Papers and Originals

Natural History of Diverticular Disease of the Colon. A Review of 521 Cases

T. G. PARKS,* M.CH., F.R.C.S

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Summary: In a survey of the natural history of 521 patients with diverticular disease of the colon half of the patients had had symptoms for less than one month on presentation at hospital, and these carried the highest morbidity and mortality. Progression of the disease was usually within segments initially involved, and extension to other regions of the colon rarely occurred. The overall prognosis of patients with total colonic involvement was similar to those with localized disease, while the morbidity and mortality associated with a recurrent attack were higher than in the initial acute episode.

Introduction

Since Spriggs and Marxer (1927) introduced a four-stage classification for the development of colonic diverticula the concept of the progressive nature of diverticular disease has been widely accepted. Henderson (1944) emphasized that progress occurred not only in the segment originally affected but frequently extended to involve other segments.

The increased incidence of diverticular disease with age is well documented (Kocour, 1937 ; Welch, 1958 ; Debray *et al.*, 1961). The frequency of associated inflammation has also been shown to increase significantly with age (Kocour, 1937 ; McGowan and Wolff, 1952 ; Welch *et al.*, 1953).

Interest in diverticular disease of the colon has been focused recently on the nature of the muscle defect (Morson, 1963 ; Williams, 1963, 1965), but there are few recent reports of the natural history of the condition.

Present Study

This study reviews patients seen at the Royal Victoria Hospital, Belfast, between 1951 and 1965 inclusive. The hospital classification of patients' diagnoses during this period was such that most patients traced were inpatients, so that this is essentially a review of the more severely affected persons. Of the 521 patients in this review 455 were treated as inpatients (0·3% of all admissions to the hospital during the period).

Criteria for Diagnosis of Diverticular Disease of the Colon.—In this study patients with isolated caecal diverticula have not been included, as this is probably a distinct condition. In addition, all patients in whom the diagnosis of diverticular disease of the colon was indefinite were excluded. Diagnosis of diverticular disease was based on clinical features, together with one or both of the following: (*a*) radiological evidence of diverticula or deformity consistent with diverticular disease ; and (*b*) confirmation of the presence of diverticula or of local inflammatory involvement of the colon consistent with diverticular disease at operation or necropsy. A clinical diagnosis alone is not reliable.

Plan of Investigation.—Information from patient records was prepared in digital form and transferred to 80-column cards (International Computers and Tabulators Ltd.) for analysis. The detailed information obtained in this survey, only part of which is included in this paper, would not have been possible without the use of mechanical aids. Two hundred and fifty-nine patients were contacted personally ; 154 had died, and recent information about the remainder was obtained from other hospitals, general practitioners, and relatives. Only two patients (0·4%) could not be traced, but were known to have emigrated. In view of the completeness of follow-up and the nature of the medical services in Ulster it is unlikely that many patients were admitted to other hospitals without this fact being noted in this review.

Results

Sex Distribution.—Of the 521 patients 204 were male and 317 female (an approximate ratio of 2:3).

Age at Onset of Symptoms.—The age at onset of symptoms was similar in men and women (Table I). Symptoms seldom began before 40 years of age, developing more frequently in the sixth, seventh, and eighth decades. Forty patients (7·7%) were in their ninth decade when they first complained.

TABLE I.—*Age at Onset of Symptoms of Diverticular Disease*

Age at Onset	Males	Females	Total
20–29 years	2 (1·0%)	1 (0·3%)	3 (0·6%)
30–39 years	8 (3·9%)	9 (2·8%)	17 (3·2%)
40–49 years	24 (11·8%)	19 (6·0%)	43 (8·2%)
50–59 years	56 (27·4%)	71 (22·4%)	127 (24·4%)
60–69 years	56 (27·4%)	109 (34·4%)	165 (31·7%)
70–79 years	44 (21·6%)	82 (25·9%)	126 (24·2%)
80–89 years	14 (6·9%)	26 (8·2%)	40 (7·7%)
Total ..	204 (100%)	317 (100%)	521 (100%)

Age at Presentation at Hospital.—The youngest man to present at hospital with diverticular disease was 29, the eldest 87, and the average age at presentation was 61·8 years. The youngest woman was 30, the eldest 89, and the average age at presentation was 65·9 years. Over 92% of the patients were more than 50 years of age when they first attended hospital with symptoms (Table II).

Patient's Age in Relation to Extent of Disease.—The mean ages at presentation of 31 patients who had total colonic involvement are compared with those of 430 patients who had lesser degrees of involvement (Fig. 1). Patients in whom the whole colon was involved by disease were, in fact, younger than patients in all categories of less extensive disease.

* Senior Registrar and Senior Tutor, Department of Surgery, Queen's University, Belfast. At present Senior Registrar, Royal Victoria Infirmary, Belfast BT12 6BA.

Patient's Age in Relation to Number of Diverticula.—Patients were arbitrarily divided into those having many diverticula and those having few diverticula. A comparison of the age distribution of the two groups is shown in Fig. 2. Patients with many diverticula tended to be older than those with few diverticula.

TABLE II.—*Age at Presentation with Symptoms of Diverticular Disease*

Age at Presentation	Males	Females	Total
20–29 years	1 (0·5)	—	1 (0·2%)
30–39 years	6 (2·9)	5 (1·6)	11)2·1%(
40–49 years	17 (8·3)	11 (3·5)	28 (5·4%)
50–59 years	62 (30·4)	65 (20·5)	127 (24·4%)
60–69 years	55 (27·0)	115 (36·3)	170 (32·6%)
70–79 years	48 (23·5)	91 (28·7)	139 (26·7%)
80–89 years	15 (7·4)	30 (9·4)	45 (8·6%)
Total	204 (100%)	317 (100%)	521 (100%)

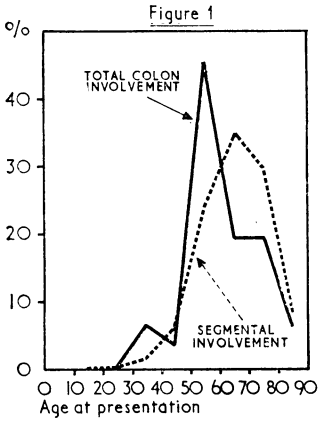

FIG. 1.—Age in relation to extent of disease.

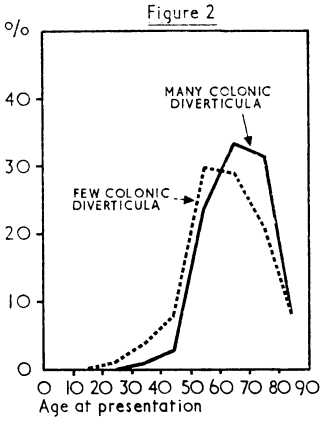

FIG. 2.—Age in relation to number of diverticula.

Distribution of Colonic Diverticula.—Four hundred and sixty-one patients had barium enema on first presentation at hospital, and the distribution of colonic diverticula in these patients is given in Table III. The sigmoid was involved alone

TABLE III.—*Distribution of Colonic Diverticula in 461 Patients*

Site of Colonic Diverticula	No. of Patients
Sigmoid colon	302
Descending colon	14
Transverse colon	4
Sigmoid and descending colon	83
Sigmoid and transverse colon	5
Sigmoid and ascending colon	3
Sigmoid, descending, and ascending colon	19
Whole colon	31

in 302 cases (65·5%) and in combination with other regions in 443 (96%) cases. The descending colon alone was affected in 14 patients and the transverse colon alone was affected in four cases.

Time of Year of First Presentation at Hospital.—The time of year when patients presented with symptoms of diverticular disease of the colon is shown in Table IV. Neither the initial attack nor the recurrences of disease occurred at any particular time of the year.

TABLE IV.—*Time of Year of Presentation with Symptoms*

Time of Year	Percentage of Patients	Time of Year	Percentage of Patients
January–February	17·0	July–August	14·6
March–April	16·2	September–October	18·0
May–June	18·6	November–December	15·6

Number of Previous Acute Attacks.—Of 41 patients who recalled a previous acute attack similar to that necessitating hospital admission, 36 had a single attack, two had two attacks, one had three attacks, and two had five previous attacks. Of these 41 patients only half had features suggestive of colonic inflammation on barium enema, though when a full clinical assessment was made 37 were considered to have inflammatory involvement.

Duration of Symptoms on Presentation at Hospital.—Half the patients had a history of less than one month and three-quarters had symptoms for less than one year when they first attended hospital for investigation of colonic symptoms (Table V). Twenty-five (55·6%) of the 45 patients in their

TABLE V.—*Duration of Symptoms Before Presentation at Hospital in 521 Patients*

Length of Previous History	No. of Patients	Length of Previous History	No. of Patients
Less than 1 month	267	5–9 years	31
1–3 months	46	10–19 years	15
4–6 months	44	20–29 years	6
7–12 months	32	30+ years	4
1–2 years	34	Not known	6
3–4 years	38		

ninth decade stated that their symptoms had been present for less than one month. Only one-quarter of those with a history of less than one month continued to have symptoms after conservative treatment, whereas half of those with a history of more than one year continued to have symptoms after the acute phase had passed. Of the 267 patients with symptoms of less than one month's duration 219 were diagnosed as having had inflammation of the colon. Patients in whom radiography showed changes consistent with inflammatory involvement did not have a longer history than those with diverticula only.

Duration of Symptoms in Relation to Extent of Disease.—When the length of the history was correlated with the extent of the disease it was found that patients with more extensive disease had shorter histories than those with more localized involvement. Eighteen (58%) of the 31 patients with diverticular disease involving the whole colon had symptoms for less than one month, whereas only 130 (43%) of 302 patients with sigmoid disease and 42 (50·6%) of 83 patients with involvement of the sigmoid plus descending colon had such short histories.

Prognosis in Relation to Extent of Disease.—In general, prognosis was no worse in patients with diverticular disease of the whole colon than those with only the sigmoid or sigmoid and descending colon affected (Table VI). This table refers only

TABLE VI.—*Prognosis in Relation to Extent of Disease*

	Sigmoid Colon (302)	Sigmoid and Descending Colon (83)	Whole Colon (31)
Inflammatory mass	60 (19·9%)	16 (19·3%)	3 (9·7%)
Radiological features consistent with inflammation	167 (55·3%)	39 (47·0%)	11 (35·5%)
Complications	120 (39·7%)	32 (38·5%)	9 (29·0%)
Surgery performed	76 (25·2%)	23 (27·7%)	4 (12·9%)
Persistent symptoms	81 (28·1%)	22 (26·0%)	16 (51·6%)
Death related to diverticular disease	10 (3·3%)	0	2 (6·5%)
Death from other causes during follow-up	76 (25·2%)	17 (20·5%)	3 (9·7%)

to the major categories of involvement in which there were sufficient numbers of patients to allow various clinical aspects to be compared. Patients with total colonic involvement developed inflammation less often and had fewer spontaneous complications and indications for surgery than the other groups. On the other hand, there was a higher incidence of persistent symptoms where diverticular disease involved the whole colon. This may be partly a reflection of the fact that elective surgery was undertaken less often in extensively involved cases. Readmission rate was only slightly higher in patients with total colonic involvement.

Overall Prognosis in Patients Requiring Hospital Admission.—As it is possible that the event of hospital admission may in itself affect prognosis, patients not admitted to hospital have been excluded for the purpose of assessing the overall prognosis in the more homogeneous group of inpatients. The outcome and condition at final follow-up of the 455 who were admitted to hospital for treatment of diverticular disease of the colon are shown in Table VII. One hundred and thirty-eight had an

operation performed either during their first admission or within a few months when acute symptoms had subsided. Of the remaining 317 patients who were treated medically on the first admission a further 20 required subsequent surgical treatment because of recurrent attacks. Twenty-two of the inpatients (4·8%) died as a result of the disease, 17 of them after operation, and 15 of the fatalities occurred during the first hospital admission. Ten of the fatal cases were over the age of 70 and six were over 80. Twelve of the deaths occurred in patients in whom symptoms had been present for less than one month before admission.

TABLE VII.—*Outcome of 455 Patients Admitted for Treatment of Diverticular Disease of the Colon*

Condition at Final Follow-up	Medically Treated (297)	Surgically Treated (158)	Total (455)
Alive and well	121	72	193
Alive with mild symptoms ..	77	32	109
Alive with severe symptoms ..	11	3	14
Death related to diverticular disease	5	17	22
Death due to other causes ..	81	34	115
Not known	2	0	2

Persistent symptoms were common in both medical and surgical patients. About one-third of those who had been treated medically and who were still alive had mild symptoms at the time of final follow-up and 5% had severe symptoms. In the surgically treated group about one-third of the patients still complained of mild symptoms and 3% had severe symptoms.

Readmission to Hospital with Recurrent Attacks.—The 138 patients who were surgically treated as a result of the presenting attack had a variable number of admissions mostly related to staged procedures and are not further considered here. Of the 317 who were medically treated on their first admission to hospital 78 (24·6%) were readmitted with a second attack, 12 (3·8%) with a third attack, and five (1·6%) with a fourth attack. In addition, other patients had less severe episodes for which admission was not required. The section which follows considers the course and prognosis in the 78 patients whose symptoms were severe enough to warrant readmission for hospital treatment.

Readmissions

Patients' Condition between Acute Attacks.—The interval condition of the 78 patients who were medically managed on the first admission and who required subsequent readmission for a recurrent attack is given in Table VIII. Only 21 (26·9%) of the 78 patients remained free of symptoms in the interval, but symptoms were mild in more than half of the group. During the period between the second and third admissions only one of the 12 patients was symptom-free, half had mild symptoms, and the remainder had intermittent severe symptoms.

TABLE VIII.—*Condition of 78 Patients in Interval Between First and Second Hospital Admissions with Acute Attacks*

Condition between Admissions	No. of Patients	Condition between Admissions	No. of Patients
Symptom-free	21	Continuous mild symptoms	3
Intermittent mild symptoms	43	Continuous severe symptoms	3
Intermittent severe symptoms	5	Not known	3

Time Interval between Acute Exacerbations.—Of 78 patients treated medically who needed further inpatient care, 36 (46%) were readmitted within one year and 71 (91%) within five years (Table IX). The time interval between second and third admissions was similar. Patients who had continuous or severe intermittent symptoms had shorter periods between hospital admissions.

Outcome of Recurrent Attacks.—Six of the 78 patients died as the result of the acute exacerbation responsible for their second hospital admission. This mortality rate was twice that of the presenting attack. Twenty of the 78 came to surgery as a result of the acute exacerbations. Medical treatment of recurrent disease was less rewarding than treatment of the presenting attack, and more than half of the patients continued to have symptoms after discharge from hospital.

TABLE IX.—*Time Interval Between First and Second Hospital Admissions with Exacerbations in 78 Medically Treated Patients*

Interval between Admissions	No. of Patients	Interval between Admissions	No. of Patients
Less than 1 month	5	1–2 years	16
1–3 months	8	3–4 years	19
4–6 months	11	5–9 years	6
7–12 months	12	10–19 years	1

Discussion

This study presents detailed information on the natural history of diverticular disease. It surveys a large number of patients, 99·6% of whom were followed up, and allows a firm statement to be made on the course and prognosis of the disease in its more severe forms of presentation. It mainly concerns patients who required a period of treatment in hospital, and in this respect should not be regarded as presenting the overall pattern of diverticular disease in the population at large. In fact, a large proportion of patients with colonic diverticula have no symptoms at all. Parks (1968) found that 37% of colons examined carefully at necropsy had diverticula, and others have quoted similar figures in elderly patients, yet the majority apparently are symptomless.

It is difficult to determine with accuracy the time of onset of this disease in some individuals. Many patients have no symptoms, while others have vague complaints of insidious onset so that the condition may have been present for years before the diagnosis is established. On the other hand, many patients with a short history are found to have pronounced disease on investigation.

Diverticular disease of the colon occurs mainly in the second half of life. In this series only 3·8% of patients were less than 40 years of age when symptoms first began. Again, since 40 patients first complained of symptoms in the ninth decade, it is unlikely that a congenital cause can be implicated.

The majority of reports in the early part of this century quoted a higher incidence in men than in women (Telling and Gruner, 1917 ; Spriggs and Marxer, 1927 ; Rankin and Brown, 1930), but many reports in the past decade indicate a higher incidence among women (Greene, 1957 ; Boles and Jordan, 1958 ; Brown and Toomey, 1960 ; Manousos *et al.*, 1967a). In the present survey a male to female ratio of 2:3 is in keeping with the recent trend. It may be that changes in incidence are associated with the changing role of women in modern society.

The distribution of diverticula of the colon has often engaged attention. It is generally believed that when a colon is affected by diverticular disease more diverticula develop with the passage of time (Henderson, 1944). Our findings that patients with many diverticula were on average older than those with few diverticula would support this view. Patients with extensive or total involvement of the colon, however, were not older than patients with disease localized to the sigmoid or sigmoid and descending colon. It seems that if a segment of colon is to be involved in the disease process this is determined early in its course. Progress of the disease is more often within the segments affected initially rather than by spreading to new ones, and not, as is widely held, by progressing to involve one segment after another. Sometimes patients are encountered who have had serial *x*-ray examinations over a period of years, where additional segments have become involved subsequently, but probably this is uncommon. The patient with localized disease

is not necessarily marked out for relentless progression to other parts of the colon, whether resection is undertaken or not. Most patients who have localized disease when first seen do not develop disease proximally and even in severely involved persons a second resection is seldom necessary.

Over half of the patient had symptoms for less than one month when first seen at hospital, and yet many had pronounced and serious complications. The fact that over half of the fatalities occurred in this group is worrying, since little can be done to prevent the catastrophic presentation of these patients until the aetiology is better understood.

In this study the immediate risk to life during the first hospital admission was 3%. This figure was considerably higher in patients with complications. Most patients died because of inflammatory complications. In addition to the patients in this series with a firm diagnosis of diverticular disease, a further small number of elderly patients with suspected diverticular disease were admitted to hospital during the period under review and died soon after admission with peritonitis, and because they did not have a barium enema or necropsy performed they could not be included in this series. Hence the true mortality during the first hospital admission may be more than 3%.

The complication rate and the necessity for surgical intervention were less frequent in patients with total colon involvement, which seems to incriminate pathology in the distal colon as being most likely to result in the development of a situation demanding surgery. This may encourage the surgeon who finds it necessary or expedient to leave behind a segment of proximal colon with several diverticula when resecting the distal colon in diverticular disease. If this line of management has to be adopted it is rare for a second operation to be required to deal with complications in the proximal segment.

It has been suggested that diverticular disease may be a sequel to the irritable colon syndrome (Almy, 1965 ; Manousos *et al.*, 1967b) on the basis of similarities of some but not all features of intestinal motility (Arfwidsson, 1964 ; Manousos *et al.*, 1967b ; Parks *et al.*, 1969). In this series, however, more than one-half of the patients had a history of less than one month, and three-quarters of them had a history of less than one year, on presentation at hospital with established disease. As these patients did not have a prolonged history of symptomatic irritable colon it is unlikely that in them it preceded diverticular disease. It is possible that in some of the remaining patients gut symptoms preceding the development of diverticular disease could have been those of irritable colon, but even this remains speculative.

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Reappraisal of Clinical Features of Diverticular Disease of the Colon

T. G. PARKS,* M.CH., F.R.C.S.

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Summary : In patients with diverticular disease of the colon factors which indicate a worse prognosis include widespread abdominal pain, nausea and vomiting, disturbed bowel habit, a palpable abdominal mass, abdominal distension, and any of the inflammatory complications. While radiology is of prime importance in the initial diagnosis, it is often impossible to differentiate between diverticulosis and diverticulitis. A more accurate distinction can be made by assessing all the available clinical, radiological, and pathological data, but again there are limitations and inaccuracies. The use of the term " diverticular disease " is preferable.

Introduction

A previous communication (Parks, 1969) outlines the natural history of patients with diverticular disease of the colon treated at the Royal Victoria Hospital, Belfast, between 1951 and 1965 inclusive, and details of the plan of the investigation have been described. This paper presents the clinical features of the same group of 521 patients.

Clinical and radiological differentiation between diverticulosis and diverticulitis is often difficult and sometimes impossible, but in order to assess if any useful division could be made and to determine if these terms had any prognostic or therapeutic significance this detailed study of the symptomatology has been made.

Material and Methods

In addition to reviewing the clinical features in the group as a whole, account was taken of patterns in patients with

* Senior Registrar and Senior Tutor, Department of Surgery, Queen's University, Belfast. At present Senior Registrar, Royal Victoria Hospital, Belfast BT12 6BA.