Early Complications Following Operations for Cancer of the Rectum and Anus*

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THE DESIRE to avoid a permanent colostomy after surgery for rectal cancer has resulted in the introduction of low anterior resection. We have used both abdominoperineal and low anterior resection for cure during the last ten years. Randomization of the groups was not attempted, low anterior resection being performed whenever it was possible to resect 5 cm below the tumor. This procedure was justified because of a crude five-year survival rate of 66 per cent after low anterior resections for cure.[1]

The ensuing analysis was undertaken to evaluate postoperative lethality and early morbidity after the two methods and to identify factors contributing to morbidity and lethality and thereby obtain a rationale for eventual changes in selection and treatment of the patients.

Material and Methods

From 1962 to 1973, 720 patients with rectal and 26 with anal cancer were admitted to the department of Surgical Gastroenterology F, Bispebjerg Hospital, Copenhagen. The rectum was defined as extending 18 cm orad from the anus by rectoscopic examination. Most of the patients were subjected to abdominoperineal resection (APR) or low anterior resection (LAR), the latter implying resection of the rectum and lower sigmoid followed by an anastomosis below the pelvic peritoneal floor. Both operations were performed electively and concomitant defunctioning colostomy was not used, but a cecostomy was performed in ten patients before LAR because of ileus.

Three chief surgeons performed 76 per cent of the operations, the remainder being done by senior registrars. Palliative colostomies were performed in 108 patients, while 37 had other operations. Thirty-two patients had no operation. The tumor was removed in 81 per cent of all patients operated upon. Dukes' A and B tumors were found in 33 and 53 per cent of the patients treated with APR, while the corresponding figures for LAR were 41 and 52 per cent.

All patients were prepared with purgation, repeated enemas and special diet before elective operation. In patients having a chance for LAR, intestinal asepsis was obtained by administering Nebacetin (neomycin sulfate and bacitracin), 1.5 g every 6 hours, and Sterosan (chlorchinaldole), 100 mg every 8 hours, three days preoperatively. Resection was decided upon when the dissection had demonstrated that it was feasible without compromising radicality. After dissection of the rectum down to the pelvic floor, the distal segment was clamped 5 cm below the tumor and irrigated with either Chlorpactin (oxychlorosene) and saline solution or Dakin's solution and saline solu-

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TABLE 1. *Postoperative Lethality after Surgical Operations for Anorectal Cancer*

	Abdominoperineal Resection	Low Anterior Resection	Palliative Colostomy	Other Operations
Patients operated on for cure	297	171		21
Hospital deaths	31	9		1
Lethality (per cent)	10.4	5.3		4.8
Patients with palliative operations	65	36	108	16
Hospital deaths	4	3	30	3
Lethality (per cent)	6.2	8.3	27.8	18.7

TABLE 2. *Principal Causes of Hospital Death after Abdominoperineal and Low Anterior Resection*

Causes of Death	Abdominoperineal Resection Number of Patients	Low Anterior Resection Number of Patients
Cardiac complications	9	2
Pulmonary complications	7	2
Thromboembolism	8	4
Cerebral hemorrhage	1	1
Septicemia and/or peritonitis	7	2
Peroperative bleeding	3	0
Bleeding duodenal ulcer	0	1
No hospital death	327	195
TOTAL	362	207

tion. An end-to-end inverting anastomosis was performed using one layer of through-and-through chromic catgut or polyglycolic acid and two layers of interrupted serosal silk sutures. Extraperitoneal drainage was used. After APR the perineal wound was either sutured using extraperitoneal drainage or left open, depending upon hemorrhage and contamination. The colostomy was fashioned ten days after the operation.

The patients were followed every third month the first year, twice the second year, and once a year until five years after the operation. The shortest follow-up period was nine months.

The analysis was prospective from 1969. Since randomization of APR and LAR was

TABLE 3. *Distribution by Age and Sex of Patients Subjected to Abdominoperineal and Low Anterior Resection and Palliative Colostomy Alone*

	Abdominoperineal Resection		Low Anterior Resection		Palliative Colostomy	
Age (Years)	Men	Women	Men	Women	Men	Women
21–40	2	2	2	3	1	0
41–50	12	16	8	6	3	1
51–60	44	29	21	27	8	4
61–70	74	55	33	36	22	13
71–75	36	28	17	23	11	6
76–80	31	15	11	10	10	9
81–90	8	10	6	4	10	9
91–	0	0	0	0	0	1
TOTAL	207	155	98	109	65	43

not attempted, no statistical test to compare the relative merits of the two operations is available. Differences in proportions among factors contributing to morbidity and lethality were evaluated by the chi-square test with Yates correction. Comparisons including continuous variables were evaluated by the rank sum test. Significance of relationships was stated for $P < 0.02$.

Results

Postoperative Lethality: The number of hospital deaths after APR for cure was two times as high as that after LAR for cure (Table 1); no difference in lethality after palliative APR and LAR was found. The principal causes of death are listed in Table 2.

Distribution by sex and age is recorded in Table 3. Lethality after APR and LAR for cure increased with increasing age ($P < 0.02$). Lethality in patients more than 70 years old was 16.7 per cent after APR for cure and 9.4 per cent after LAR for cure.

Lethality after LAR was insignificantly higher ($P < 0.05$) in obese patients (more than 10 per cent above the average weight in Documenta Geigy 1960) than in normal and thin patients (Table 4). Lethality after APR was higher in patients with cardiac disease than in those without ($P < 0.001$). The same was not true for patients with LAR ($P > 0.05$).

Lethality was *not* related significantly to: other severe preoperative diseases (diabetes, cirrhosis, etc.); anemia and hypoproteinemia (corrected before operation); hypertrophy of the prostate; preoperative urinary infection; hypercreatininemia (≥2.0 mg/100 ml); pathologic urography; pre- and peroperative number of blood transfusions;

TABLE 4. *Preoperative Weight and Postoperative Lethality (Normal Weight 10 Per Cent below to 10 Per Cent above the Average in Documenta Geigy 1960)*

	Abdominoperineal Resection			Low Anterior Resection		
	Thin	Normal	Obese	Thin	Normal	Obese
Number of patients	100	189	64	58	104	38
Number of hospital deaths	10	20	3	1	4	5

TABLE 5. *Abdominal Wound Complications and Postoperative Lethality*

	Abdominoperineal Resection		Low Anterior Resection	
	Men	Women	Men	Women
Wound rupture without infection	16	2	11	5
Hospital deaths	4	0	3	1
Wound rupture and infection	16	4	1	0
Hospital deaths	1	0	0	0
Wound infection alone	14	22	3	4
Hospital deaths	3	3	0	1
Uncomplicated wound	161	127	83	100
Hospital deaths	13	11	4	3

TABLE 6. *Anastomotic Leakage and Postoperative Lethality after Low Anterior Resection*

	Leakage	No Leakage
Number of patients	19	188
Number of hospital deaths	6	6
	($P<0.001$)	

TABLE 7. *Postoperative Ileus*

	Abdomino-perineal Resection Number of Patients	Low Anterior Resection Number of Patients
Adynamic ileus	21	6
Mechanical ileus not necessitating relaparotomy	6	3
Mechanical ileus necessitating relaparotomy	13	4
Mechanical ileus treated with temporary colostomy	0	1
No ileus	322	193
TOTAL	362	207

TABLE 8. *Urologic Complications and Postoperative Lethality*

	Abdomino-perineal Resection Number of Patients	Low Anterior Resection Number of Patients
Operative lesions of the ureter	9	2
Hospital deaths	1	0
Operative vesicourethral lesions	4	0
Hospital deaths	0	0
Urinary retention, incontinence, infection and other complications	114	23
Hospital deaths	10	5

peroperative hypotension (fall in systolic pressure by at least 50 mm Hg below preoperative value during 15 minutes or longer); duration of operation; experience of the surgeon; position of tumor in cm from the anus and in relation to the pelvic peritoneal floor; fixation of tumor by digital rectal exploration; tumor perforation; Dukes' classification; resection of other viscera in 39 patients; inadvertent perforation of rectum during operation in 108 patients; peroperative urologic lesions in 15 patients.

Abdominal wound rupture (Table 5) was associated with increased lethality after LAR ($P<0.01$), but not after APR. Anastomotic leakage (fecal fistula or anastomotic breakdown demonstrated by reoperation or autopsy) (Table 6), mechanical and adynamic ileus (the latter necessitating gastric aspiration for more than five days), and urologic complications (Tables 7 and 8) also increased lethality after LAR ($P<0.01$).

Postoperative cardiopulmonary complications (Tables 9 and 10) and general infections (Table 11) increased lethality after APR, LAR and palliative colostomy ($P<0.01$). Postoperative hypercreatininemia in 41 patients was associated with greater lethality after LAR ($P<0.02$), but not after APR and palliative colostomy ($P<0.05$). Thromboembolism (Table 12) increased lethality after APR and LAR ($P<0.001$). Lethality was not related to intestinal asepsis or perineal wound and colostomy complications.

Sixteen of the 35 hospital deaths after APR occurred during the first 19 days, the corresponding figures for LAR being three of 12 (Table 13).

The variables investigated in relation to lethality were also examined in the following, but insignificant relationships were omitted to spare space.

Postoperative Morbidity:

Abdominal wound complications (Table 5). Wound rupture (with and without infection) was more frequent in men than in women after APR, but not after LAR. Rupture after LAR was related to obesity ($P<0.02$), no bowel antibiotics (six ruptures among 23 patients) and more than three

TABLE 9. *Pulmonary Complications and Postoperative Lethality*

	Abdominoperineal Resection Number of Patients	Low Anterior Resection Number of Patients	Palliative Colostomy Number of Patients
Atelectasis necessitating tracheobronchial toilet	13	6	5
Hospital deaths	3	3	3
Pneumonia and/or pleural exudation	19	10	8
Hospital deaths	4	5	8
Respiratory insufficiency necessitating tracheostomy	8	0	0
Hospital deaths	8	0	0
No pulmonary complication	322	191	95
Hospital deaths	20	4	19

TABLE 10. *Cardiac Complications and Postoperative Lethality*

	Abdominoperineal Resection Number of Patients	Low Anterior Resection Number of Patients	Palliative Colostomy Number of Patients
Cardiac complications	38	8	11
Hospital deaths	21	3	9
No cardiac complication	324	199	97
Hospital deaths	14	9	21

TABLE 11. *General Infections and Postoperative Lethality*

	Abdominoperineal Resection Number of Patients	Low Anterior Resection Number of Patients	Palliative Colostomy Number of Patients
Peritonitis and/or septicemia	17	7	7
Hospital deaths	8	4	4
Subphrenic abscess	1	0	1
Hospital deaths	0	0	1
Staphylococcal enterocolitis	2	3	0
Hospital deaths	0	1	0
Other general infections	8	10	3
Hospital deaths	3	2	2
No general infection	334	187	97
Hospital deaths	24	5	23

blood transfusions peroperatively ($P<0.01$). Rupture after APR was related to preoperative anemia, postoperative ileus ($P<0.001$), pulmonary complications ($P<0.001$), and general infections ($P<0.001$). Rupture combined with infection of the wound was more frequent after APR than after LAR. Fifty-two of the 55 ruptures were present in patients with one or more unfavorable conditions (25 ruptures in patients with two or more unfavorable conditions).

Wound infection without rupture was more frequent after APR than after LAR. Infection after LAR was related to no bowel preparation with antibiotics and bacterial growth in culture from the bowel

TABLE 12. *Thromboembolism and Postoperative Lethality*

	Abdominoperineal Resection Number of Patients	Low Anterior Resection Number of Patients	Palliative Colostomy Number of Patients
Deep phlebitis without embolism	10	6	4
Hospital deaths	3	4	0
Embolism ± deep phlebitis	12	2	2
Hospital deaths	8	1	2
No thromboembolism	340	199	102
Hospital deaths	24	7	28

TABLE 13. *Hospital Stay after Operation and Postoperative Lethality*

	Abdominoperineal Resection Number of Patients	Low Anterior Resection Number of Patients	Palliative Colostomy Number of Patients
Nine days or less	6	4	13
Hospital deaths	6	1	11
10–19 days	58	133	44
Hospital deaths	10	2	6
20–29 days	135	39	28
Hospital deaths	10	4	3
1–2 months	136	27	17
Hospital deaths	4	4	7
More than 2 months	27	4	6
Hospital deaths	5	1	2

($P < 0.02$). Infection after APR was related to Dukes' C tumors ($P < 0.01$), closed perineal wound complications, postoperative ileus, and general infections ($P < 0.001$). All abdominal wound infections were accounted for by one or more of the unfavorable factors.

Anastomotic leakage (Table 6) was related to obesity ($P < 0.01$), postoperative pulmonary complications, thromboembolism, and general infections ($P < 0.001$). Leakage was not related significantly to fixation of tumor by rectal exploration ($P < 0.05$). All leakages were accounted for by one or more of the pre- and peroperative fatal conditions. No relation between leakage and tumor localization, bowel preparation with antibiotics, or intestinal bacterial growth was found. Four patients had septicemia and/or peritonitis without accompanying fecal fistula, but leakage could be excluded in three.

Perineal wound complications (Table 14) necessitating surgical revision were not more frequent after primary closure than in open wounds. All perineal wound complications prolonged the hospital stay.

Colostomy complications (Table 15) after APR were related to obesity ($P < 0.02$) and cardiac disease ($P < 0.01$). Necrosis of the colostomy necessitated relaparotomy in six patients.

Postoperative ileus (Table 7) was associated with peroperative infusion of more than 1,500 ml blood, pulmonary complications, and general infections ($P < 0.001$), hypercreatininemia and urologic complications ($P < 0.01$), abdominal wound rupture, and infection after APR.

Pulmonary complications (Table 9) were

more frequent in men than in women. In addition to the relationships mentioned above, pulmonary complications were related to age ($P<0.01$), postoperative cardiac complications, general infections, and urologic complications ($P<0.001$).

Cardiac complications (Table 10), including coronary occlusion, incompensation, pulmonary edema, arrhythmias, and other rarer abnormalities were more frequent after APR than after LAR. They were related to preoperative cardiac disease and age ($P<0.001$), infusion of more than 1,500 ml of blood ($P<0.01$), thromboembolism, and general infections ($P<0.001$). One or more of the unfavorable factors were present per- and preoperatively in 52 of the 57 patients with cardiac complications. Peroperative hypotension was not related significantly to cardiac complications ($P<0.05$).

Thromboembolism (Table 12) was related to anastomotic leakage ($P<0.001$). Cerebral hemorrhage was seen in three patients after APR and in one after LAR.

General infections (Table 11) were related to spontaneous tumor perforation and urologic complications ($P<0.001$), in addition to the factors mentioned above. General infection after APR was not related significantly to inadvertent perforation of the rectum during dissection, occurring in 98 of the 362 patients ($P<0.05$). Patients with Dukes' B or C tumors had inadvertent perforations more frequently than patients with Dukes' A tumors ($P<0.001$). Only two of the five patients with staphylococcal enterocolitis had had antibiotic preparation of the bowel, and the one patient whose death may have been caused by enteritis was not among the two.

Postoperative psychosis was seen in 12 patients and was related to peroperative hypotension ($P<0.001$).

Urologic complications (Table 8), excluding lesions, were related to hypertrophy of the prostate ($P<0.01$) and lack of bowel preparation with antibiotics ($P<0.001$), in addition to the factors mentioned above. Urologic complications were more frequent after APR than after LAR. Postoperative hypercreatininemia was related to peroperative infusion of more than 1,500 ml of blood ($P<0.02$) and to urologic complications ($P<0.001$).

Hospital stay (Table 13) was shorter after LAR than after APR. Nearly all complications prolonged the stay.

Sixty-one of 362 patients with APR had no complication at all. The figure may be increased to 117 of 362 if perineal wound complications not necessitating revision are included as no complication. LAR resulted in no complication in 126 of 207 patients.

TABLE 14. *Perineal Wound Complications*

	Primary Closure with Drainage Number of Patients	Open Perineal Wound Number of Patients
Complications necessitating surgical revision	41	34
Complications, revision not needed	54	78
No complication	55	100
TOTAL	150	212

TABLE 15. *Early Complications Following Colostomy*

	Abdominoperineal Resection Number of Patients	Palliative Colostomy Number of Patients
Necrosis ± infection	14	2
Infection alone	13	1
Retraction	3	1
Other complications	4	1
No complication	328	103
	362	108

Discussion

Lethality after APR and LAR was similar to that in the literature,[8] including a comparable number of patients, a third being more than 70 years old. Not less than 72 per cent of deaths resulted from cardiopulmonary and vascular complications, and 60 per cent of hospital deaths occurred in patients more than 70 years old.

The high lethality in obese patients after LAR can partly be explained by technical difficulty in performing the anastomosis, since two of the five deaths occurred in patients with leakage and one in a patient with peritonitis.

Preoperative cardiac disease increased lethality to 19 per cent after APR, making LAR more attractive. The high lethality associated with abdominal wound rupture after LAR could be explained partly by leakage and ileus. The rates of wound rupture and infection may be reduced by using antibiotic bowel preparation in all patients subjected to LAR and by reducing the perioperative blood loss.

The lethality of 30 per cent in patients with leakage was similar to that in other centers,[4, 7] while the incidence of leakage was equal to or less than that in studies including patients with antibiotic bowel preparation.[5, 7, 8] Leakage was also more frequent in studies comprising a large number of surgeons and changing preparations of the bowel.[2, 6] The rate of leakage may probably be reduced by avoiding fecal contamination during operation[3] and performing APR in patients with obesity and fixated tumors (three leaks occurred among nine patients with fixated tumors). We cannot evaluate the effect of antibiotics definitely, since only 23 patients had no preparation before LAR; the missing leakages among these could be due to our three-layer suture technique.

The general infection rate might be reduced by avoiding rectal perforation during operation. However, the experience of the surgeon was not related to this complication. Also, no relation was found between Dukes' classification and experience of the surgeon.

The incidence of thromboembolism probably cannot be reduced because of a large proportion of old immobile patients and the indispensable dissection along the pelvic vessels. The lethality associated with thromboembolism amounted to 26 per cent of the collective lethality after APR and LAR.

Urologic complications will be studied in a report of 549 urographic examinations of the 714 patients operated upon.

Summary and Conclusion

Lethality and morbidity during the hospital stay after abdominoperineal and low anterior resection for anorectal cancer have been analyzed during a 10-year period. These operations were used for cure, the latter being performed whenever it was possible to resect the rectum 5 cm below the tumor. Antibiotic bowel preparation was used when rectoscopy made low anterior resection probable.

Abdominoperineal resection was followed by higher rates of abdominal wound rupture and infection, cardiac and urologic complications, and a longer hospital stay than low anterior resection. The latter could be performed for cure in 36 per cent of the patients with rectal cancer operated upon for cure.

Lethality following abdominoperineal resection was related to cardiac disease and that following low anterior resection to anastomotic leakage, wound rupture, ileus, urologic complications, and hypercreatininemia. Lethality after both operations was related to age, cardiopulmonary complica-

tions, thromboembolism, and general infections.

Accepting that long-term survival is the same after low anterior resection and abdominoperineal resection for rectal cancer, the former should be performed as described, excluding patients with fixated tumors by rectal digital exploration, and probably excluding obese patients, but the last proposition demands a randomized study.

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Memoirs

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