ANTERIOR RESECTION FOR MALIGNANT LESIONS OF THE UPPER PART OF THE RECTUM AND LOWER PART OF THE SIGMOID*†

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THE OPERATION OF ANTERIOR resection for lesions of the terminal part of the large intestine with re-establishment of intestinal continuity has been criticized by many authors as not being sufficiently radical. The present paper is an evaluation of the operation. The efficacy of any surgical procedure for cancer is judged by the number of persons undergoing the procedure who are alive five years or more and not on an anatomic basis —the extent of the excision.

This study is limited to the most controversial segment of the large intestine; namely, the distal 20 cm. It is for this region that new procedures are constantly being advocated and interest in old ones is being rekindled. A matter of 3 or 4 cm. from the dentate line makes the difference between an operation involving a permanent colonic stoma and one in which intestinal continuity can be re-established. While the majority of patients become adjusted to a permanent colonic stoma, there are some who have difficulty in its management. It should be remembered that those "cured" by anterior resection can live normally in every respect.

Because it is so important in determining the possibility of re-establishing intestinal continuity, I have considered the cases in this study in respect to the distance of the lower edge of the lesion from the dentate (pectinate) line as measured by the proctoscope. By studying the prognosis for each segment separately one could determine the lowest level at which it is sage to apply the procedure. I have avoided the use of the term "rectosigmoid" since it is merely a clinical designation for the rectosigmoidal juncture. Variation of the length of the rectum and of the level of the pelvic peritoneal fold, change of the length of the rectum after mobilization, shrinkage of the tissue by the time the pathologist measures it and differences in the interpretation of descriptive terms have led me to depend on the distance measured proctoscopically.

DEVELOPMENTAL BACKGROUND

The operation of anterior resection had been applied to lesions of the sigmoid before 1910, at which time primary anastomoses were performed, a large rectal tube being placed through the anastomosis for the purpose

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of decompression. The application of the procedure to lesions of the rectum came about in a roundabout way. A series of operations were performed in which continuity of the bowel was not re-established. In the first stage sigmoidal loop colostomy was performed; in the second procedure the lesion and its mesentery were excised and the sigmoidal and rectal stumps were closed. If the patient survived, subsequent exploration and re-establishment of intestinal continuity were warranted. It became customary to advise the patients that if they got along well they could return in six to 12 months for sigmoidorectostomy. The satisfactory survival rates, despite extensive lesions of high grade, suggested that the intestinal anastomosis could be performed at the second stage of the operation. Three facts were apparent: First, the rectal stump can survive if supplied by the inferior hemorrhoidal vessels alone, regardless of the fact that the textbooks have denied this; secondly, Sudeck's point is not as critical as described and, thirdly, it is possible to excise sufficient tissue in the mesocolon and distal portion of the sigmoid and to obtain good clinical results. Apparently it sufficed to remove only 3 or 4 cm. of bowel distal to the lesion. This latter observation was difficult to reconcile with Miles's[9] work but subsequent careful study of cleared specimens showed that the occasional distal spread of carcinoma to lymph nodes beyond 2 cm. is due to proximal blockage.[1,7,13] In such instances it is possible that no surgical procedure is sufficiently radical to include the centrifugal spread from such obstructed lymphatic drainage.

The procedure outlined here I first performed in 1930. It has been reported previously in detail.[2-4] Up to 1938 the majority of such operations were carried out in three stages including preliminary transverse colostomy. In the second stage the lesion was removed and colosigmoidostomy or colorectostomy was performed through a low left rectus incision. In the third step the colonic stoma was closed after suitable clamping of the spur. Since 1938 colostomy has been performed at the time of resection unless there was severe obstruction. With progress in methods of decompression and with the preoperative use of sulfasuxidine or sulfathaladine and vitamin K, antecedent colostomy is being performed in fewer cases than before. At present, with few exceptions, patients come to the operating room well prepared by administration of sulfasuxidine and rectal irrigations, and the surgeon has definite proctoscopic information regarding the grade, level, mobility and extent of the lesion. This has reduced the mortality rate and permitted the performance of an open accurate anastomosis.

The performance of sigmoidal colostomy as a preliminary or emergency procedure in these cases makes the resection extremely difficult by limiting the mobility of the colon and frequently dissection of the colonic stoma from the abdominal wall is necessary in addition to the performance of transverse colostomy.

Since 1941 such patients have received preoperatively a minimal daily oral administration of 12 Gm. (180 grs.) of sulfasuxidine or sulfathaladine

for a period of three to eight days. In addition, 5 Gm. of sulfathiazole is scattered intraperitoneally at the close of the operation. I feel that this chemotherapy has produced a distinct reduction of the mortality rate. Culture of stools after adequate preparation with the insoluble, poorly absorbed sulfonamides has shown a dramatic fall of the count of coliform organisms. This advantage is appreciated most by the surgeon who prefers an open anastomosis. With the use of the sulfonamides, peritonitis has become much less common. In addition, there has been a fall in the incidence of thrombophlebitis and pulmonary emboli, probably resulting from a reduction of the contribution that is made by infection in these complications.

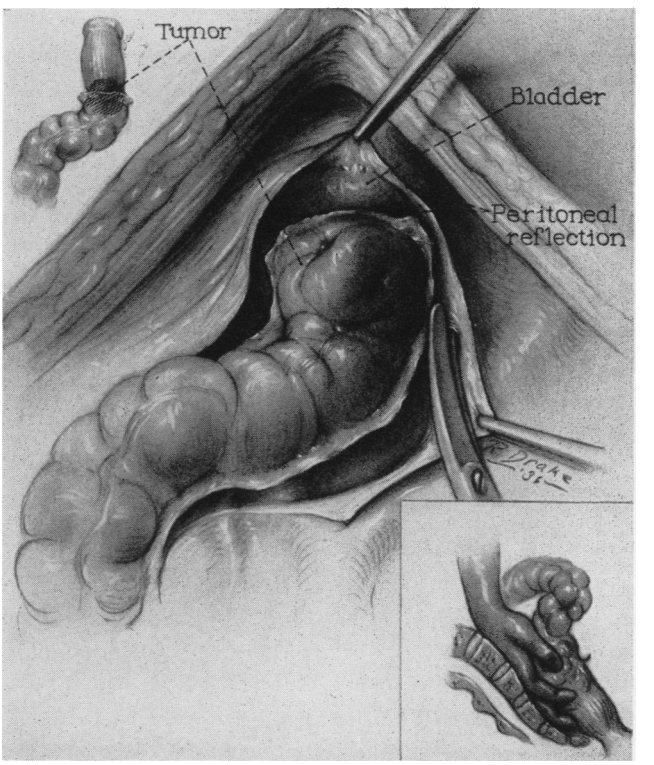


FIG. 1.—The peritoneum is incised as indicated, freeing the sigmoid and rectum. The rectum is mobilized from the sacrum as shown in the lower right insert.

The use of streptomycin was for a time thought to be as effective in reducing the coliform count as was that of either of the aforementioned sulfonamides. It has been demonstrated that streptomycin does lower the bacterial count in the bowel but for two to three days only. After this period, regardless of the amount of streptomycin administered, the coliform organisms return to their normal count. It would seem, therefore, that streptomycin must be considered as an adjunct only to sulfonamides in surgery of the colon.

THE TECHNIC OF LOW ANTERIOR RESECTION

The operation is performed with the patient in a steep Trendelenburg position and a long left rectus muscle-splitting incision is used. The pelvic colon is mobilized by dissecting the fused lateral peritoneum free from the mesosigmoid. The peritoneal incision is outlined so that an adequate cuff of peritoneum is excised with the colon, passing up the lateral aspect, curving around the rectovesical or rectocervical space and passing back on the mesial aspect (Fig. 1). The entire left portion of the colon is then mobilized by incising the lateral peritoneal reflection of the left paracolic gutter as far as the splenic flexure. Both ureters are identified and isolated.

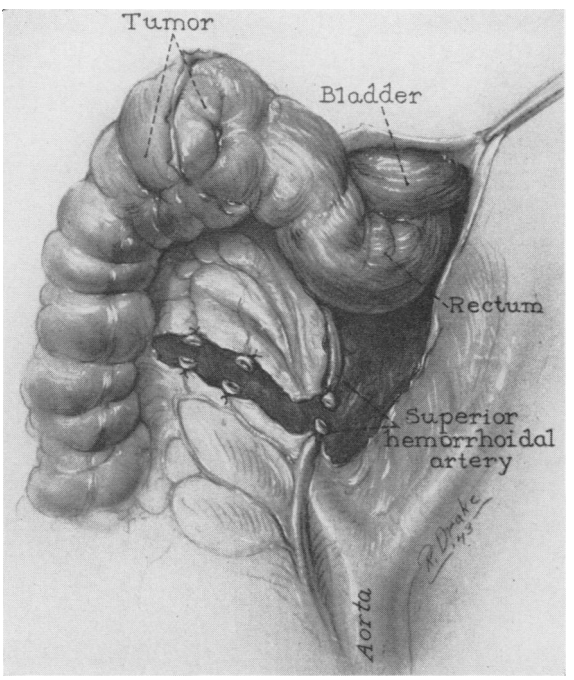


FIG. 2.—After mobilization of rectum and sigmoid the site for the ligation of the superior hemorrhoidal or inferior mesenteric vessels is selected and a V-shaped section of mesentery is excised.

The rectal ampulla is then mobilized from the hollow of the sacrum as far as the coccyx (Fig. 1) and from the vagina or seminal vesicles and prostate by blunt and sharp dissection. Usually in the case of a low lesion, such as is under consideration here, a large portion of the branches of the middle hemorrhoidal vessels, which are of irregular distribution, must be sacrificed.

The mobilized mesocolon is then transilluminated and the vascular pattern is determined. When the mesentery is very fat one must depend on palpation. The point of ligation of the inferior mesenteric or superior hem-

orrhoidal vessels is then outlined. My colleagues and I do not recognize any critical point in this determination, rather depending on the precepts of rational cancer surgery and providing the correct amount of excision to allow the sigmoid or descending colon, as the case may be, to reach or bridge to the rectal or rectosigmoidal transection without tension. It should be recognized that the mesentery of the sigmoid usually is omegoid and that one obtains more colon to reach into the pelvic outlet by going higher up with the mesenteric ligation (Fig. 2). Because of this the low resections themselves insure the adequate resection of the pelvic mesocolon since often it is impossible to obtain enough mobile colon unless one ligates rather high up on the inferior mesenteric artery. While in the earlier developmental years, resections were somewhat less radical, there has been a tendency in the past five years to standardize the operation more or less so that as much bowel as possible is removed even if the lesion is situated above the pelvic peritoneal fold.

If one does not feel certain of the pattern of the circulation to the upper segment, the bowel may be transected before the inferior mesenteric artery is ligated and the effect of ligation at the selected site may be determined by pinching the artery. Instead of depending on the color of the intestine it seems wiser to look for the pulsations in the arteries as they enter the colonic wall. After ligation of the vessels and transection of the colon the intestine is reflected over the pubis. Steady slow traction is exerted on the rectum with a hand deep in the hollow of the sacrum. The smooth muscle of the rectum and vascular stalks relaxes slowly. The curves, valves and folds of the rectum straighten and give more length. The anal canal and levator ani muscle are slowly funneled into the pelvic bowel. This maneuver may permit ligation of the rectal stalks as far lateral as 4 cm. to include any lateral spread in this area. These measures permit placement of rubber-covered intestinal clamps (Fig. 3) well below the lesion in selected cases even when it is 6 to 8 cm. from the dentate line. Actually, after mobilization of the rectum, the lesion is 10 to 12 cm. from the dentate line and one can resect the normal rectum at least 3 to 4 cm. below the lesion. In order to determine completeness of resection, frozen sections of the distal portion of the resected rectum are made routinely and thus a check is made on the surgeon's ability to palpate the lowest limit of spread.

The colon is then prepared for anastomosis to the rectum by placing another especially constructed rubber-shod curved intestinal clamp close to the end. The fat must not be cleared from the edge too extensively or the blood supply which enters the colon through the base of the fat tags will be sacrificed. The curved clamps on the colon and the curved clamps on the rectum are placed side-by-side (Fig. 3) in the deep pelvis and an open end-to-end anastomosis is performed without tension. Since the posterior portion of the rectum is thin and devoid of serosa only a single posterior row of stitches is placed. Anteriorly the rectum is thicker and a second

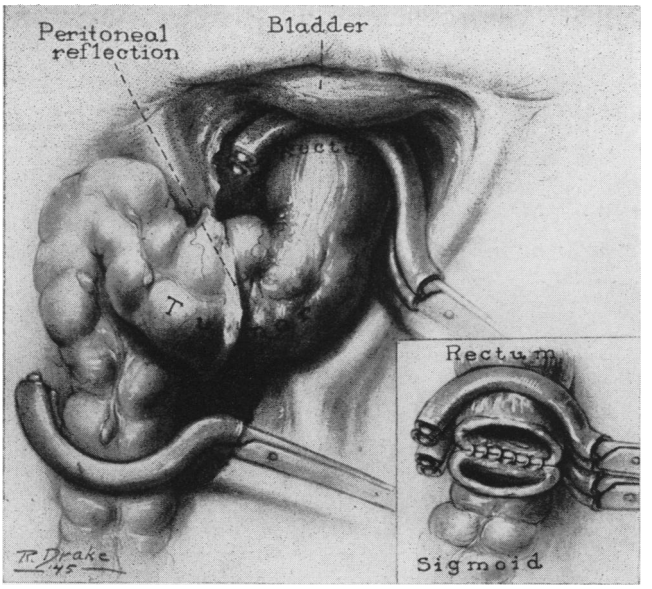


FIG. 3.—Curved intestinal clamps are placed beyond the lines of resection of the intestine. After the segment is resected the clamps are placed side by side and the open colorectostomy is performed as indicated in the insert.

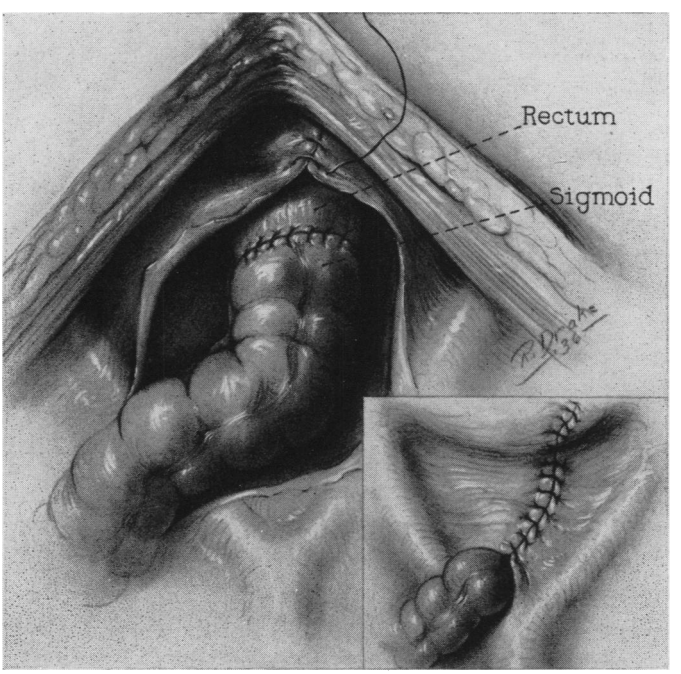


FIG. 4.—The pelvic peritoneum is closed at a higher level, which makes the anastomosis retroperitoneal. The drain has been omitted from the drawing.

inverting row is feasible. Any so-called aseptic anastomosis in this region is a gymnastic feat attended by difficult clamp maneuvers deep in the pelvis, danger of tearing the rectum, the hazard of catching the opposite mucosa to create a persistent diaphragm or of perforating the rectum in forcing the anastomosis open, and finally the possibility of a poor anastomosis. A valuable extra centimeter or more of rectum may be consumed in the process. Furthermore the posterior rectal wall is so thin that every stitch passes into the lumen and occasionally tears the rectal wall. For these reasons one questions how aseptic the closed anastomosis is.

In concluding the operation, 5 Gm. of sulfathiazole is dusted into the region of the anastomosis, a Penrose cigaret drain is placed in the hollow of the sacrum, emerging through the lower angle of the incision, and the peritoneum is sutured around the colon to reconstruct the pelvic floor proximal to the anastomosis (Fig. 4). The incision is closed after a loop of the transverse colon has been brought through the omentum and out of the upper angle of the incision to serve as a temporary colonic stoma and the omentum is brought down to cover the loops of intestine.

In the early cases the drain was brought out through an incision just in front of the coccyx. While the drainage is excellent, this introduces difficulties in draping the patient so that the assistant can make the stab wound to draw the drain through. Furthermore, the site of drainage is uncomfortable to the patient and it is easily contaminated and favors temporary fistula at the site. My colleagues and I have found that a drain brought out suprapubically is satisfactory and usually we begin to remove it about the eighth postoperative day. In cases in which there has been considerable perforation or soiling, sulfadiazine is administered postoperatively. Otherwise it is not necessary unless some abdominal or pulmonary complication indicates its use. Sulfasuxidine is administered only when a fistula or leak presents. When proximal colostomy is performed, a paste of sulfasuxidine can be instilled into the distal loop. The colonic stoma is opened by cautery incision in the patient's room from 18 to 24 hours after operation.

The colonic stoma usually is closed three to four weeks after the anterior resection. In preparation for the closure, patency and healing of the anastomosis are tested by passing water downward from the distal loop of the colonic stoma and upward from the anus. If a proctoscopic examination is made in the interval before closure the anastomosis is occasionally found to be as small as 2 cm. in diameter. A proctoscopist who has not encountered similar cases before will be distressed over the finding and will occasionally advise against the closure of the colonic stoma because of stricture. However, it has been found that although the lumen at the site of anastomosis may appear small the function is satisfactory and proctoscopy no longer is performed on such patients before closure of the colonic stoma. The free passage of water up and down through the anastomosis

is accepted as adequate proof of satisfactory function. Normally, the rectosigmoidal junction is the narrowest part of the colon and such narrowing is consistent with normal function. The subsequent passage of fecal matter is the best dilator and at a later time the anastomosis will be found to be much larger than before. Delay in closure will only serve to permit further narrowing because of disuse and scar formation (contraction).

Leakage from the site of anastomosis occurred in 12 cases but with the proximal temporary colonic stoma, there is little febrile reaction and there is merely a delay of an extra week or two for the fistula to close before proceeding with closure of the stoma.

The preoperative preparation employing sulfasuxidine and the technic of closure of the colonic stoma were reported in 1944.[5] That report presented data on 102 cases in which colonic stomas made in various surgical procedures were closed by a standardized intraperitoneal procedure without a single death. Since then, the closure of colonic stomas has been performed with two deaths. The mortality rate for the entire series of closures is 0.6 per cent. In the deaths mentioned, one was caused by coronary occlusion. The patient had suffered from angina for five years. The cause of the second death was probably peritonitis. Necropsy was not permitted. A fecal fistula developed in three cases. In three cases there was purulent drainage and escape of gas. Five of the fistulas closed spontaneously within two months. In the remaining case the escape of gas occurred intermittently for ten months and then the fistula closed spontaneously. This would appear to demonstrate that the added risk of temporary colostomy is small if full advantage is taken of chemotherapy before and during closure of the stoma.

During the past five years, postoperative roentgen therapy has been used as an adjunct to surgical treatment in a series of patients whose lesions had progressed to the state of nodal involvement. An impression that this may be of value has been obtained from sporadic cases in which it was tried. The consensus at present seems to be that roentgen treatment is of little or of no value. Definite information on this matter will not be available for some time.

The question of provision of a temporary colonic stoma.—Previous to the advent of the sulfonamides, numerous methods of decompressing the colon proximal to the colorectal anastomosis were investigated but the provision of a temporary defunctioning loop type of transverse colonic stoma proved apparently to be the safest procedure. Enterostomy, appendicostomy and cecostomy were less efficient. A rectal tube with its orifice proximal to the anastomosis occasionally was responsible for ulceration and perforation of the colon and frequently became plugged. Preliminary sigmoidal colostomy has many disadvantages, which have been outlined earlier in this paper. The advent of sulfasuxidine warranted re-evaluation of the safety of omitting colostomy. The problem was approached with an open

mind but, at present, the mortality rate is considerably higher when colostomy is omitted than when it is included. The possibility exists that the introduction of coliform-effective antibiotics may make anastomosis without proximal colostomy safe if the lesion is above the pelvic peritoneal fold. Analysis of recent series of cases of anterior resection without colostomy[8,11,12] reveals that many of the lesions were above the pelvic peritoneal fold; yet in 10 to 20 per cent of the cases colostomy had to be performed as a postoperative emergency operation.

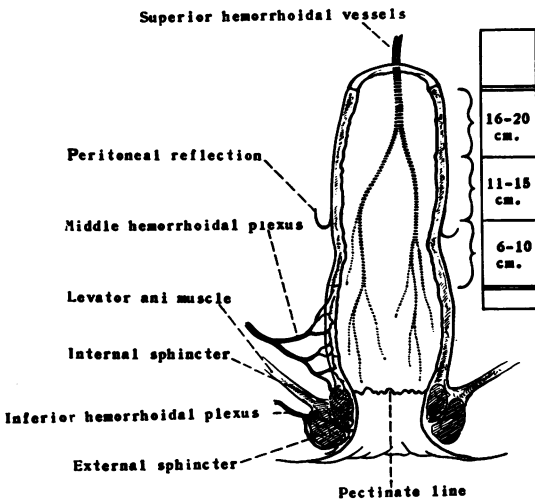
The omission of temporary colostomy in cases in which the lesion is near or below the pelvic peritoneal fold is fundamentally dangerous because the blood supply to the distal segment has been decreased. The sigmoidal anastomotic vessels above and the inferior hemorrhoidal vessels below provide a marginal blood supply that is adequate for healing under ideal conditions but not under strain. It has been long realized that anastomosis of a serosa-covered segment of bowel to a segment devoid of serosa requires 14 to 21 days to heal completely. Pemberton[10] has recently demonstrated by means of roentgenographic study of the segment of bowel distal to the colonic stoma in cases of low anterior resection of the lower part of the sigmoid and of the upper part of the rectum that at the site of the anastomosis barium often leaks into the pelvis or the hollow of the sacrum. Such leakage must then occur in many cases in which a colonic stoma is not established. Proximal colostomy seems indicated also if the lesion is adherent to the posterior vaginal wall, for the branches of the middle hemorrhoidal artery which supply the vaginal wall are often sacrificed in the dissection. Rectovaginal fistula may develop in such cases, especially if a temporary colostomy is performed. Closure of the stoma is then deferred for a month or two; this is occasionally necessary for complete healing in cases in which a portion of the vaginal wall has been excised.

I have applied the technic outlined in this paper in 523 cases, the first operations having been performed in 1930. In 46 cases, even though the distal loop was long enough to permit exteriorization, a short mesentery, obesity, intussusception of the growth, or some anatomic variation made anterior resection the procedure of choice. In 477 cases the lesion was 20 cm. or less from the dentate line. Of these operations, 39 were palliative and the procedure was performed in the face of distinct nodular metastasis to the liver. A number of these patients lived for more than a year. The lesion had invaded the wall of the bladder extensively in 12 of the cases and simultaneous partial cystectomy was performed. The latter group of cases was included in a recent report.[6]

Age.—The average age of the patients was 53.8 years. The youngest patient was 7 years of age and it is gratifying to report that this boy is still alive seven years after operation. Two of the patients were 79 years old.

Sex.—Of the 426 patients 55.6 per cent were male and 44.4 per cent were female. However, if the cases are analyzed it can be seen that the

worst lesions are found among females. Thus, in 24 of 37 cases in which there were high-grade malignant processes with nodal involvement the patients were female. In 28 of 40 cases in which the patients were less than 36 years of age, the patients were female. If one examines the lesions between 6 and 10 cm. one will find that the male to female ratio is 40:60. As the level proceeds toward the dentate line the proportion of females increases and the grade of the process rises, as has also been noted when one approaches the dentate line from below. To summarize: The lesions among females tend to be of higher grade and closer to the dentate line than among males, while the patient tends to be younger.



	Grade	Nodal involvement Without	With	Cases	Total cases
16-20 cm.	1	22	9	31	118
	2	45	28	73	
	3	4	8	12	
	4	0	2	2	
11-15 cm.	1	21	8	29	132
	2	44	41	85	
	3	9	5	14	
	4	2	2	4	
6-10 cm.	1	8	8	16	90
	2	16	24	40	
	3	11	13	24	
	4	3	7	10	
					340

FIG. 5.—Distribution of the malignant lesions in the 340 cases in which the operation of anterior resection was applied. Palliative operations are omitted. The number at each stated distance from the pectinate (dentate) line is given in the figure. The incidence of each grade with and without nodal involvement is also included.

Pathologic character and location of lesions.—The lesions in the 426 cases were all adenocarcinomas. Figure 5 shows the distribution by grade and nodal involvement for each 5 cm. segment in the region under consideration. The specimens were not cleared but were examined by multiple incisions in the search for lymph nodes. All of the lesions were segregated according to Dukes's classification and graded by Broders' method. Few lesions of type A were found in the series. The majority of the lesions removed by anterior resection were perforating, since the rectum is so thin that all layers are usually involved before detection. Twenty lesions (5.9 per cent) were of the mucous (colloid) type. Five were described as papillary. Multiple synchronous malignant lesions were found in 18 cases (5.3 per cent). Gross venous or perineural involvement, which invariably gives a poor prognosis, was noted in seven cases.

The lesions were separated into groups depending on their distance

from the pectinate line (Fig. 5). This was done in order to learn if there was a difference between the survival rates of patients having lesions at various levels in the bowel, for if the operation of anterior resection is not sufficiently radical the survival rate of those having the lowest lesions would certainly be less than that of those found to have lesions above the pelvic peritoneal fold.

Resectability, indications and limitations of the method.—The examination of any large series of cases in which there are lesions in this zone shows that 12 to 14 per cent of the patients have gross hepatic, peritoneal or omental involvement and that only palliative colostomy is justifiable. In the series being reported resection was undertaken even when the palpable hepatic nodules aggregated less than 3 cm. in diameter.

The resectability of the lesions by the method of anterior resection depends on the level of the lesion. For lesions more than 10 cm. from the dentate line the resectability rate was 86 per cent. All resectable lesions at this level were removed by anterior resection. If the lesion was perforating, a part of the abdominal wall or psoas muscles was excised by cautery as necessary. Involvement of the bladder, ureters or small intestine did not prevent resection. For lesions at 10 cm. from the dentate line the resectability rate was 80 per cent and for those at 8 cm. it was 44 per cent. This is the lowest level of general applicability of the operation. At 6 cm. there must be favorable anatomic relations—a thin person with a broad, flat pelvis. It is my opinion that low anterior resection is applicable only rarely when the lesion is situated as low as 6 cm. from the dentate line. There are several alternative methods for handling such lesions. In this region one approaches the point where the allowable 3 cm. of retrograde spread and lateral direct extension involve the lateral efferent lymphatics accompanying the middle hemorrhoidal vessels. Such lesions must be resected by a method which in addition to removing the spread in the pelvic mesocolon allows for resection of (1) the stalks of the middle hemorrhoidal vessels, (2) levator ani muscle with the nodes included between it and the pelvic fascia, (3) the ischiorectal fat and (4) a large part of the perianal skin. One must not apply the pessimistic aphorism that if the lymphatics or veins are involved no operation is radical enough and that if there is no spread of the disease most operations for cancer are too radical.

HOSPITAL MORTALITY RATE FOLLOWING ANTERIOR RESECTION

In the 426 cases of anterior resection of lesions between 6 and 20 cm. from the dentate line there were 25 deaths (5.9 per cent). Eighteen of the deaths occurred after the first stage of the operation, the anterior resection, and seven followed closure of the colonic stoma. Seven of the 18 deaths after anterior resection followed peritonitis, two followed pelvic abscess, and each of the following was responsible for a death: coronary occlusion, pulmonary embolus, diabetic acidosis and bronchopneumonia. Of the seven deaths following closure of a colonic stoma, four resulted from peritonitis,

two from pulmonary embolus and one from coronary occlusion. Five of the seven deaths occurred before antibiotics and sulfonamides were employed preoperatively and postoperatively.

The mortality rate from colonic operations has fallen remarkably with the years. For all operations on the colon at the Mayo Clinic in 1934 the mortality rate was 16 per cent. For some reason the rate increased in 1936 and was 22 per cent but during the past four years it has been less than 5 per cent. I attribute a large part of the success in reducing the mortality rate to the use of sulfonamides. Inspection of the figures broken down, to reveal the rates for the sigmoid, rectosigmoid and rectum, will further demonstrate this. From 1907 to 1936 the mortality rates remained nearly constant and those figures are grouped together. The startling improvement

TABLE I.—*Anterior resection* 1930-1947: *hospital deaths by periods*

Date	Cases	Deaths	
		Number	Per cent
1930-1935	47	4	8.5
1936-1940	109	14	12.8
1941-1947	270	7	2.6
All years	426	25	5.9

TABLE II.—*Anterior resection; nonpalliative operations; five-year survival rates for different levels*

Distance from dentate line, cm.	All cases		Nodes not involved		Nodes involved	
	Number	Per cent survival	Cases	Per cent survival	Cases	Per cent survival
6-10	74	63.7	32	72.4	42	57.1
11-15	97	70.2	58	78.8	39	57.7
16-20	101	66.9	60	71.5	41	60.4
All levels	272	67.7	150	74.0	122	58.5

has occurred in the resection of sigmoidal lesions. The mortality rate following sigmoidal resection is 8.2 per cent of what it was ten years ago while that of the rectosigmoid is 15 per cent, and of the rectum, 41 per cent of what it was ten years ago. Resection of the rectum which used to be the safest has been improved the least and now operation in that region is carried out with the least safety. The majority of operations for lesions in this segment are combined abdominoperineal procedures. The improvement in rectal surgery occurred at the time of the introduction of the intraperitoneal vaccine and systemic and intraperitoneal administration of sulfonamides. There was no additional improvement from the use of sulfasuxidine. On the other hand, with lesions occurring above the pelvic peritoneal fold, there was a further marked improvement after the introduction of sulfasuxidine. The improved results cannot alone be attributed to vitamins, intravenously administered amino acids, multiple blood transfusions or aseptic anastomosis, since these adjuvants were rarely used in this series of cases.

Table I shows the mortality rates for the operation of anterior resection for three periods. During the years 1936 to 1940 more tissue was excised at the operations than previously and the mortality rate was 12.8 per cent. This mortality rate compares favorably with that for other operations in the same region at the same period. However, in the past seven years, the mortality rate has been reduced to 2.6 per cent.

SURVIVAL RATES

In 272 cases the operation was performed sufficiently long ago to provide data for calculating survival rates. Figure 6 shows graphically the survival rate in the 272 cases. After five years 67.7 per cent of the patients were alive; 49.8 per cent were alive after ten years. By the method of calculating survival rates it is impossible to prolong the curve beyond the last death recorded in the series.

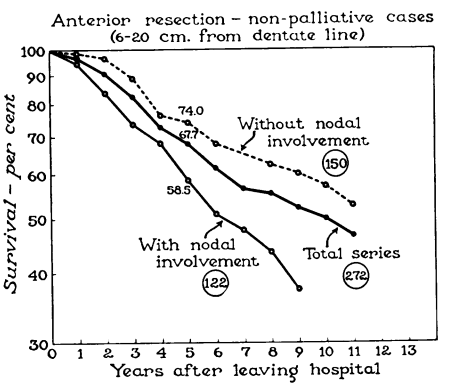


FIG. 6.—Survival rates of 272 cases in which the operation of anterior resection was performed. Palliative operations are omitted. The poorer prognosis in the 122 cases in which the lymph nodes were involved is demonstrated. The five-year survival rates are indicated.

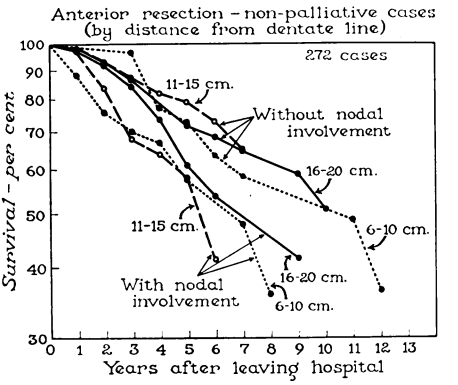


FIG. 7.—Survival rates of the same 272 cases as are included in figure 6. In figure 7, however, the rates are given for the different segments of the rectum and sigmoid in order to show that the operation of anterior resection applied to the upper half of the rectum is not attended by a greater degree of recurrence.

Table II gives the five-year survivals for each level in cases with and without nodal involvement. The best results were obtained from the removal of lesions occurring 11 to 15 cm. from the dentate line. It was hoped to show the effect of the grade of the lesion by breaking down this table but the numbers were too small to be statistically significant. Worthy of mention however are two cases in which the lesion was of grade 4, type C (Dukes). The patients are still alive six years after the resection. The first patient on whom the operation was performed in 1930 is still alive. Figure 7 shows graphically the survival rates for cases with and without nodal involvement divided according to incidence at each level in the bowel. Here again it was necessary to discontinue the curve at the last death in the series.

In 20 of the cases the lesion was of the mucous (colloid) type of adenocarcinoma; 18 patients were dead within three years. One patient lived five years; the other survivor lived nine years. It seems that the mucous type of lesion is rarely amenable to cure by resection. A similar poor prognosis was noted for those cases in which the lesion was of the papillary type, for none of the five patients lived for three years.

In eight cases an asynchronous primary malignant lesion was subsequently removed; in five of these cases the lesions were in the colon and in three they were in the breast. Of the 85 patients who survived operation but died subsequently, the cause of death, according to available data, was obtained either at death, on a return visit to the clinic or from an adequate report from the local physician who was present at the death. In 15 cases there was local recurrence of the disease. In four carcinomatosis was present and in four, intestinal obstruction was responsible for the death. In 20 cases the liver was involved but there was no evidence of local recurrence. Metastasis to the bone was observed in five cases, to the liver and bone in two, and to the lung and bone in two. In 11, the death was from some other cause: cardiac in four, cerebral hemorrhage in three, pneumonia in two, and from an accident in two. The cause of death was not definitely determined in six cases.

Stricture at the site of anastomosis occurred in five cases. This condition was managed by manual dilation in two cases. In two cases exploration was carried out; one required reperformance of colostomy six months after a stoma had been closed. This patient subsequently refused laparotomy to repair the stricture and still depends on the stoma for adequate elimination.

SPHINCTERAL CONTROL AND SEXUAL FUNCTION

No change in sphincteral control was observed in any of the cases. In fact, many patients who formerly complained of constipation stated that their intestinal habit had improved.

Although a survey was not made of the sexual function in cases after operation there seemed to be no complaint, other than that eight male patients volunteered that while erection occurred as before there was no emission during ejaculation. In all of these eight cases the lesion was low in the bowel and extensive and it is probable that the seminal vesicles or ducts were detached in the course of the dissection.

RELATIONSHIP OF ANTERIOR RESECTION TO OTHER PROCEDURES

When it was found at the exploratory operation that the lesion was too low in the bowel to be removed by anterior resection, colostomy was performed and the lesion removed by posterior resection two to three weeks later, with the patient in prone position. If the patient is in good condition or if there is nodal involvement a single-barreled sigmoidal stoma is provided by bringing the bowel out through a stab wound, the superior hemorrhoidal vessels are ligated and the sutured stump of rectosigmoid is left free in the abdomen.

The blood supply from the middle and inferior hemorrhoidal vessels is adequate to sustain the normal intestine but when posterior resection is carried out approximately two weeks after colostomy it is observed that the lesion has undergone degenerative changes and its vessels are thrombosed. If the patient presents a poor risk, double-barreled sigmoidal colostomy is as much as should be attempted at the time of the exploratory procedure. In such circumstances, at perineal resection, one can ligate the vessels and transect the intestine well up in the abdomen. One does not attempt to remove the rectum as a tube but takes out all of the perirectal tissue en bloc, dissecting along the membranous urethra and prostatic capsule, or vaginal wall, as the case may be. The coccyx is removed and the levator ani muscle with its investing fascia and nodes is resected. No procedure really eliminates the lateral spread to the hypogastric nodes but one carries out the most radical excision that is possible.

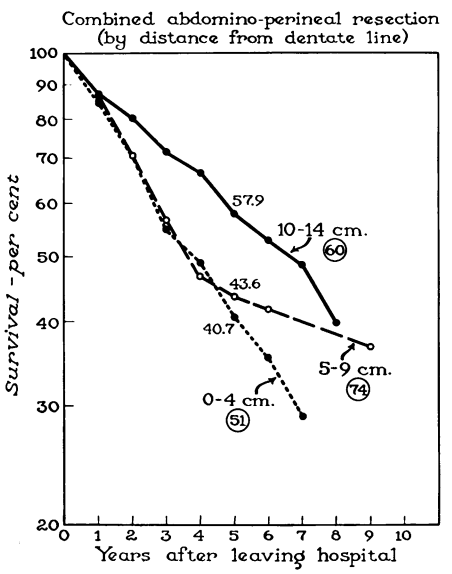


FIG. 8.—Survival rates in 185 cases in which the Miles combined abdominoperineal resection was applied. The incidence in the various segments is given and the curves show the poorer prognosis after resection of lesions of the lower half of the rectum. The five-year survival rate for each segment is indicated.

When performed in the classic fashion[9] the one-stage combined abdominoperineal resection leaves little room for improvement. However, in practice, a poor resection is common in the region of the lesion, while the resection of the pelvic mesocolon is excellent. After spending the major part of the time eliminating the distal spread of the disease the surgeon may merely cone out the rectum itself, ignoring the local lateral efferent lymphatics. A radical abdominal operation and a radical perineal resection are often more than the average patient can withstand at one time.

To evaluate this contention I have selected a group of cases in which one-stage combined abdominoperineal resection was carried out during the same time interval as the anterior resections were performed and have divided the cases according to the distance between the lesion and the dentate line (Fig. 8). The series are not strictly comparable with one another but the differences in survivals for the same operation at different levels are comparable. The five-year survival rate for the patients having the lowest lesions, 0 to 4 cm., was 40.7 per cent; for lesions 5 to 9 cm. from the dentate line it was 43.6 per cent, and for those 10 to 14 cm. from the dentate line,

57.9 per cent. The survival rates in cases in which the lesions were below the pelvic peritoneal fold and in which the combined abdominoperineal resection was employed, are distinctly poorer than those in cases in which the lesion was above the pelvic peritoneal fold. The added incidence of lesions in the lower segment with nodal involvement is not sufficient to account for the difference.

To complete the picture, Figure 9 shows the survival rates in 475 cases of posterior resection performed in the same interval, 1930 to 1944 inclusive. It will be remembered that this operation was carried out when the lesion was too low for anterior resection. Therefore, it includes the most extensive lesions at 6 to 8 cm. from the dentate line in addition to all of the lesions below 6 cm. that were encountered in the series. Thus, the group of anterior resections plus this one of posterior resection corresponds roughly to the group of combined abdominoperineal resections.

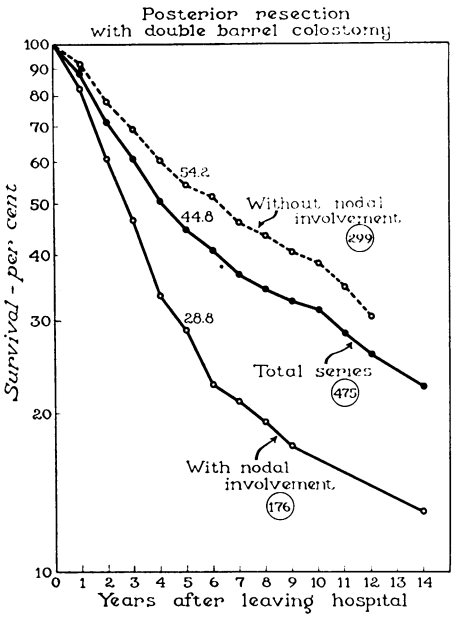


FIG. 9.—Survival rates in 475 cases in which a radical posterior resection was performed. This figure is a complement to figure 7, for these are the cases in which the lesion was too low for performance of the operation of anterior resection. This figure includes the lesions in the distal 6 cm. of rectum plus those occurring up to 10 cm. from the dentate line, in which the lesion was too extensive for anterior resection. The curves show that resection of lesions of the terminal portion of the rectum is attended by a poorer prognosis and that nodal involvement in this region is of graver significance than in cases in which anterior resection could be performed.

The five-year survival rate in the series of cases of posterior resection was 44.8 per cent. This operation is considered inadequate by many authors. Yet, when properly carried out, it is much more radical locally than combined abdominoperineal resection and can be as radical along the pelvic mesocolon. The corresponding five year survival rates for the combined operation were, as stated previously, 40.7 per cent for lesions 0 to 4 cm. and 43.6 per cent for lesions 5 to 9 cm. from the dentate line. Figure 9 also gives the survival rates for posterior resection, divided according to lesions with and without nodal involvement. The five-year survival rate of 28.8 per cent for cases in which there was nodal involvement as compared with 54.2 per cent for those without nodal involvement shows how much poorer the prognosis is in the presence of lesions of type C (Dukes) in the low rectal region. Carcinoma in this region occupies a very strategic position,

straddling the anastomosis between the portal and systemic venous systems. In addition the spread that takes place along the lateral efferent lymphatics accompanying middle and inferior hemorrhoidal vessels, along the sacral and internal iliac nodes and along the base of the broad ligaments in the female, makes attempts to extirpate the lesion discouraging indeed. In practice, resection of the node-bearing tissue between the pelvic fascia and pelvic peritoneum is usually inadequate. The operation of abdominoperineal proctosigmoidectomy is deficient in these respects and also fails to excise sufficient perianal tissue.

SUMMARY

Anterior resection for removal of carcinomas of the upper part of the rectum and lower part of the sigmoid was performed in 426 cases from 1930 through 1947. While there is a slight predominance of males in the series, the female patients tend to be younger and their lesions tend to be of higher grade and closer to the dentate line. There were 25 deaths among the 426 cases, giving a mortality rate of 5.9 per cent. In 270 resections since the present method of preoperative and postoperative management has been used there were 7 deaths (2.6 per cent). Of 272 patients, the five-year survival rate was 67.7 per cent. Comparisons of the mortality and survival rates according to the location of the lesions in various segments of the bowel revealed that the operation is sufficiently safe and radical for lesions of the upper half of the rectum. In cases of adenocarcinoma of the mucous (colloid) and papillary types the prognosis is poorer. The signal improvement in the operative mortality rate in colonic surgery in the past ten years has not been as marked for lesions in the rectum as immediately above that region. Whereas, ten years ago operations for rectal lesions were safest, this no longer is true. The survival rate after resection of low rectal lesions is poorer than that following resection of lesions higher in the bowel. This results from the increase of nodal involvement and greater difficulty in resecting the region of spread. The lesions covered by this study are considered in terms of their distance from the dentate line because of the foregoing consideration and because the possibility of saving the sphincter is determined by this distance.

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