBD) involving the colonic mucosa, always involving the rectum and often extending proximally in a continuous way. Approximately one-third of patients diagnosed with ulcerative colitis involving the colon proximal to the splenic flexure will require surgery within 15 years of diagnosis in the form of subtotal colectomy and ileostomy[1], either due to medically refractory disease or due to development of dysplasia or invasive cancer. Patients may keep their ileostomy permanently with the diverted rectum left in place (DR) or with a later completion proctectomy. Alternatively, restoration of bowel continuity can be obtained by means of either an ileorectal anastomosis (IRA) or an ileal pouch anal anastomosis (IPAA)[2]. IPAA is the gold standard and is thus preferred in most parts of the world but IPAA and IRA are employed equally in Sweden [3].

Cancer development is a well-known risk associated with longstanding extensive ulcerative colitis in non-colectomized patients[4]. Less is known about the risk for rectal cancer in colectomized patients, in particular for patients with ileostomy and the diverted rectum in place. There are some reports on the risk of developing rectal cancer in IPAA [5-7] and IRA [6,

[8, 9)], but the risk estimates in these studies are not population based as they are from centers of excellence and as such more severely ill patients.

This study aimed to assess the risk of developing rectal cancer in the diverted rectal stump or after reconstruction with IRA or IPAA in colectomized UC patients and to compare this risk with that for the general population. A second aim was to identify other risk factors for development of RC.

Method

Setting

A unique personal identity number is assigned to all permanent residents in Sweden. Through linkage of the Swedish Patient Register and the Swedish Cancer Register, this identity number enables us to identify and all subsequent diagnoses made for each patient for various diseases (including cancer and severe dysplasia), operations performed, causes of death, and migration from Sweden. However, low-grade dysplasia is not reported in the registries.

Cohort

A cohort was identified from the Patient Register including all patients with a diagnosis of IBD in Sweden between 1 January 1964 and 31 December 2010. For this study we selected all patients with a diagnosis of UC (ICD7 572.20, 572.21, 578.03; ICD8 563.10, 569.02; ICD9 556*; ICD10 K51*). The type of IBD diagnosis may change over time – the last registered IBD type was used in this study as the true diagnosis for patients with varying registrations. The date of the first registered IBD diagnosis was considered as the date of onset of the disease. A concomitant diagnosis of primary sclerosing cholangitis (PSC) was also identified (ICD7 K585.29; ICD8 575.05; ICD9 576 B; ICD 10 K83.0)

From this cohort of UC patients, we identified all patients that had been operated with subtotal colectomy (operation codes 4651, JFH10, JFH11 or JFH96). We also identified patients that had had multiple partial colonic resections eventually adding up to a subtotal colectomy. The final operation in this chain of operations was regarded as the date of colectomy. This defines the study sub-cohort of UC patients with colectomy and retained an diverted rectum (DR). We also identified the sub-cohorts of patients where the colectomy was followed by restoration of intestinal continuity through an IRA (operation code 4650,

JFH00, JFH01, JFC40, JFC41, JFG26 or JFG29) or an IPAA (operation code 4654, 4823, JFH30, JFH33, JGB50, JGB60 or JGB61), in both cases either as a primary (at time of colectomy) or secondary reconstruction (after a time period with defunctioned rectum).

Primary outcome

The primary aim was to estimate the risk of developing rectal cancer in the three sub-cohorts of UC patients during follow-up after subtotal colectomy with retained and diverted rectum or after reconstruction with IRA or IPAA. This risk was compared with that in the general Swedish population through estimating the Standardized Incidence Ratio.

Statistical analysis

Follow-up started on the day of discharge after the subtotal colectomy or after the construction of an IRA or IPAA, respectively. We found that some patients received their rectal cancer diagnosis only after several weeks had passed following a colectomy or proctectomy, probably because of delays in the pathology service and registration procedure. A rectal cancer diagnosis registered within 30 days after the date of admission for colectomy or reconstructive surgery with IRA or IPAA was therefore assigned to the period that preceded the colectomy, IRA or IPAA, respectively. For patients with a DR the follow-up

ended on the date of rectal cancer, reconstructive surgery with IRA or IPAA, proctectomy, death, emigration, or 31 December 2010, whichever came first. For patients with IRA the follow-up ended on the date of rectal cancer, reconstructive surgery with IPAA, proctectomy, death, emigration, or 31 December 2010, whichever came first. For patients with IPAA the follow-up ended on the date of rectal cancer, pouchectomy, death, emigration, or 31 December 2010, whichever came first. The risk for cancer was assessed by survival analytic technique with Kaplan-Meier curves and log rank test as well as uni- and multivariable Cox regression analysis. Standardized incidence ratios (SIR) were estimated using age-, sex- and period-specific incidence rates for the Swedish population obtained from the web-based statistical service of the Swedish National Board of Health and Welfare [(10)]. Differences in proportions were analyzed with Chi2- and Fisher's exact test as appropriate.

The analyses were carried out with Stata 13 (StataCorp, TX, USA). Statistical tests were 2 sided, and statistical significance was set at the 0.05 level. The study was approved by the Linköping Regional Ethics Review Board (Dnr 2011/419-31).

Results

During the study period from 1964 to 2010, a total of 63,795 patients were diagnosed with UC with a male to female ratio of 1.12:1. Some 7,889 (12 %) patients underwent colectomy for complicated or severe medically refractory disease or severe dysplasia/cancer after a mean duration of 4.3 (SD 6.2) years from IBD diagnosis (Figure 1). The rectum was removed along with the colon (proctocolectomy) in 1,908 of these patients. Another 95 patients were excluded because of inconsistent or erroneous registrations, leaving 5,886 patients with subtotal colectomy for analysis. A reconstruction was done with IRA in 1,112 patients and with IPAA in 1,796 patients, either at the time of colectomy or shortly thereafter. Seventy-six patients were reconstructed twice, with IRA as a first step later followed by an IPAA. Some 4,358 patients lived with a diverted rectum until the reconstruction, or until they had a completion proctectomy or for a time after either. Rectal cancer occurred in 46 (0.8 %) of the 5,886 subtotally colectomized patients. Time from IBD diagnosis was not a risk factor for RC in the multivariable analysis, despite being a risk factor in the univariable analysis (Table 3).

IRA

IRA was constructed in 1,112 patients. RC developed in 20 of them (1.8 %) after a mean

follow up of 8.6 (SD 9.1) (range 0.0-45.1) years (Table 1). Compared with the Swedish background population patients with IRA had an almost 9-fold higher overall risk of rectal cancer (SIR 8.7, 95% CI 5.6-13.4). The cumulative risk of developing RC was 1.6 % (95% CI 0.7-3.3) at 10 years and 5.6 % (95% CI 3.3-9.3) at 20 years follow up after IRA (Table 1 and Figure 2). Time from IBD diagnosis was not a risk factor of developing RC with an IRA in the multivariable analysis, despite a strong trend in univariable analysis (Table 2). Analysis with univariable Cox regression identified PSC as risk factor for RC after reconstruction with an IRA (Table 2). A trend was noted for duration of IBD diagnosis at IRA as a risk factor as well. Only PSC remained as an independent risk factor in multivariable analyses, after adjustment for covariates.

IPAA

The 1,796 patients reconstructed with an IPAA were followed up for a mean of 12.2 years (SD 6.3), and only one (0.06 %) patient developed RC giving an SIR of 0.4 (95% CI 0.0-2.5) when compared to the general population. The patient was 25 years old at cancer diagnosis and had no previous history of severe dysplasia, cancer or PSC. He died one year later due to

advanced rectal cancer. Intact diverted rectum

A total of 4,358 patients were followed with an intact and diverted rectum. RC developed in 25 (0.6 %) after a mean follow up of 5.7 (SD 7.8) years after colectomy (Table 1), two of them already during the first year after colectomy (Supplementary notes Table 2). Compared to the Swedish background population, UC patients with an intact and diverted rectum after colectomy had an almost 4-fold increased risk of rectal cancer (SIR 3.8, 95% CI 2.6-5.7). Mean duration of IBD before colectomy was 3.6 (SD 5.6) years within this group of patients. The cumulative risk of developing RC in the DR patients was 0.5 % (95% CI 0.3-1.1) at 10 years and 2.2 % (95% CI 1.4-3.6) at 20 years after colectomy (Table 1 and Figure 3).

For patients with a deviated rectum, a history of severe dysplasia or colon cancer, duration of UC at colectomy and calendar year for the colectomy were associated with the RC risk in univariable Cox regression (Table 3). Only a history of severe dysplasia or colon cancer remained statistically significant in multivariable analysis.

Discussion

This population-based cohort study investigated the risk of developing rectal cancer in 5,886

patients after subtotal colectomy due to ulcerative colitis. The absolute and relative risk of rectal cancer after reconstruction with IPAA was very low compared with the general Swedish population. By contrast, patients with deviated rectum or IRA had an increased relative risk with SIR 3.8 and SIR 8.7, respectively. However, the absolute cancer risk after DR and IRA was still moderate, with a cumulative risk after 20 years of follow-up of 2.2% and 5.6%, respectively. No significant change in risk of developing rectal cancer was observed during the decades that the study spanned. To our knowledge this is the first study to investigate the risk of developing rectal cancer in a diverted rectum after subtotal colectomy due to UC.

IPAA is the preferred reconstruction in many countries. In terms of rectal cancer, it is the safest option with only one patient developing cancer out of the 1,796. In addition there are a few previous case reports of an adenocarcinoma after IPAA with a UC diagnosis [5, 29].

In older patients and in patients unsuitable for IPAA (e.g. perineal disease or poor sphincter function), reconstruction with IRA can be performed quite safely as long as patients are aware of the necessity of topical therapy (e.g. high dose mesalamine) and annual follow up with flexible endoscopy and multiple biopsies [6,11, 15, 25].

It may also be advantageous for those who are relatively young to postpone IPAA and pelvic surgery until later in life in order to avoid the associated impairment of fecundity and sex life [12-17]. It has been suggested that laparoscopic construction of IPAA may have fewer such side effects but further studies of this possibility are required [18, 19].

Other risk factors for cancer

Patients with IRA and PSC were found to have an almost 6-fold increased risk for RC compared to other UC patients, in accordance with previous reports [22]. It has been suggested that bile composition and/or the fecal content in PSC patients may increase the cancer risk [23] but the increased risk is observed only in PSC patients with concomitant IBD [24].

Interestingly, PSC was not found to increase the risk for RC in DR in the present study. This raises the question about the role of the fecal stream for cancer development in PSC patients. Further studies in this particular area are warranted. Overall, patients with severe dysplasia or previous colonic cancer were found to have a higher risk for later being diagnosed with RC. This is in keeping with previous studies from our group and others [6, 9, 25] and is a good reason for offering these patients counseling to consider proctectomy with or without IPAA.

Limitations

As a first limitation, a previous study from Sweden found the anastomoses after IRA to be at the level of 26 cm above the anal verge on average [27]. As a result, some of the assumed IRA are in fact ileosigmoidal anastomoses and some sigmoidal cancers may have been misclassified as rectal cancers. The same applies to patients with diverted rectum as more than 15 cm of the distal bowel is commonly left at colectomy. Consequently, the relative risk of rectal cancer in IRA and DR compared to the general population may be overestimated. Secondly there is a possibility that asymptomatic cancers were present at colectomy and remained undetected until months or even years after the colectomy. However, there was only a small risk of rectal cancer development during the first 10 years after IRA (Figure 2), and the majority of patients with the rectum left in situ were diagnosed with RC more than 5 years after the subtotal colectomy (figure 3). This is in line with previous reports from our own and other centers [6, 9, 20, 21].

A third limitation inherent in the study design is that retrieving data from registries can have a few weaknesses including lack of information regarding indication for surgery, smoking status and hereditary differences for instance. The large sample size compensates for these possible weaknesses in many ways. Using a nation-wide registry also eliminates the risk of

selection bias that occurs in cohort studies from expert centers with proportionally more severely ill patients. The Swedish Patient Registry was found in a recent study [31] to have a positive predictive value between 85-95 % regarding diagnoses and procedures.
Also, the large sample size and the long follow up period make the register suitable for large-scale population-based research. Linkage to the Swedish Cancer Registry, to which both clinicians and pathologists must report, increases the validity of the Patient Registry [32].

Conclusion

IPAA is the safest surgical option for colectomized UC patients as concerns rectal cancer development. Despite an increased relative risk for RC in patients with an IRA or the rectum left in situ, the actual risk associated with IRA is still moderate, in particular during the first 10 years. Therefore, both IRA and DR may be acceptable as life-long solutions in the older population after shared decision making with an informed patient. IRA and DR may also serve as a temporary solution for younger patients, in order to postpone pelvic surgery. However, IRA cannot be recommended for UC patients with concomitant PSC. Due to the RC risk associated with severe dysplasia and/or colonic cancer these patients should be

offered a completion proctectomy.

Legends to Figures

Figure 1

Flow chart of the study population. Some 7,889 patients with ulcerative colitis had colectomy during 1964-2010. After exclusion of 95 patients with inconsistent registration and 1,908 patients with proctocolectomy there remained 5,886 patients that were operated with subtotal colectomy for analysis.

Figure 2

Cumulative risk for rectal cancer after ileorectal anastomosis (Kaplan-Meier survival curve).

Figure 3

Cumulative risk for rectal cancer in a diverted rectum (Kaplan-Meier survival curve).

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Tables and Figures

Figure 1

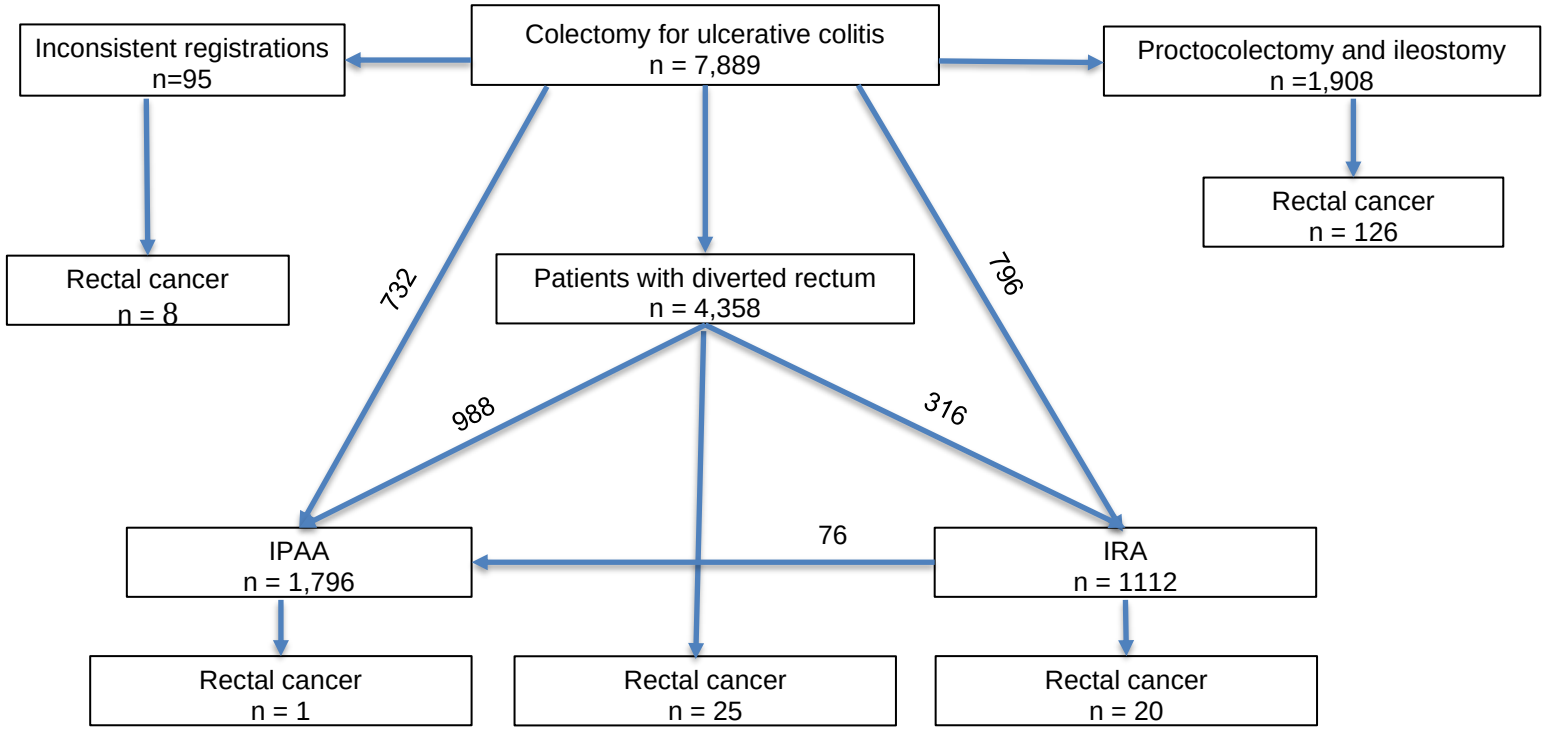

Figure 2

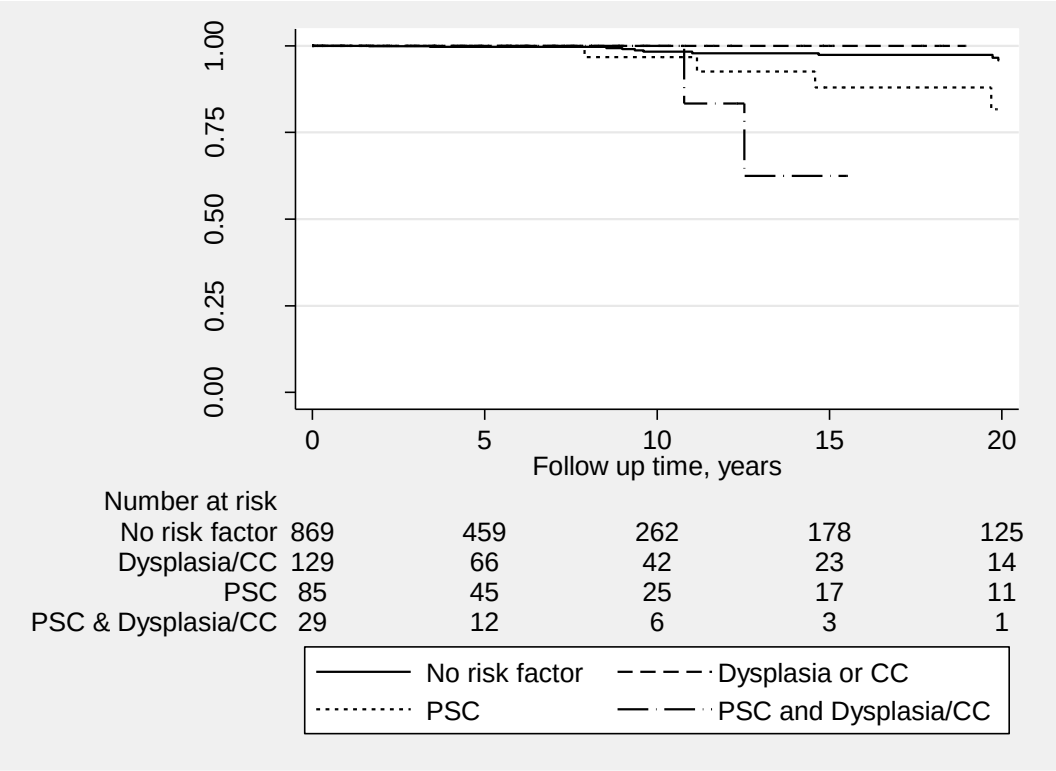
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Figure 3

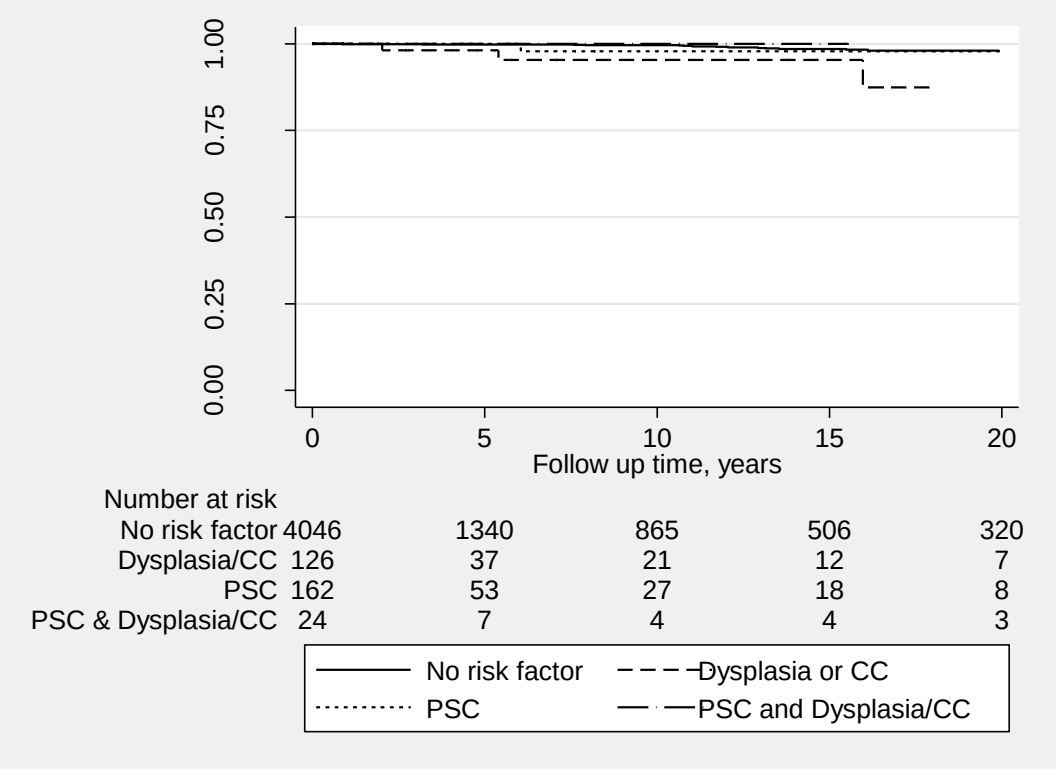
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Table 1

Demographics of the studied population of 5,886 patients with ulcerative colitis that were operated with subtotal colectomy during 1964-2010[§]

	IRA (n=1112)	IPAA (n=1,796)	DR* (n=4,358)
Male Sex No. (%)	637 (57.3)	1120 (62.2)	2630 (60.3)
Age at Ulcerative Colitis diagnosis (years mean (SD))	35.1 (15.9)	31.7 (12.2)	38.5 (18.0)
Age at Colectomy (years mean (SD))	40.6 (15.7)	36.4 (11.9)	42.1 (17.6)
Follow up (years mean (range))	8.6 (0.02-45.1)	12.2 (0.04-25.4)	5.7 (0.003-45.5)
Total follow up time (years)	9,603	21,975	24,994
Rectal cancer No. (%)	20 (1.8)	1 (0.06)	25 (0.6)
Cum risk for RC at 5 years % (95% CI)	0.3 (0.1-1.1)	0.0	0.2 (0.1-0.5)
Cum risk for RC at 10 years % (95% CI)	1.6 (0.7-3.3)	0.1(0.01-0.6)	0.5 (0.3-1.1)
Cum risk for RC at 20 years % (95% CI)	5.6(3.3-9.3)	0.1(0.01-0.6)	2.2 (1.4-3.6)
SIR (95% CI)	8.7 (5.6-13.4)	0.4 (0.0-2.5)	3.8 (2.6-5.7)

*Patients going through ileorectal anastomosis, proctocolectomy, ileal pouch anal anastomosis or completion proctectomy at a later stage are included as patients with defunctioned rectum until proctectomy or reconstruction took place.

[§]Patients who had proctocolectomy from the start or rectal cancer at time of colectomy were not included in this table.

Table 2:

Risk factors for rectal cancer among patients with ulcerative colitis and ileorectal anastomosis

	Univariable			Multivariable		
	HR	95% CI	*P value*	HR	95% CI	*P value*
Sex	1.03	0.43-2.49	0.942	1.25	0.51-3.08	0.627
Age at UC diagnosis	0.99	0.96-1.02	0.675	1.00	0.97-1.04	0.874
Primary Sclerosing Cholangitis	5.95	2.34–15.13	<0.001	6.12	2.33–16.03	<0.001
Dysplasia &/ Colon cancer before IRA	1.32	0.38-4.53	0.663	0.99	0.26-3.69	0.983
Duration of UC at IRA reconstruction	1.06	1.00-1.14	0.050	1.04	0.97-1.12	0.251
Calendar year at IRA	1.05	0.98-1.12	0.161	1.04	0.97-1.12	0.267

HR hazard ratio; CI confidence interval; UC ulcerative colitis; IRA ileorectal anastomosis

Table 3:

Risk factors for rectal cancer among patients with ulcerative colitis and an intact diverted rectum

	Univariable			Multivariable		
	HR	95 % CI	*P value*	HR	95 % CI	*P value*
Sex	0.74	0.33-1.68	0.476	0.79	0.34-1.81	0.574
Age at UC diagnosis	0.99	0.97-1.02	0.496	0.99	0.97-1.02	0.659
Primary Sclerosing Cholangitis	2.24	0.53-9.50	0.275	1.33	0.29-6.04	0.713
Dysplasia and/or Colon cancer before colectomy	4.64	1.38-15.58	0.013	3.67	1.01-13.37	0.049
Duration of UC at colectomy	1.08	1.02- 1.14	0.011	1.05	0.99–1.12	0.100
Calendar year at colectomy	1.05	0.99–1.11	0.105	1.04	0.98–1.11	0.167

HR hazard ratio; CI confidence interval; UC ulcerative colitis

IRA

Variable		Numbers	Time at risk	Observed	Expected	SIR	CI95%	
Sex	Male	500	4707	10	1.46	6.87	3.70	12.76
	Female	401	4275	10	0.80	12.51	6.74	23.29
Age UC	0-19	150	1369	3	0.03	86.20	27.80	267.26
	20-29	213	2148	3	0.16	19.28	6.22	59.78
	30-39	203	2217	7	0.34	20.55	9.80	43.11
	40-59	237	2407	7	1.00	7.03	3.35	14.74
	60-	98	839	0	0.73	0.000	.	.
Age at IRA	0-19	58	625	1	0.01	111.12	15.65	788.84
	20-29	170	1729	1	0.06	16.33	2.30	115.93
	30-39	209	2302	9	0.24	38.18	19.87	73.38
	40-59	311	3144	8	0.98	8.18	4.09	16.35
	60-	153	1181	1	0.97	1.03	0.15	7.32
Duration of UC at IRA	0	312	3745	7	1.05	6.68	3.18	14.00
	1	248	2356	4	0.44	9.01	3.38	24.00
	5	138	1521	3	0.36	8.36	2.70	25.91
	10	145	1014	4	0.31	12.85	4.82	34.22
	20	51	320	2	0.07	27.58	6.9	110.26
	30	7	26	0	0.02	0.000	.	.

Duration of follow up after UC	0	256	115	0	0.02	0.0000	.	.
	1	510	1332	1	0.24	4.20	0.59	29.82
	5	523	1982	1	0.38	2.61	0.37	18.51
	10	513	3050	9	0.76	11.85	6.17	22.78
	20	279	1819	5	0.55	9.07	3.78	21.79
	30	121	682	4	0.30	13.23	4.97	35.26
Duration of follow up after IRA	0	119	59	0	0.01	0	.	.
	1	241	624	2	0.11	17.63	4.41	70.48
	5	207	1512	5	0.33	14.97	6.23	35.96
	10	183	2582	9	0.82	11.04	5.74	21.21
	20	103	2566	3	0.62	4.86	1.57	15.06
	30	48	1637	1	0.37	2.72	0.38	19.30
Calender year at IRA	1960-1969	4	94	0	0.03	0.000	.	.
	1970-1979	86	1720	5	0.36	13.73	5.72	32.99
	1980-1989	222	3343	7	0.88	7.99	3.80	16.76
	1990-1999	209	2132	5	0.63	7.96	3.31	19.11
	2000-2010	380	1692	3	0.36	8.41	2.71	26.06
PSC	0	808	8139	13	2.08	6.26	3.64	10.79
	1	93	841	7	0.18	39.11	18.65	82.05

Colon Cancer before IRA	0	779	8013	18	1.86	9.65	6.08	15.32
	1	122	967	2	0.39	5.13	1.28	20.52
Dysplasia before IRA	0	866	8685	18	2.12	8.48	5.34	13.45
	1	35	295	2	0.13	15.33	3.83	61.29
Dysplasia / colon cancer before IRA	0	750	7764	17	1.76	9.67	6.01	15.56
	1	151	1216	3	0.50	6.04	1.95	18.73

DR

Variable		Numbers	Time at risk	Observed	Expected	SIR	CI95%	
Sex	Male	2630	14866	16	4.57	3.50	2.15	5.72
	Female	1729	10691	9	2.01	4.48	2.33	8.60
Age UC	0-19	639	3879	7	0.06	115.52	55.07	242.31
	20-29	1053	6426	5	0.28	18.01	7.49	43.26
	30-39	893	5256	5	0.64	7.78	3.24	18.69
	40-59	1115	6523	5	2.51	1.99	0.83	4.78
	60-	659	3471	3	3.08	0.97	0.31	3.02
Age at colectomy	0	337	2162	3	0.01	217.36	70.10	673.95
	20	989	6397	7	0.19	36.87	17.58	77.34
	30	888	5128	4	0.43	9.30	3.49	24.78
	40	1369	7842	7	2.43	2.88	1.37	6.05
	60	776	4038	4	3.52	1.14	0.43	3.03
Duration of UC at colectomy	0	2093	13729	11	3.77	2.92	1.62	5.27
	1	1227	6450	3	1.40	2.15	0.69	6.66
	5	568	3073	6	0.77	7.83	3.52	17.44
	10	367	1827	4	0.48	8.30	3.11	22.10
	20	93	440	1	0.15	6.87	0.97	48.77
	30	21	38	0	0.02	0.00	.	.
Duration of follow up after UC	0	1781	816	0	0.14	0.00	.	.
	1	2673	6038	1	1.31	0.77	0.11	5.43
	5	1943	6432	3	1.56	1.93	0.62	5.98
	10	1421	7803	13	2.05	6.35	3.69	10.94
	20	620	3417	6	1.09	5.49	2.47	12.22
	30	208	1051	2	0.44	4.58	1.15	18.32

Duration of follow up after Colectomy	0	1468	781	2	0.09	23.49	5.87	93.92
	1	1404	3344	3	0.75	4.00	1.29	12.39
	5	561	4139	4	1.33	3.00	1.13	8.00
	10	588	8202	11	2.44	4.50	2.49	8.13
	20	253	6112	4	1.30	3.07	1.15	8.18
	30	85	2978	1	0.66	1.51	0.21	10.72
Calendar year at Colectomy	1960-1969	23	469	0	0.13	0.00	.	.
	1970-1979	162	3079	3	0.85	3.52	1.13	10.91
	1980-1989	713	7016	7	1.55	4.53	2.16	9.50
	1990-1999	1652	8979	12	2.45	4.89	2.78	8.61
	2000-2010	1809	6012	3	1.59	1.88	0.61	5.84
PSC	0	4173	24570	23	6.42	3.58	2.38	5.39
	1	186	987	2	0.16	12.47	3.12	49.88
Colon cancer before colectomy	0	4238	24992	23	6.37	3.61	2.40	5.43
	1	121	565	2	0.21	9.71	2.42	38.83
Dysplasia before colectomy	0	4325	25378	24	6.53	3.67	2.46	5.48
	1	34	178	1	0.05	21.67	3.05	153.86
Dysplasia/Colon cancer before colectomy	0	4209	24816	22	6.33	3.48	2.29	5.28
	1	150	741	3	0.25	11.98	3.86	37.13