

by antilymphocytic serum administration may be required. In secondary and idiopathic marrow aplasias, our two successes—even though the myeloid restoration was incomplete—show that allogeneic bone marrow grafting after conditioning of the recipient by antilymphocytic serum is possible. For this reason non-malignant bone marrow aplasias are very good practical indications for this treatment. Marrow grafts have had a striking effect on infections or haemorrhagic syndromes which have been uncontrollable even after leucocyte transfusions without previous conditioning of the recipient. In these two successful cases the donor had not received antilymphocytic serum before grafting the marrow.

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Limitations of Radiology in the Differentiation of Diverticulitis and Diverticulosis of the Colon

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British Medical Journal, 1970, 2, 136-138

Summary: While barium enema is the most useful investigation in the primary diagnosis of diverticular disease of the colon, this paper presents further evidence that the terms "diverticulosis" and "diverticulitis" are unsatisfactory and shows that a radiological classification on the traditional criteria is not accurate in determining whether or not inflammation is associated with colonic diverticula.

Introduction

In 1914 Abbe published a paper entitled "A case of sigmoid diverticulitis simulating malignancy, demonstrated by radiology, operation and specimen." This appears to be the first account of the value of radiology in which "bismuth injection" was used to demonstrate colonic diverticula. Spriggs and Marxer (1927) stressed the importance of radiology in establishing a diagnosis and in assessing the stage of the disease. They recognized three interdependent conditions—the prediverticular state, diverticulosis, and diverticulitis. These distinctions, while widely used, have never been clearly defined and have been the subject of debate ever since. Thus,

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for example, the so-called prediverticular state has been represented as either diverticula in the early stages (Lockhart-Mummery and Hodgson, 1931; Edwards, 1939) or as evidence of diverticulitis (George and Leonard, 1919; Todd, 1955; Zunino, 1961).

Though initially the distinction between diverticulosis and diverticulitis was made, it is evident that confusion persists. The difficulty of distinguishing clinically and radiologically between diverticulosis and diverticulitis has been recognized and the term "diverticular disease" introduced as an acceptable compromise (Morson, 1963), but the older terms are still widely used in clinical, radiological, and pathological practice. Traditionally, the term "diverticulosis" describes the colon with multiple diverticula but with little evidence of narrowing or deformity of the lumen. Diverticulitis is said to be characterized by narrowing of the lumen, distortion and deformity of the haustral pattern, and an irregular contour.

The present study was undertaken to assess the accuracy of radiology in determining whether or not inflammation is present in association with colonic diverticula.

Patients Studied and Methods

A comparative study was made of the radiological and clinical features of 461 patients diagnosed and treated for diverticular disease of the colon at the Royal Victoria Hospital,

Belfast, during 1951 to 1965 inclusive. In this series 90% of the subjects were inpatients and represent more severely affected persons.

During the 15-year period barium enema examinations were carried out by a number of radiologists with varying degrees of experience, but the practice of this hospital was for all x-ray films to be examined by a competent senior radiologist. It so happens that of the 461 cases reported, 230 were considered at the time to have diverticulosis and 231 to have diverticulitis. Other information about the clinical and pathological aspects of this series and the outcome of the disease in these patients has been presented elsewhere (Parks, 1970). The data presented here have been used to assess the clinical validity of the distinctions "diverticulosis" and "diverticulitis."

To determine if observer variation was a factor in the assessment of diverticular disease on barium enema examination and to find if modern criteria of assessment led to consistent reporting of enema films, two consultant radiologists were presented with x-ray films of 40 patients from the series but were not given clinical details of the patients. Each radiologist divided the enemas independently into categories of either diverticulosis or diverticulitis without knowledge of the comments of the other or of the nature of the original radiological opinion. This was also available for subsequent comparison, as was a pathological report in each case.

Results

Comparison of Findings in 461 Patients

Length of History before Referral to Hospital.—The duration of symptoms in patients with a radiological diagnosis of diverticulosis was compared with the duration in those with a radiological diagnosis of diverticulitis (Table I). There were

TABLE I.—Comparison of Radiological Diagnosis with Length of History Before Referral to Hospital

Length of History	Diverticulosis (230)	Diverticulitis (231)
Less than 1 month	117 (50.9%)	100 (43.3%)
1-12 months	53 (23.0%)	69 (29.9%)
1-5 years	35 (15.2%)	28 (12.1%)
More than 5 years	25 (10.9%)	34 (14.7%)

only marginal differences in the two groups. A slightly higher proportion of patients in the diverticulosis group had a history of less than one month and a slightly higher proportion of patients in the diverticulitis group had a history of more than five years.

Number of Previous Acute Attacks.—Thirty-six patients stated that they had had at least one previous acute attack similar to that leading to their admission to hospital. Nineteen (8.3% of the diverticulosis group) were considered on radiological grounds to have diverticula only, and 17 (7.4% of the diverticulitis group) were considered to have diverticulitis.

Clinical Features on Referral to Hospital.—The incidence of several clinical features in the two groups on referral to hospital is compared in Table II. Abdominal pain, nausea,

TABLE II.—Comparison of Radiological Diagnosis with Clinical Features on Referral to Hospital

Clinical Features	Diverticulosis (230)	Diverticulitis (231)
Abdominal pain	178 (77.4%)	192 (83.1%)
Nausea or vomiting	40 (17.4%)	43 (18.6%)
Urinary symptoms	31 (13.5%)	31 (13.4%)
Abdominal distension	25 (10.9%)	33 (14.3%)
Palpable mass in left iliac fossa	38 (16.5%)	52 (22.5%)

vomiting, and urinary symptoms occurred with equal frequency in the two groups. Abdominal distension and the

presence of a palpable mass in the left iliac fossa were only slightly more common in the diverticulitis group than in the diverticulosis group.

Bowel Habit.—A study of the bowel habit before referral to hospital showed a close similarity in the two groups (Table III). The bowel habit in the two groups was the same both before admission to hospital and while in hospital.

TABLE III.—Comparison of Radiological Diagnosis with Bowel Habit Before Admission

Bowel Habit Before Admission	Diverticulosis (230)	Diverticulitis (231)
Normal	92 (40.0%)	83 (35.9%)
Continuous diarrhoea	1 (0.4%)	3 (1.3%)
Intermittent diarrhoea	39 (17.0%)	47 (20.3%)
Intermittent diarrhoea/constipation	23 (10.0%)	20 (8.7%)
Intermittent constipation	46 (20.0%)	33 (14.3%)
Constant constipation	29 (12.6%)	45 (19.5%)

Complications.—There was a similar high incidence of complications in both the diverticulosis group and the diverticulitis group (Table IV). Patients with diverticulosis suffered less often from perforated abscess and internal fistulae.

TABLE IV.—Comparison of Radiological Disease with Complications in Diverticular Disease

Complications	Diverticulosis (230)	Diverticulitis (231)
Bleeding	50 (21.7%)	50 (21.6%)
Obstruction	13 (5.6%)	17 (7.3%)
Abscess	11 (4.8%)	16 (6.9%)
Perforation of abscess	3 (1.3%)	12 (5.2%)
Free perforation	6 (2.6%)	5 (2.2%)
Vesicocolic fistula	0	1 (0.4%)
Enterocolic fistula	0	1 (0.4%)
Portal pyaemia	0	1 (0.4%)

Medical and Surgical Management of the Two Groups.—Though there was little overall clinical difference between the two groups, surgical intervention was undertaken in 18.2% of patients diagnosed as cases of diverticulosis but in as many as 30.3% of patients diagnosed as diverticulitis (Table V). This

TABLE V.—Management of Patients Diagnosed as Diverticulosis and Diverticulitis

Management	Diverticulosis (230)	Diverticulitis (231)
Medical	188 (81.8%)	161 (69.7%)
Surgical	42 (18.2%)	70 (30.3%)

latter figure is weighted by patients in whom the radiologist could not exclude a carcinoma in association with the diverticular disease.

Incidence of Suspected and Proved Cases of Associated Carcinoma of the Colon.—Twenty-nine patients were suspected radiologically of having carcinoma of the colon, usually of the sigmoid, but this was not confirmed in 23 (Table VI), 17 of whom had been operated on and the other

TABLE VI.—Radiological Diagnosis of Carcinoma of the Colon Associated with Diverticular Disease

	Diverticulosis (230)	Diverticulitis (231)
Carcinoma suspected but not subsequently confirmed	2	21
Carcinoma suspected and confirmed at operation	3	3
Carcinoma not suspected but found at operation	2	1
Carcinoma not suspected but found at necropsy	1	1

six were followed up for a prolonged period without any definite evidence of neoplasm having presented. Most of the difficulties in the radiological diagnosis arose in the diverticulitis group, which, in part at least, accounts for the higher incidence of surgical intervention in the diverticulitis group. In the other six cases, three from each group, carcinoma of the colon was either suspected or convincingly demonstrated (Table VI), but in only two of these was the growth in the sigmoid colon, where diagnosis is especially difficult. In two patients a carcinoma was not suspected on the first barium enema examination and there was nine months' delay before a second enema showed an obvious carcinoma. In five patients radiology did not reveal a carcinoma. Three of these had surgery performed on clinical grounds. All had sigmoid carcinomas and one had a coexisting carcinoma of the transverse colon. Two other patients died of carcinoma nine months after radiological diagnosis of diverticulosis and diverticulitis respectively. At necropsy one was found to have a sigmoid carcinoma and the other a carcinoma of the transverse colon.

State of Patient at Time of Final Follow-up.—The state of the patients at the final review is compared in Table VII.

TABLE VII.—Radiological Diagnosis and State of Patients at Time of Final Follow-up

Outcome	Diverticulosis (230)	Diverticulitis (231)
Alive and well	105	95
Alive with mild symptoms	60	58
Alive with severe symptoms	6	5
Died from the disease	1	6
Died after surgery for disease	5	3
Died from other causes	51	62

There was little difference between the two groups in the numbers of those who did well, the minor difference being accounted for by deaths from other causes. Twelve patients in the diverticulosis group and 14 in the diverticulitis group had a poor outcome and still had severe symptoms or died from the disease or as a result of surgery. Thus the overall prognosis was similar in the two groups.

Observer Variability

The two radiologists who reassessed the barium enemas of 40 patients, using modern criteria of diagnosis, agreed in only 25 of the 40 cases (Table VIII). When, in addition, the

TABLE VIII.—Observer Variability in Distinguishing Diverticulitis from Diverticulosis in 40 Patients with Diverticular Disease

	Agreement	Disagreement
2 Radiologists	25	15
3 Radiologists	15	25
3 Radiologists + pathologist	12	28

radiological report made at the time of the original barium enema examination was included, agreement among all three occurred on only 15 occasions. Agreement among the three radiologists and the pathologist occurred on only 12 occasions.

In 12 cases in which at least one radiologist considered inflammation to be present, the pathologist was unable to confirm its presence in the resected specimens.

Discussion

Most of the patients in this retrospective study were examined radiologically during the period when traditional criteria were in vogue. In recent years, however, advances have been made towards a better understanding of the pathogenesis of diverticular disease (Morson, 1963; Williams, 1963, 1965, 1967; Arfwidsson, 1964), and it is evident that some earlier views about the radiographic appearances need revision.

This communication confirms that radiology has not been accurate in distinguishing between the conditions called diverticulosis and diverticulitis, and that these radiological distinctions are not helpful in assessing the immediate or subsequent clinical state.

It would be helpful to the clinician to have an accurate radiological assessment of the presence of inflammation, and more definite criteria for the diagnosis of inflammatory changes are being sought by radiologists. There are a number of features which point to the presence of inflammation. An abscess cavity or sinus tract outside the colonic wall but in communication with the lumen of the bowel or occasionally an intramural sinus tract may be outlined. An extramural abscess may not fill with barium but may be recognized by an eccentric impression on the colonic wall. Flattening of the colonic mucosa may result from pressure by an extracolonic mass. A fistula communicating with the bladder or the small bowel may be demonstrable. Fixation of a segment of colon usually represents inflammation provided carcinoma can be confidently excluded. Restricted distensibility or "stiffening" probably indicates similar pathological changes. Oedema of the mucosa or wall of the adjacent small bowel is also an acceptable sign of inflammation.

In spite of the application of modern criteria to 40 cases in this series, however, the variability among radiologists remains high and the correlation of radiological and pathological diagnoses poor. Clearly a high degree of observer variability persists in relation to these diagnostic criteria.

We wish to thank Professor E. A. Cheeseman and his staff of the department of medical statistics, Queen's University, Belfast, for their help in processing the data.

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