EXPERIENCES WITH THE SURGICAL MANAGEMENT OF DIVERTICULITIS OF THE SIGMOID*

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A SURVEY of the literature and of experiences with the management of diverticulitis of the colon at the Massachusetts General Hospital during the past 15 years indicates that this is a comparatively rare disease. It is the result of inflammation in and about outpocketings from the bowel. These most frequently appear to consist of mucosal pouches which protrude through the muscularis, presumably the result of pressure from within, probably acting in conjunction with some congenital defect in the muscular layer (Mayo, Wilson, and Griffin [1907]). This condition, known as diverticulosis, is rare, for Rankin and Brown (1930) found evidence of it in 0.3 per cent of 765,795 patients subjected to roentgenologic examination. Time is apparently an important factor, for if the age of the patient is taken into consideration, it would appear that approximately 5 per cent of people who are age 40 or over will have diverticulosis (Brown [1939]). It is not surprising, therefore, to find that diverticulitis is rare in the younger age-groups. It begins to make its appearance in the fourth decade of life and is maximal in the sixth (Table I). It is also apparent that males are affected more commonly than

TABLE I

DIVERTICULITIS

Age	No. of Cases*
20-29	1
30-39	24
40-49	86
50-59	131
60-69	105
70-79	19
80-89	3
Total	369

* Graham (1937), Brown (1939), Eggers (1941), and M. G. H. (1942).

females, the ratio being 1.6 to 1. This is particularly apparent in those patients who develop spontaneous bladder fistulae, where the ratio of males to females increases to 8.5 to 1 (Table VI).

The distribution of diverticula in the colon is of interest, as this has a bearing upon surgical complications. It is apparent that the sigmoid is involved more frequently than any other segment of the large bowel and the rectum least frequently. The sigmoid contains diverticula in 75 per cent of cases,† and the rectum in 2.4 per cent. Between the sigmoid and the cecum,

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† Spriggs and Marxer (1927), and Brown and Marcley (1937).

the incidence of diverticula in the various segments of the colon decreases steadily. All segments of the bowel are occasionally involved (14.4 per cent). One might, therefore, expect that, on the law of chances, surgical complications would occur most frequently in the sigmoid. This appears to be the case, in fact, they rarely occur in any other segment. During the 15-year period, in which the 64 cases included in this report were operated upon for diverticulitis of the sigmoid, there were only two other cases subjected to surgery for complications of diverticula in other portions of the colon. One involved the cecum, and the other the ascending colon. In the latter instance, actinomycosis was also present. D. F. Jones (1930) stated that he had seen but one surgical complication of diverticulosis above the upper end of the sigmoid and that was in the cecum. This indicates that other factors which affect the sigmoid in particular, such as a narrow lumen, stasis, and solid fecal material may be important.

The sigmoid is also the most frequent site of carcinoma of the colon. Allen and Welch (1939) found that in a series of 634 carcinomata of the large bowel, not including the rectum, the lesion was situated in the sigmoid in 53.9 per cent. This probably is the reason why there is an association between diverticulitis and cancer, rather than that the former favors the occurrence of the latter. This appears to be the conclusion of most who have commented upon this matter in the more recent literature, Abel (1935), Brown and Marcley (1937). Certain statistical data also supports this viewpoint, as Rankin and Brown (1930) found diverticula associated with cancer in only four of 679 carcinomata of the bowel, an incidence of 0.6 per cent, and cancer associated with diverticulitis in four of 227 cases, an incidence of 1.8 per cent. The latter figure is lower than that reported by Eggers (1941), who found the incidence to be 6.1 per cent. On the other hand, this figure was less than the incidence of carcinoma of the sigmoid detected in a series of 428 consecutive barium enemata, which Eggers (1941) found to be 7.2 per cent. In this same series of roentgenologic examinations, the incidence of diverticulitis was 4.2 per cent.

The differential diagnosis between diverticulitis and cancer has been a topic for some discussion, particularly with regard to bleeding as a symptom and the value of roentgenograms as a diagnostic aid. Considerable evidence is available upon the former question, and indicates that a history of bleeding was present in 15.7 per cent of 568 patients* known to have diverticulitis. Of 309 cases† known to have diverticulitis in which the incidence of cancer and bleeding were both recorded, the incidence of cancer was 2.9 per cent, and of bleeding 16.5 per cent. With regard to the value of the roentgen ray in differentiating between the two lesions, Schatzki (1940) stated that the differential diagnosis is easy in most, difficult in some, and impossible in a few cases. Because of the fact that the symptoms, the signs, the age of the patient, the area

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* Judd and Pollock (1924), Spriggs and Marxer (1927), Rankin and Brown (1930), Ochsner and Bargen (1935), Eggers (1941), and M. G. H. (1942).

† Rankin and Brown (1930), and Eggers (1941).

of the bowel involved, the roentgenologic findings, and the gross appearance of the lesion at operation may be quite similar, it seems clear that excision of the involved segment of the bowel is the only certain answer to this question. This was the reason for resection of the sigmoid in eight (24.2 per cent) of the 33 cases included in this report. No case in which cancer and diverticulitis were associated in the same segment of the bowel is included in this series. In one case, a small, low, nonobstructing carcinoma of the rectum was present, and is included because it was felt that it had no obvious connection with the perforated sigmoid with abscess formation. Benign polypi were found in two of the 33 resected specimens.

The question arises as to how frequently patients with diverticulosis of the sigmoid develop diverticulitis. Some statistical data bearing upon this point indicates that roentgenologic evidence of diverticulitis was present in 25.1 per cent of 2,400 cases* having diverticulosis. Brown (1939) believes that as many patients with diverticulosis probably have mild attacks of diverticulitis and are not roentgenographed, that a more likely estimate would be 10 per cent. It is likewise impossible to estimate accurately the number of patients with diverticulitis who require surgical intervention. From reports in the literature dealing with both the medical and surgical management of this lesion, it was found that 28.5 per cent of 1,332 cases† coming under observation were operated upon for one reason or another. Here again, this figure is probably too high and it would seem more likely that about 10 per cent of all cases of diverticulitis require operation. This is in keeping with the experiences of Brown and Marcley (1937) with the medical management of this disease, in which they state that the results were found to be satisfactory in 63 per cent of their cases and adequate in three-quarters of the remaining 37 per cent, which implies an unmanageable situation in 9.3 per cent of patients with diverticulitis. During the 15-year period which this report covers, our own experience indicates that of all patients hospitalized for diverticulitis, 64 (19.2 per cent) were treated surgically and 269 (80.8 per cent) were treated medically. Undoubtedly, there were many more cases treated medically without hospitalization. To summarize this matter briefly, it would appear that about 5 per cent of people over 40 years of age have diverticulosis. Graham (1937) has estimated that this means about 12 in 250 patients over 40 will have diverticulosis and one in 250 will have diverticulitis. If we assume that one in ten cases with diverticulitis will require operation, this means that a surgical problem will arise in approximately one in 2,500 people over 40 years of age. It is apparent that the experience of most surgeons with this disease cannot be great, and it is not surprising that the literature dealing with the results of various operations is not extensive.

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* Rankin and Brown (1930), and Brown and Marcley (1937).

† Spriggs and Marxer (1937), Rankin and Brown (1930), Brown and Marcley (1937), Stetten and Abeloff (1938), Lockhart-Mummery (1938), Eggers (1941), and M. G. H. (1942).

TABLE II

MANIFESTATIONS OF DIVERTICULITIS*

	No. of Cases	Perforation	Per Cent
(a) Incidence acute perforation............................	545	73	13.4
(b) Incidence abscess....................................	506	60	11.9
(c) Spontaneous bladder fistula...........................	611	80	13.1
			38.4
(d) Various other lesions Acute Subacute | nonperforated....................... Recurrent Chronic			61.6
			100.0

* Judd and Pollock (1924), Rankin and Brown (1930), Graham (1937), Brown and Marcley (1937), Lockhart-Mummery (1938), Brown (1939), Eggers (1941), and M. G. H. (1942).

It is apparent (Table II) that nearly 40 per cent of the patients who come to operation for diverticulitis have either an acute perforation, an abscess, or a spontaneous bladder fistula. The incidence of these three complications appears to be about the same. An occasional case may have fistulae into other intestinal loops. About 60 per cent are operated upon for various other lesions, largely nonperforated or not obviously perforated. In many instances, the preoperative diagnosis is incorrect, and was so in 29 (45.3 per cent) of our 64 cases. Appendicitis, intestinal obstruction, carcinoma, and pelvic tumors were the more common mistakes. It is of interest that the symptoms in the majority of 156 cases* were of short duration, less than a month in 25 per cent, less than a year in 66.6 per cent, and less than five years in 91 per cent. This has been emphasized by Brown (1939). In our series, it was found that the first attack was severe and required operation in 48 per cent of the cases. The implication is that in cases which come to operation the disease is unusually severe or persistent.

TABLE III

MORTALITY STATISTICS*

	No. of Cases	Deaths	Per Cent
(a) Acute perforation—principally drainage ±suture...........	42	10	23.7
(b) Abscesses—incision and drainage.......................	43	4	9.3
(c) Bladder fistula—various operations......................	53	10	18.9
(d) Various lesions—various operations not including resection but including colostomy................................	173	17	9.8
(e) Various lesions—resection of sigmoid—all technics..........	181	31	17.1†

* Graham (1937), Brown and Marcley (1937), Lockhart-Mummery (1938), Brown (1939), Eggers (1941), and M. G. H. (1942).

† Mortality of various types of resection (25.0–6.1 per cent).

The immediate mortality is variable (Table III) and depends upon the nature of the lesion and the type of operation performed. It was 23.7 per cent for acute perforations, 9.3 per cent for abscesses, and 18.9 per cent for bladder fistulae. The mortality for various operations including colostomy, appendicectomy, exploratory celiotomy, cecostomy, and miscellaneous maneuvers for various lesions was 9.8 per cent. The mortality for resection by all technics for various lesions was 17.1 per cent. This has been emphasized by

* Total of Brown (1939), and M. G. H. (1942).

Laufman (1941). The mortality for resections by certain technics (Table IV) varied, and was 11.5 per cent for Mikulicz resections, 17.3 per cent for resection with anastomosis following preliminary colostomy, 20 per cent for obstructive resections, and 26.3 per cent for one-stage resection with anastomosis.

TABLE IV

RESECTION BY CERTAIN TECHNICS*

Technics	No. of Cases	Deaths	Mortality
(1) Mikulicz resection. Later close colostomy................	61	7	11.5%
(2) Preliminary colostomy. Subsequent resection, with anastomosis. Later close colostomy...........................	52	9	17.3%
(3) Obstructive resection. Later close colostomy.............	20	4	20.0%
(4) One-stage resection. With anastomosis..................	19	5	26.3%
Total...	152	25	16.4%

* Brown and Marcley (1937), Brown (1939), and M. G. H. (1942).

TABLE V

LATE RESULTS—VARIOUS LESIONS

	No. of Cases	Living and Well	Living, Not Well	Subsequent Death from Disease	Subsequent Death Other Cause	Unknown
(a) Various operations other than colostomy or resection*.................	98	45 (45.9%)	33 (33.7%)	8 (8.2%)	8 (8.2%)	4 (4%)
(b) Colostomy*.............	78	49 (62.8%)	12 (15.3%)	7 (9%)	8 (10.2%)	2 (2.6%)
(c) Close colostomy*........	36	19 (52.8%)	14 (38.9%)	3 (8.3%)	..	..
(d) Resections†.............	109	83 (76.1%)	8 (7.4%)	4 (3.7%)	8 (7.4%)	6 (5.4%)

* Brown and Marcley (1937), Lockhart-Mummery (1938), Brown (1939), Eggers (1941), and M. G. H. (1942).
† Lockhart-Mummery (1938), Brown (1939), and M. G. H. (1942).

The late results (Table V) and mortality following various operations, such as exploratory celiotomy, appendicectomy, with or without drainage, and miscellaneous operations, not including colostomy or resection for various lesions, including patients surviving suture and drainage of acute perforations and drainage of abscesses, have been collected from the literature in 98 cases. Of these, 45.9 per cent are living and well, and 33.7 per cent living and not well. The late results of proximal colostomy are given for 78 cases, of which 62.8 per cent are living and well, and 15.3 per cent living and not well. These results appear to be better as far as relief of symptoms are concerned, but the late mortality of the disease was not significantly altered being 8 to 9 per cent in each group. It is of interest to note that colostomies were closed in 36 cases. This was unsuccessful in 47.2 per cent of cases. The late results of resections of the sigmoid indicate that this is a more effective form of treatment. Of 109 cases, 76.1 per cent were well, 7.4 per cent not well, and the late mortality from the disease was 3.7 per cent.

One of the more distressing complications is the bladder fistula (Table VI). This occurs primarily in males and has already been commented upon. Certain operations, particularly direct attempts to close the fistula have not met with much success. Colostomy has been helpful, resection appears to be more effective.

TABLE VI

BLADDER FISTULA

	No. of Cases	Males	Females
(a) Sex incidence			
Brown (1939).............................	30	27	3
M. G. H. (1942).........................	8	7	1*
	—	—	—
	38	34	4
		or 8.5	1
(b) Sex incidence diverticulitis†..................	535	333	202
		or 1.6	1

	No. of Cases	Living and Well	Not Well	Subsequent Death from Disease
(c) Late results miscellaneous operations				
Brown (1939).............................	10	0	6	4
M. G. H. (1942).........................	1	0	1	0
	—	—	-	-
	11‡	0	7	4
(d) Late results proximal colostomy				
Brown (1939).............................	1	1	-	-
M. G. H. (1942).........................	4	1	2	1
	—	—	-	-
	5	2	2	1
(e) Late results resection sigmoid				
Brown (1939).............................	12	12	-	-
M. G. H. (1942).........................	3	3	-	-
	—	—	-	-
	15	15	0	0

*Previous total hysterectomy

†Judd and Pollock (1924), Stetten and Abslot (1938), Lockhart-Mummery (1938), Brown (1939), and M. G. H. (1942).

‡Close fistula five cases

The immediate and late results of all operations, excepting resection, which were performed in 42 cases of diverticulitis are summarized in Table VII. There were four cases with acute perforation, nine with abscesses, three with bladder fistulae, and five with acute diverticulitis and early peritonitis, simulating appendicitis. The remaining 21 cases had various lesions which were less acute to chronic in nature. A mass was present in all at operation. These were nonperforated or not obviously perforated lesions. Large bowel obstruction was present in five. There were two deaths (4.8 per cent), both from general peritonitis, one following drainage of an abscess, and one following suture and drainage of an acute perforation. There were 13 immediate complications. Seven cases developed fecal fistulae, two general peritonitis, in one, a bladder fistula recurred six days after closure. One case developed major wound sepsis with separation, and one developed small intestinal obstruction.

The late result is known in the 40 surviving cases. Sixteen (40 per cent) are classed as well. Of these, six had proximal colostomies, and one, an enteroenterostomy between the transverse colon and the sigmoid distal to the lesion. The colostomy was closed in two cases. The symptoms recurred in both. No further surgery has as yet been necessary. Of the remaining nine cases in this group, three have subsequently died of other causes, two years eight

Excepting Resection—Arranged According to the Lesion

			Immediate Result				Late Result		
Lesion	No. of Cases	Operation	Compli-cations	Deaths		No. of Cases	Living and Well*	Not Well†	Subse-quent Death —Dis-ease
Acute perforation......	4	Suture and drain	2	1		3	2	1	–
Abscess..............	9	I. and D.	6	1		8	2	5	1
Bladder fistula........	3	Prox. col. (2) Close fist. (1)	1	0		3	1	1	1
Acute diverticulitis.....	5	Append. with drain (4)	3	0		5	1	4	0
Acute Subacute Chronic } All with mass	2	Exp. celiotomy Colos.	0	0		2	0	2	0
	4	Exp. celiotomy Biopsy Exc. T and O. Enter'ty	0	0		4	2	2	0
	7	Exp. celiotomy Colos.	1	0		7	5	1	1
	3	Exp. celiotomy Cecostomy	0	0		3	1	1	1
	5	Cecostomy Obstructed	0	0		5	2	2	1
	42		13 (30.9%)	2 (4.8%)		40	16 (40%)	19 (47.5%)	5 (12.5%)

* Two subsequent deaths, unrelated cause.
† One subsequent death, cause unknown.

months; 5 years seven months; and seven years two months after operation. Six are living and well, from seven months to 14 years after operation.

Nineteen cases (47.5 per cent) were classed as not well. Of these, 15 (78.9 per cent) have required further operation either for persistent symptoms or disease or for recurrent disease. In 11, resection was necessary. Three cases are living from two years six months to five years after operation, with persistent symptoms or recurrent attacks for which no further surgery has as yet been necessary. One patient died one year 11 months following proximal colostomy for bladder fistula. Until then his urinary tract infection persisted. The exact cause of death is not known.

Five cases (12.5 per cent) subsequently died of their disease. In one case, a bladder fistula, multiple operations were performed, including a terminal ileostomy. The patient eventually died of urinary tract sepsis and uremia, seven years six months after onset. One case died two years after cecostomy of a recurrence of his disease, further surgery being performed elsewhere. One case died elsewhere, six months after proximal colostomy of persistent sepsis. Two patients did well for six years and eight years six months after operation, and then died of recurrent disease. In one, a further operation for drainage of a recurrent abscess was performed, and death was due to general peritonitis.

A study of these results indicates that the outlook for patients with severe forms of diverticulitis is not very bright. The majority have not done well.

The sigmoid was resected in 33 cases. Eleven had had previous operations as described in Table VII. This makes the total series 64 cases. The immediate and late results are given in Table VIII. Six cases which were followed for less than one year were eliminated from the tabulation of late results. The average follow-up for the remaining 25 cases was four years six months. Fifteen cases have been followed for from one to five years, and nine for from five to ten years. The result in one case operated upon six years six months ago is unknown.

TABLE VIII

RESECTION SIGMOID (M. G. H. 1942)—33 CASES

Arranged According to the Lesion

	Immediate Result			Late Result (1–10 Yrs.)				
Lesion	No. of Cases	Compli-cations	Deaths	No. of Cases	Living and Well*	Not Well	Subsequent Death— Disease	Un-known
Recurrent diver'tis, with mass	9	3	0	8	7	1	0	0
Recurrent diver'tis, without mass, with thickened mesentery	3	0	0	3	1	2	0	0
Chronic diver'tis, with mass, ? ca	8	5	2	5	4	0	0	1
Bladder fistula	4	2	0	3	3	0	0	0
Persistent ext. fistula	4	1	0	2	2	0	0	0
Acute diver'tis, with mass	2	0	0	2	2	0	0	0
Acute diver'tis, with abscess	2	0	0	1	1	0	0	0
Subacute and chronic diver'tis, with persistent obs	1	0	0	1	1	0	0	0
	33	11 (33.3%)	2 (6.1%)	25	21 (84%)	3 (12%)	0 (0%)	1 (4%)

* Two subsequent deaths, unrelated cause.

Twelve cases were resected because of recurrent attacks of diverticulitis, eight because of chronic diverticulitis with a mass simulating carcinoma, eight because of persistent fistulae, four had acute lesions with an associated abscess in two instances, and one case had persistent obstruction due to a fibrostenosing lesion.

There were two deaths, a mortality of 6.1 per cent. There were 11 complications (33.3 per cent). Of the 25 cases included in the tabulation of late results, 21 (84 per cent) are classed as well, three (12 per cent) as not well. There have been no subsequent deaths from the disease. The result in one case is unknown. Of the 21 cases classed as well, two have subsequently died of other causes, one of a cardiac lesion four years six months later and the other committed suicide one year after operation. Until then there were no difficulties due to diverticulitis, although it appears that the many operations which had been performed upon the patient who committed suicide probably contributed to his depressed state of mind. On the whole, the results in this group of resections are encouraging, and the impression gathered from a study of these cases suggests that this form of treatment appears to offer the patient

suffering from a severe form of diverticulitis the greatest hope for relief and appears to lessen the subsequent mortality from the disease.

TABLE IX

RESECTION OF SIGMOID—EARLY RESULTS

(1) *Exteriorizing Operations—15 Cases*
Immediate Complications

Technic	No. of Cases	Number	Nature	Deaths		
(a) Proximal loop only. Anterior resection with closure distal stump. Drainage 2, No drainage 2, Proximal colostomy 2, Primary resection 2..................	4	4	Gen'l perit'tis, retroperitoneal sepsis, 2 Fecal fistula, small bowel obs., 1 Gangrene colostomy, small bowel obs., 1	2 0 0	No. of Cases 4 C 4 100%	D 2 50%
(b) Both loops. Mikulicz 10, loops separated 1. Primary resection 9 (Alone 4, with cecostomy 5), preliminary cecostomy or colostomy 2......	11	3	Small bowel obs., 3	0	No. of Cases 11 C 3 27.3%	D 0 0%
	15	7 (46.7%)		2 (13.3%)		

(2) *Resection with Immediate Anastomosis—18 Cases*

	No. of Cases	Number	Nature	Deaths		
(a) Aseptic end-to-end anastomosis. Prel. cecostomy 3, accompanying cec'my 3.....................	6	2	Serious leakage suture line, abscess, ext. fistulae, 2	0	No. of Cases 6 C 2 33.3%	D 0 0%
(b) Preliminary transverse colostomy. Aseptic end-to end 6, aseptic lateral 1...............	7	1	Leakage suture line, local abscess, 1	0	No. of Cases 12	
(c) Preliminary transverse colostomy. Open end-to-end.......	5	1	Leakage suture line, local abscess, 1	0	C 2 16.7%	D 0 0%
	18	4 (22.2%)		0 (0%)		
Total for all groups..........	33	11 (33.3%)		2 (6.1%)		

An attempt has been made to determine what factors play a rôle in the immediate mortality, the immediate complications, and why the late results in certain cases were not satisfactory. First of all, it would appear that the technic of resection is a factor. Data bearing upon this point are presented in Table IX. In this, the cases are divided according to the technic employed. Fifteen exteriorizing procedures are contrasted with 18 resections with immediate anastomosis. All the deaths occurred in the former group, and the complications were over twice as frequent. If, however, one divides the exteriorizing operations into two groups, it is apparent that in the first, consisting of four cases in which the proximal loop only was exteriorized and the distal loop closed, all the deaths and the majority of the complications occurred. In the second group (11 cases) in which both loops were brought out by the Mikulicz technic, with one exception, there were no deaths, but small bowel obstruction occurred in three cases. In the first group with the closed distal

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loop, fatal general peritonitis and retroperitoneal sepsis occurred in two cases. In the other two, a persistent fecal fistula leading to the distal loop and small bowel obstruction for which multiple subsequent operations have been performed occurred in one, and in the other small bowel obstruction and gangrene of the colostomy resulted, necessitating further operative procedures both immediately and later. It is also of interest that in two of the four cases in this group a preliminary proximal colostomy had been performed eight and nine months previously. In both groups, intestinal obstruction occurred. This complication appears to be characteristic of exteriorizing procedures. It is possible that infection and inadequate peritonealization are factors because this technic is often employed when resecting acute and subacutely inflamed lesions.

The 18 resections with anastomosis may be divided into two main groups, first those with preliminary or accompanying cecostomy. Two of six cases with aseptic end-to-end anastomosis developed leakage at the suture line, extensive sepsis, and abscess formation. Multiple subsequent operations necessitated long hospitalization. In both, this was a near fatal complication. It would appear that neither preliminary nor accompanying cecostomy is adequate protection for this type of anastomosis performed for an inflammatory lesion. The other group consists of 12 cases with preliminary proximal colostomy. Either aseptic or open end-to-end suture was performed in 11. There was one aseptic lateral anastomosis. The same complication occurred in two cases. Of these, one had an aseptic and the other an open end-to-end anastomosis. This indicates that leakage may follow end-to-end suture whether open or closed, whether immediate or delayed. On the other hand, when proximal colostomy preceded resection this complication was not recognized clinically, but only because postoperative roentgenograms happened to be taken. In one instance, the perforation closed in one month and in the other, it practically closed in the same period of time. This demonstrates one advantage of preliminary proximal colostomy. It would appear that the Mikulicz resection or immediate anastomosis preceded by proximal colostomy are comparable as far as low mortality and similar incidence of complications are concerned. In the former, small bowel obstruction was the problem, in the latter it was leakage at the suture line with localized abscess formation. A review of the operative notes in 18 cases with immediate anastomosis and four cases in which anterior resection was performed, indicates that the Mikulicz technic could not have been used in 12 because the lower portion of the sigmoid loop was primarily involved. There probably were others as well. As it does not appear to be possible to decide with certainty beforehand which technic will be indicated, it would seem best to advocate preliminary proximal colostomy in all cases in which resection of the sigmoid for diverticulitis is to be performed if serious complications are to be reduced to a minimum.

Other possible factors which may have a bearing upon immediate complications and late results should be considered. As judged by the length of bowel removed at operation, it would seem that less extensive resections were

performed in the group with immediate leakage at the suture line. The group living without symptoms had more extensive resections, the average difference being 4.3 cm. This impression is also gathered from a study of such postoperative roentgenograms as were available. The majority of the patients who had either leakage or who were living with symptoms had end-to-end anastomosis of which six of seven were of the aseptic type. Spasm, delay, and narrowing at the anastomosis were common findings in these groups, and were less frequent in patients living without symptoms. In the latter group, narrowing was present in two of nine cases, and spasm in one. Perhaps the most noteworthy finding was absence of delay at the anastomosis in all of the good results examined roentgenologically. Residual diverticula were usually present after operation in all groups.

The character of the bowel at the time of operation is undoubtedly a factor. A narrow lumen, a thick wall, and acute inflammation all seem important, particularly with regard to end-to-end anastomosis. It is also reasonable to believe that the mortality and immediate complications following the Mikulicz type of resection, comparatively safe as it is as a primary procedure, might be, likewise, reduced by a period of delay. If such is the case, the added time consumed would be amply justified. One of the principal reasons for performing a preliminary proximal colostomy is to allow infection to subside. The period of delay should be dependent upon the time required for this to take place.

A review of the pathologic specimens removed at operation showed that of 14 cases in which primary resections were performed acute inflammatory changes were present in 12. There was a time interval of 11 days to three weeks between cecostomy or transverse colostomy and resection in six cases. Acute diverticulitis was present in four. Seven weeks to three months elapsed between proximal colostomy and resection in four cases. Acute inflammation was present in three of these specimens. The time intervals in five cases between transverse colostomy and resection were three and one-half, five, five, five, and eight months, respectively. There was no evidence of acute inflammation in any of these. This suggests that the time interval should be not less than three months and probably need not be over six months. There was a time interval of six to ten months in four cases with persistent external or bladder fistula, between proximal colostomy and resection. Acute inflammatory changes were present in all. It seems reasonable to believe such would be the case as long as a fistula persisted. The interval in such cases would, therefore, appear to depend more upon the time it takes for such fistula to heal.

In this connection, it was found that external fistulae developed in seven of 17 cases in which drainage was employed in the management of acute perforation (three), abscesses (ten), and acute diverticulitis for which appendicectomy and drainage were performed (four). Spontaneous healing occurred in two cases in nine weeks and 11 weeks, respectively. In five cases, the fistulae persisted and were observed for five, five, 17, 19 months, and three

years, respectively. At these times, further surgical procedures were instituted, proximal colostomy followed by resection in three, proximal colostomy only in one, and excision with transverse colostomy in one. In the three cases which were resected, the time intervals between colostomy and resection were four and one-half, five, and six months, respectively. The bowel opening was patent in every case. The external fistula healed in one case (time interval six months). One other case, with a fistula of one week's duration, was resected ten months after proximal colostomy. Both openings of the fistula were still patent. In one case, with proximal colostomy only, for external fistula of three years' duration, the external opening closed promptly. The patient also had a bladder fistula which did not heal, suggesting that the bowel opening was still patent.

No evidence of spontaneous and persistent healing of bladder fistulae was found. Proximal colostomy followed by resection was performed in four cases. The duration of the fistulae at the time of colostomy was two years, six months, four and one-half months, and three months. The time intervals between colostomy and resection were two, nine, three, and nine months, respectively. The bladder opening was closed in the first and fourth, the bowel opening in the fourth only.

Proximal colostomy only was performed in four cases with bladder fistulae. In one of these a terminal ileostomy was performed. The fistulae had been present for one, 15, one, and two months, respectively. In the third case, clinical evidence indicates that the fistula healed promptly and has remained healed for seven and one-half years. In the other three, clinical evidence suggests that the fistulae remained active for 15 months, six and one-quarter years, and six and one-third years, respectively. Two of these cases are dead, the first and third. The latter is known to have died primarily of urinary tract sepsis and uremia, and the other was known to have persistent urinary tract sepsis up to the time of death.

It appears to take not less than three months of proximal decompression by colostomy for evidence of acute inflammation in resected specimens to disappear except in cases in which external or bladder fistulae persist. In these cases, acute infection was invariably present even after ten months of proximal colostomy. External fistulae following drainage operations either healed spontaneously in three or four months or persisted up to three years. Following proximal colostomy, two external fistulae healed promptly or within six months. The bowel opening did not heal in either of these. Following proximal colostomy, three external fistulae persisted, the bowel being open in all at the time of resection four and one-half, five and ten months later. Following proximal colostomy for bladder fistulae, healing occurred within a few months in one case and did not take place in three cases for fifteen months, six years three months, and six years 4 months, respectively. From this, it would appear that a time interval of from three to six months should elapse between proximal colostomy and resection. There appears to be little to be gained in cases without fistulae by a shorter interval except where the

possibility of carcinoma exists, and little to be gained by a longer delay in patients with external or bladder fistulae which have not healed within this period of time.

The length of the resected segment of bowel was short in the majority of instances. This figure is known in 27 cases, the average for the group being 13.6 cm., or 5.4 inches. In 23 cases (85 per cent), the area removed ranged from seven to 15 cm., averaging 12.3 cm. In only four cases was a longer segment removed, the measurements being 17, 17, 24, and 25 cm. In none was this done because the lesion was unusually extensive. In the first two, the purpose was to remove as much as was readily possible and still restore continuity. In the third, the bowel was unusually redundant, and still is according to postoperative roentgenograms. In the fourth, an anterior resection was performed for a low lesion thought to be carcinoma, the segment removed far exceeding the involved area. These findings confirm the statement of Spriggs and Marxer (1927), that the disease generally involves a localized area of the bowel. The reason why the disease is serious in some cases and not in others does not appear to be because it is more extensive, but rather because there is a more serious and persistent process in a localized segment of the bowel. Continuity of the bowel was reestablished in 27 (81.8 per cent) of the 33 resected cases, and judging by the operative notes, could have been restored in all, with one possible exception. When approached directly in the acute phase, the impression may be gathered that the lesion is extensive, for the inflammatory process in the bowel may reach far beyond the point of origin. When in a quiescent phase, it is generally found to be localized in extent, resectable, with restoration of continuity in the great majority of cases, and higher in location than was expected. The lower third of the sigmoid was principally involved in 12 (36.4 per cent) of 33 cases.

CONCLUSIONS

(1) The late results of operations for diverticulitis, which neither divert the fecal stream nor remove the involved segment of the bowel, were unsatisfactory in over 40 per cent of cases. In these, some further surgical procedure often was necessary.

(2) The late results of proximal colostomy were better. Unsatisfactory results occurred in about 25 per cent of cases subjected to this procedure. This operation does not appear to lower the late mortality due to the disease. It does relieve symptoms. Later closure of the colostomy was unsuccessful in over 45 per cent of cases.

(3) The late results of resection of the involved segment of the bowel were unsuccessful in approximately 12 per cent of cases. This operation appears to lower the late mortality due to the disease.

(4) The immediate mortality for resections has been high, the average being 17.1 per cent. This figure varies considerably (25–6.1 per cent). The immediate complications in our series were frequent (33.3 per cent).

(5) The Mikulicz operation was found to be comparatively safe, although

complicated by small bowel obstruction occasionally. The reported mortality (11.5 per cent) for the operation should be reduced if possible. Both open or aseptic end-to-end anastomosis were complicated by leakage at the suture line and abscess formation. In these, the length of the segment removed was short. Leakage was a serious matter in cases in which a preliminary colostomy had not been performed. Preliminary or accompanying cecostomy was not adequate protection for resection with immediate anastomosis. The late results of the Mikulicz operation and open end-to-end anastomosis were satisfactory. There was no evidence of delay at the anastomosis in these. In three cases with less satisfactory late results, aseptic end-to-end suture was performed. In two of these, delay at the anastomosis was found. In general, as judged by postoperative roentgenologic examination, the more extensive resections were performed in cases with satisfactory late results. Anterior resection with closure of the distal segment was found to be an unsatisfactory technic.

(6) The inflammatory process is generally situated in the sigmoid, and confined to a localized area. Resection with reestablishment of continuity is usually possible. There appears to be no contraindication to removing more than the involved segment of bowel. This should place the point of anastomosis in more favorable territory. It would tend to reduce the number of residual diverticula and perhaps the statistical chance of recurrence. In this connection, it appears desirable to guard against delay at the anastomosis.

(7) It is suggested that a preliminary transverse colostomy be performed in all cases in which resection is contemplated, and that the period of delay before resection be from three to six months.

(8) If resection should for some reason be performed in the acute stage, an exteriorizing procedure, of the Mikulicz type, should be employed. It must be stated, however, that this technic could not be used in over one-third of our cases. Resection should be avoided in the acute stage of the disease.

(9) It is impossible to differentiate between carcinoma and diverticulitis in a few cases. In these, resection is indicated.

(10) Resection of the involved segment of the bowel appears to offer patients suffering from the more severe and complicated forms of diverticulitis the greatest hope for improvement. If carefully planned, the mortality should be low, serious complications few, and unsatisfactory late results infrequent.

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DISCUSSION.—DR. HENRY W. CAVE (New York): The first cases of perforated diverticulitis with abscess formation in the American literature were reported by Dr. George Emerson Brewer, an attending surgeon at the Roosevelt Hospital, before the American Surgical Association, in May, 1907 (35 years ago). He reported six cases.

To some of us, certain suggestions offered by Doctor Smithwick in the surgical management of diverticulitis seem, at first, radical; and they are radical, when compared with our former notions of colon surgery. But, assuredly, he has shown that the morbidity and the mortality can be lowered in properly selected and properly prepared patients. No doubt, with the judicious use of the newer chemotherapeutic agents and methods of proximal decompression, the operative mortality can be still further reduced.

In the past, most of us have treated the complications of the disease, rather than attacking primarily the disease itself; this has necessitated emergency surgical measures. Whereas, Doctor Smithwick has not stopped at that, but has gone on with elective procedures which promise a more effective and lasting cure.

Cancer and diverticulitis are not infrequently seen coincidentally, but there is no evidence to assume that the presence of diverticulosis or diverticulitis predisposes to the development of a malignancy; this is accepted by all of us.

The statement is accredited to the late Dr. Daniel Jones, of Boston, that bleeding from the rectum is a prime symptom of malignancy and not diverticulitis. Doctor Smithwick has stated that a history of bleeding is present in 15.7 per cent of patients known to have diverticulitis. It is the experience of most of us that patients with the history of rectal bleeding, sent to the roentgenologist for a barium enema, return with a report of diverticulosis or diverticulitis and not cancer.

In eight, or 24.2 per cent, of the 33 cases resected by Doctor Smithwick, the history, the roentgenographic findings, and the operative findings, all suggested malignancy; and there was no other way except resection, to answer the problem; usually the involvement is beyond the reach of the sigmoidoscope and the tell-tale biopsy specimen.

From 1920 to 1942, a 21-year period, at the Roosevelt Hospital, 43 patients of a group of 116 admitted to the Surgical Service were operated upon for acute or chronic diverticulitis; of these, 11, or 25.6 per cent, were explored for a possible or probable malignancy. These figures on this particular point in the two series, the one from the M. G. H. the other from the Roosevelt Hospital, are almost identical.

In other respects, our series correspond similarly to those of Doctor Smithwick, as to the indications for surgery, the methods of approach, and the mortality; except that in no instance have we resected the sigmoid for recurrent attacks of diverticulitis *per se.*

Doctor Smithwick has resected the sigmoid in 33 individuals, with a relatively low mortality rate of 17.1 per cent, considering the nature of the disease. And, in a group of 12 of 33 resected, he had a surprisingly low mortality of 6.1 per cent.

To me, this group of 12, resected because of recurrent attacks of diverticulitis, is one of the principal features of his splendid presentation.

Preliminary proximal colostomy he considers preferable to cecostomy, and should be done in all cases where resection of the sigmoid is to be carried out. The wider the excision, the lower the chance of leakage at the suture line; and added security by suturing healthy bowel wall.

Wisely has he set a time interval of from three to six months of proximal decompression, by colostomy, before proceeding with the resection.

Stenosis as a complication at the site of removal is not infrequent by the Mikulicz method in our own series.

In dealing with an inflammatory and not a malignant lesion, I believe it can be stated with fairness that any type of exteriorization procedure is as complete and, to me, is safer, than suturing the colon end-to-end, or even side-to-side; and I say this even in spite of the sulfonamide drugs and the Devine method of dysfunctioning the left colon.

In the series here presented, colostomies were closed in 36 instances, and only 52.8 per cent remained well, indicating that the inflammatory lesion persisted. The late results following resection have proven more satisfactory.

Doctor Smithwick, I am sure, has stimulated us in an attempt to completely eradicate the diseased segment of the colon, thus permitting these individuals to be well and not semi-invalids.

DR. RICHARD B. CATTELL (Boston, Mass.) : Doctor Smithwick's presentation of the difficulties of diverticulitis is of unique interest, since there are 64 patients treated by every possible method of treatment that could be applied to diverticulitis, and they are an unselected group. I think he has demonstrated, very conclusively, that a reasonable mortality can be expected if we delay resection to be a late and elective procedure.

Doctor Walker and I have recently reviewed our patients who have been operated upon for diverticulitis at the Lahey Clinic. We think there are only two operative indications: one, the complications of inflammation, and second, and most important, the indication of obstruction.

I would like to propose a relatively different conception with regard to the treatment of abscess in diverticulitis. From our experience and from that in the literature, where free pus is drained into the peritoneal cavity, the mortality has been high. I believe that if we delay operation in those cases with abscess until they either point in the left lower quadrant or by rectum, and if operation is indicated, do not operate in the field where the diverticulum is located but establish a colostomy of the transverse colon, we will reduce the mortality. Furthermore, these abscesses frequently drain spontaneously into the lumen of the bowel.

We have, because of our own mistakes and high mortality, made another rule, very clearly brought out by Doctor Smithwick, and that is that with diverticulitis we do not perform a primary resection at any time, if we know with what we are dealing. Where we have resected the diverticulitis as a primary procedure with a mistaken diagnosis of carcinoma, our mortality has been 50 per cent. With regard to procedure of colostomy in the transverse colon if a long spur is formed greater ease will be experienced in the subsequent extraperitoneal closure.

DR. CARL EGGERS (New York) : I rise to discuss Doctor Smithwick's paper, largely to call attention to the importance of the subject of diverticulitis and the danger associated therewith. In my own personal experience, the condition has not been uncommon. I have seen 82 cases with acute diverticulitis of sufficient severity to warrant a surgical consultation. In 36, or 43.9 per cent, a condition developed which required surgical intervention. In other words, 36 patients were operated upon either for perforation or obstruction or mistaken diagnosis. Of those operated cases, 20, or 24.4 per cent, had perforation. Twenty-four per cent of the acute diverticulitis cases had perforation. Their operation was forced on the surgeon. That is what I want to call attention to. That was the group we had to handle surgically. Of that group, ten died, a mortality of 50 per cent.

The total mortality in the 34 cases operated upon was 23.5 per cent, which is restricted entirely to acute perforations. Among this group there were five patients with cancer, all of whom eventually succumbed to their disease.

Of the late complications which follow this condition, one of the most annoying is the persistent fistulae. If the fistulae discharge only suppurative material, the patients do not mind so much, and some prefer to have the fistula drain itself rather than be subject to operation, but if there are feces draining, there is a different condition. During the last four or five years we have had four such cases. One preferred to drain and finally healed after about four years. Two were operated upon, and by complete excision of the fistulae and closing the sigmoid opening, it was possible to heal them. The fourth one has had several attempts at closure, but it was not permanent.

Another interesting complication is sigmoid-bladder fistulae. I think much depends on the extent of the involvement in that and/or the place of attachment. If the place of attachment is close, the closure should not present much difficulty, if one uses prompt cleansing of the bowel and bladder both, and interposes a layer of omentum between the two sutures after completion. But the important thing is the danger of perforation. If the perforation can be avoided in some of the patients who have repeated attacks of pain and obstruction, an operation of choice in those patients may be indicated, as Doctor Smithwick has stressed, and there one can prepare them adequately the way one does in carcinoma. One of the difficulties with resection, however, in these cases is the length of involvement of the bowel. That is one of the very important differential diagnostic points. Carcinoma usually involves a small segment; diverticulitis, a long segment, so long you have to operate in diseased tissue if you want to resect the whole area. That is one of the very serious difficulties. Also, resection does not guarantee that one will not have recurrence. I have had two patients who had resection done, who later had recurrences, and one of them is under observation now. It was resected ten years and he was pretty well. Now he has recurrent attacks of severe pain resembling obstruction, and roentgenograms show very extensive diverticulitis along the whole sigmoid region.

DR. CHARLES C. LUND (Boston, Mass.) : In connection with Doctor Smithwick's paper and Doctor Cave's comments on it, both mention the occasional incidence of bleeding in diverticulitis. I want to call attention to the fact that that bleeding may be quite severe.

A few months ago a patient at the City Hospital, in Boston, came in with a history of a marked hemorrhage of fresh blood. He was in such shape that the interns transfused him as soon as possible after admission. During the time that the first transfusion was running into his veins, he called for the bed-pan, and a measured amount of 1,500 cc. of pure blood was evacuated. Transfusions were repeated. Many pints of blood were given. We got far enough ahead of the hemorrhage so that, on the second morning, it seemed reasonable to try a desperate operation. The situation that was found was a fistula that had burrowed from a diverticulum into the ileac fossa. I did not feel justified, with the scarred conditions found, to try to do anastomosis. I tied off the artery; the patient did very well for a few hours, and then died of hyperpyrexia, which possibly is accounted for by the period of pretty severe shock, or low blood pressure, that he was in before the operation. I do not know; I think that is a unique case.

Doctor Berring and I have studied it to some extent. We find no reference to such an instance in either surgical or pathological literature. If any of you have had any experience approximating that, I would appreciate it if you would speak to me about it.

I think Doctor Smithwick's paper was really very, very valuable. In our experience, which has not been studied at the City Hospital, I would say it is my personal impression that when our cases have done well they have been handled in the way in which Doctor Smithwick's cases have been handled. When they have not done well, they have been handled in the way the cases at the General that have not done well have been handled, as he has shown.

DR. R. H. SMITHWICK (closing) : I think the discussion this afternoon in regard to diverticulitis is fairly representative of what you find in the literature, namely, that there is considerable difference of opinion about what should be done and when it should be done. Strangely enough, although there is a great deal of literature on certain aspects of this problem, there are surprisingly few reports of late results of any maneuver, whatsoever. Many people, of course, have been operated upon, but there are very few late results in the literature, for which reason it is difficult for one to make a decision as to what really should be done under various circumstances. My impression is that there is a real need for further reports of late results of various forms of treatment.