30 resected tumours. Boyd (1955, p. 218) also doubts if Broders's grading is of prognostic value in the individual patient.

Discussion

In the present series Dukes's staging proved reliable in prognosis; Broders's grading was less helpful in my hands. If the patient survived the operative period and reached the first anniversary the outlook was good. Three patients did, however, succumb to their carcinoma in the second five-year period. In assessing the results the age-group of the patients must be considered, as excision of a large-bowel tumour cannot confer immortality. In this series 43 (15%) had no treatment for their carcinoma, this being thought too advanced for a short-circuit operation or colostomy. Five patients (1.8%) refused surgery.

There have been many pleas for a more radical outlook in the treatment of colon carcinoma, and Wangenstein *et al.* (1954) have encouraged surgeons to take a second look. Although the numbers in this series are not large enough to prove it, the impression obtained throughout the study was that the end-result was decided by the stage of the tumour at the time of operation rather than the extent of the latter. Earlier diagnosis is therefore the key to better results, but it must be remembered that the family doctor working in this area saw only four cases in 10 years. During this period many patients must have consulted him regarding constipation and slight bleeding from haemorrhoids. Aylett (1949) found an average of nine months' delay between the onset of the initial symptom and arrival at hospital in 155 cases of carcinoma of the rectum and suggested suitable public propaganda to encourage the seeking of medical advice early. Until we are certain that the medical delay is negligible it might be more profitable to concentrate on medical as opposed to public propaganda.

It seems that the published series are often not dealing with comparable groups of patients. Thus in Britain, Naunton Morgan (1955) gives St. Mark's figures for 477 cases of rectal and rectosigmoid carcinoma as 95% resectable, with an operative mortality of 3.2%. Muir (1956), summing up the outlook in colon carcinoma, finds 60% resectable with a 6% operative mortality and a 31% five-year survival rate. Yet the *British Medical Journal* (1955) quotes figures from the Registrar-General's office showing that of the cases of cancer of the rectum registered in 1945-6 at their initial hospital attendance, only 11% of the males and 17% of the females were alive at the end of five years. For the colon the figures were 10% and 14%. In America, Allen (1950) gives a resectability rate of 96% with an operative mortality of 2.4% during 1945-9. In Grinnell's (1953) series the five-year survival rate was 45.5% for the colon and 46.4% for the rectum in those cases in which resection was possible. On the other hand, Cameron, Chapnick, and McLean (1954) sum up the results in Detroit as follows: of 218 cases 40% were discharged presumably cured but only 15.3% were alive and well five years later.

It may be that in the near future surgery as a method of treatment will have to be compared with a non-surgical or part-surgical approach. Care will have to be taken to obtain a wide picture of present results, since it must be presumed that a large percentage of these cases are, in fact, dealt with in the general surgical units of non-teaching hospitals.

Summary

A series of 284 cases of carcinoma of the colon and rectum, the total number admitted to two general surgical units of the Royal Northern Infirmary, Inverness, during 1944-53, are discussed: 130 (46%) had a radical operation; 104 (37%) left hospital with the possibility of cure; seven cases were untraced; and 49 (17%) lived for five or more years.

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SPONTANEOUS RUPTURE OF THE COLON

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Constipation is such a common minor complaint that one is surprised to learn that it may on rare occasions be the cause of a grave acute abdominal condition which, in the absence of urgent surgical treatment, proves rapidly fatal. Yet such is the case. Since Huntley (1919) described the case of an Army officer subject to chronic constipation who collapsed from a tear in the rectosigmoid while straining at stool, a handful of similar cases have been recorded. There is a striking resemblance between most of the descriptions. The patient is troubled by constipation, which may have been aggravated by the ingestion of alkalis for the treatment of a peptic ulcer. He is suddenly taken with acute abdominal pain, more severe in the lower abdomen and left side to begin with. He rapidly becomes collapsed, and on reaching hospital the picture is one of perforation of a hollow viscus. At operation turbid free fluid with a faecal odour is found in the peritoneal cavity, but there is not much evidence of inflammatory change in the peritoneum, which is the more surprising when large lumps of solid faeces are found lying freely in the pelvis. The colon is loaded with faeces and a tear is found in the sigmoid on its antimesenteric border. The hole has a ragged margin, and, although there may be some bruising, a striking feature is the absence of inflammatory change in the

bowel wall around it. The faeces often have a whitish appearance from the presence of bismuth or other alkali. We have encountered four examples of this disorder.

Case Reports

Case 1.—A 67-year-old painter was admitted to hospital in a shocked condition with a nine-hour history of severe generalized abdominal pain. The presence of a duodenal ulcer had been proved, and he had been treating himself for eight years with a variety of alkaline medicines. A diagnosis of a perforated duodenal ulcer was made, but at operation pale rock-like masses of faeces were found lying freely in the peritoneal cavity, about 10 in number, and each measuring about 10 cm. in diameter. In the pelvis, where some faeces had crumbled, faecal fluid was found, but there was relatively little peritoneal reaction. A chronic duodenal ulcer was present. The faeces were removed and a rent 7.5 cm. long on the antimesenteric border of the sigmoid colon at about the rectosigmoid junction was closed. A transverse colostomy was established. After operation the patient's general condition deteriorated and death took place 25 hours later. Necropsy confirmed that, apart from the tear, the colon was normal.

Case 2.—A clerk aged 62 had undergone investigation eight years previously for abdominal colic and constipation, but no cause had been found and a barium-enema examination showed a normal colon. He continued to have similar attacks from time to time, but did not seek further advice. While suffering from an attack of recurrent bronchitis he was admitted to hospital with a 24-hour history of severe abdominal pain and vomiting, this attack being quite different from his usual episodes. The physical signs were those of general peritonitis, and this was confirmed at laparotomy. A quantity of formed faeces was removed from the pelvis, and a half-inch (13-mm.) tear in the antimesenteric border of the sigmoid repaired. His post-operative course was complicated by wound dehiscence on the twelfth day and faecal impaction 12 days later. He was discharged after a five-week stay in hospital.

Case 3.—A farmer aged 74 was crossing the farmyard to the lavatory in answer to an urgent call to stool when he was suddenly taken with severe upper abdominal pain. He did not vomit. During the previous two years he had had occasional episodes of acute abdominal pain lasting several

hours. There was no history of any injury, however trivial, prior to the onset of his present symptoms. He had had a left inguinal hernia for 20 years and for this had worn a truss. On examination he was apprehensive and complaining of pain, but his general condition was fairly good; B.P. 160/80. The abdomen showed generalized tenderness and board-like rigidity. Perforated duodenal ulcer was diagnosed. At operation (R. E. S.) thin purulent fluid and a large quantity of faeces were found in the abdomen. On the antimesenteric border of the pelvic colon a 4-cm. tear was found. The margins were bruised but there was no inflammatory change in the bowel wall. A little further down in the bowel a few diverticula were noted, but there was no evidence of diverticulitis, and the tear was not at the site of a diverticulum. The whole colon and some of the terminal ileum were loaded with solid faeces. The faecal contents of the peritoneum were removed and the affected loop of the colon exteriorized through an incision in the left iliac fossa. The abdomen was closed, with drainage. With gastric suction, intravenous fluids, and chemotherapy he made an excellent recovery and was discharged five weeks later. A barium-enema examination subsequently showed nothing abnormal except for the diverticula noted at operation. He refused to have his colostomy closed.

Case 4.—A 71-year-old retired coalminer had been troubled with indigestion for a few weeks and had also taken "granules" for constipation. He was admitted to hospital with a five-hour history of severe generalized abdominal pain of sudden onset. On examination he was found to be a pale thin man in severe pain. The abdomen was rigid and there was generalized tenderness. B.P. 135/90. After resuscitative treatment the abdomen was explored, the provisional diagnosis being a perforated duodenal ulcer. An anterior duodenal ulcer was found, but there was no perforation. A good deal of free fluid was present in the peritoneal cavity, and the pelvis contained a large quantity of solid faeces. After this had been removed a longitudinal tear 5-6 cm. long was found in the sigmoid, but there were no other changes in the bowel wall to suggest diverticulitis or other disease. The descending and sigmoid colon contained faeces. The tear in the bowel was closed and a proximal inguinal colostomy was performed. With chemotherapy and supportive measures the patient made an uneventful recovery, and 27 days later the colostomy was successfully closed.

Reported Cases of Spontaneous Rupture of the Colon

No.	Author	Age and Sex	Constipation	Hernia	Peptic Ulcer or Alkalies Taken	Muscle Strain	Site of Lesion	Treatment	Result
1	Huntley (1919)	34 M	Yes	No	No	Straining at stool	Rectosigmoid	Suture of perforation	Death
2	Hahn (1931)	37 M	No	B.I.H.	"	" " "	Mid-sigmoid	Perforation converted to external fistula	Recovery
3	Brown (1944)	30 M	"	No	"	No	Rectosigmoid	Suture of perforation	"
4	Hoffert (1946)	63 M	Yes	"	Yes	"	Mid-sigmoid	Exteriorization	"
5	Lataix (1949)	43 F	No	Incisional	No	"	Rectosigmoid	Suture of perforation and colostomy	"
6	Serjeant and Raymond (1952)	67 F	Yes	No	"	"	"	"	"
7	Weinstein and Roberts (1952)	63 M	"	"	"	Straining at stool	Sigmoid	Suture of perforation and caecostomy	"
8	Brearley (1954)	68 M	"	"	Yes	No	"	Exteriorization	Death
9	Mathieson (1954)	41 M	"	"	"	"	"	"	Recovery
10	Pemberton and Kirkman (1954)	55 M	"	"	"	"	"	Abdominal exploration	Death
11	Bradley (1954)	59 M	No	"	No	Straining at stool	Mid-sigmoid	Exteriorization	"
12	Birbis (1955)	38 M	Yes	"	"	" " "	Rectosigmoid	Suture of perforation and colostomy	Recovery
13	"	69 M	"	"	"	" " "	"	"	"
14	Eadie (1955)	57 F	"	"	"	" " "	Mid-sigmoid	Exteriorization	"
15	Henderson (1957)	38 F	"	"	Yes	No	Sigmoid	"	"
16	"	49 F	"	"	No	"	Rectosigmoid	Closure of perforation and colostomy	"
17	Rapp (1958)	69 F	"	"	"	"	Lower sigmoid	Suture of perforation and colostomy	Death
18	"	65 F	No	"	"	"	"	"	Recovery
19	Cronin (1959)	41 M	"	L.I.H.	"	Sneezing	"	"	"
20	"	69 F	Yes	No	Yes	No	Mid-sigmoid	Exteriorization	Death
21	Kirkham (1960)	54 M	"	"	No	Straining at stool	Sigmoid	Suture of perforation and colostomy	Recovery
22	"	76 M	"	"	"	No	Rectosigmoid	"	Death
23	Berger and Shaw	67 M	"	"	Yes	"	"	"	"
24	"	62 M	"	"	No	"	Sigmoid	Suture of perforation	Recovery
25	"	74 M	"	L.I.H.	"	"	Mid-sigmoid	Exteriorization	"
26	"	71 M	"	No	Yes	"	Sigmoid	Suture of perforation and colostomy	"

Discussion

Spontaneous rupture of the colon is a very rare condition. Cronin (1959) could find only eight adult cases in the literature, to which he added two cases of his own, but he appears to have overlooked several other examples. Interesting cases of this disease have been reported by Bradley (1954), Brearley (1954), Mathieson (1954), Pemberton and Kirkman (1954), Rapp (1958), and others. The Table on page 1423 summarizes the main features of these cases.

Mechanism of Rupture

Constipation.—The Table shows the importance of constipation as an aetiological factor in this disorder. Constipation is almost a universal symptom, but in these cases not only is there a history of the symptom but many authors comment on the severe degree of faecal impaction in the bowel and describe the hard rock-like masses which are present. In our Case 3 the whole colon was packed with solid faeces, which also occupied several loops of terminal ileum. To Brearley (1954) must go the credit for pointing out that the constipation may be aggravated by the taking of alkalis for the alleviation of symptoms of peptic ulcer. Out of 20 cases in which constipation was an outstanding feature, 8 were known to have been taking alkali. Brearley stresses that bismuth and aluminium hydroxide are particularly constipating, and more than one writer has commented on the whitish colour of the faeces found in the peritoneal cavity or bowel. In the case described by Serjeant and Raymond (1952) constipation was due to loading of the bowel with barium from a barium meal given the previous day.

Straining at Stool and the Significance of Hernia.—In eight cases there is a clear history of the sudden onset of symptoms while straining at stool and in one instance when sneezing. There can be no doubt that in these patients rupture of the bowel is caused by the sudden contraction of the abdominal muscles, but it is more difficult to explain the mechanism by which it takes place. One expects any rise in intra-abdominal pressure to be transmitted instantaneously to the inside of the bowel, so that there is no disruptive force at the level of the bowel wall. If, however, there is a weak point in the abdominal wall such as exists in the presence of a hernia, then an explosive effect may be produced at this point, and if a loop of bowel overlies the hernial ring it may well rupture. Some such mechanism has been cited in cases of rupture of the bowel with closed abdominal injuries in the presence of hernia. None the less, it does not seem that hernia is a factor of importance in spontaneous rupture of the colon. Only 4 out of 26 cases were reported as having a hernia, and only two out of the eight cases in which a muscle strain precipitated the rupture. The mechanism of rupture in these patients remains unknown.

Diverticulosis.—Edwards (1939) has shown that in the early stages of diverticulosis the muscle wall of the colon may in some areas be very thin or even absent when the bowel from the outside looks normal. Eadie (1955) has suggested that such a colon might be prone to rupture with a relatively low intracolonic pressure. One of our cases had definite diverticula, and Cronin (1959) mentions a similar case which was explored by Corry. On the other hand, most of the other cases of spontaneous rupture which recovered were subjected to barium-enema studies and none were reported as showing even the early signs of diverticulosis.

To summarize, severe constipation, often aggravated by the ingestion of alkalis, is the most important factor in the production of spontaneous rupture of the colon. Perhaps a sudden rise in the intraluminal pressure of the bowel due to contraction of the muscle coat is sufficient to burst the bowel wall, but it must be admitted that the mechanism of rupture is at the moment a mystery. Careful study of future cases may shed further light on this interesting problem. Kirkham (1960) has described a remarkable case in which a man of 54 suffered two spontaneous ruptures of the colon separated by an interval of three years. This suggests that there must be an inherent predisposition to the condition. Bradley's (1954) patient was having treatment with cortisone for rheumatoid arthritis, and this raises the question of an endocrine factor.

One or two other features of this disorder deserve mention. The part of the colon affected is invariably the sigmoid, and no other part of the large bowel has been reported as being the site of spontaneous rupture. The middle of the sigmoid loop and the rectosigmoid junction are the parts usually affected. The large quantity of faeces which may be lying free in the peritoneal cavity is a remarkable and almost unique feature. In perforation of the colon from diverticulitis or carcinoma the amount of faecal escape is very small and only traumatic rupture causes similar massive soiling. On the other hand, several authors have noted the relative absence of peritoneal reaction, and we, too, have been struck by this feature. This, again, is in contrast to the more common types of colonic perforation, where gross peritonitis is the rule.

Diagnosis

Clinically these cases are usually thought to have perforation of a peptic ulcer, especially in those patients who are taking alkalis. It is hardly likely that a pre-operative diagnosis of this rare condition will be made, but it might be thought of in cases of peritonitis of sudden onset where there is a history of severe constipation, the rectum contains hard scybala, and the x-ray film of the abdomen shows opacities from the presence of faeces.

Before a case is accepted as an example of spontaneous rupture of the colon, careful consideration should be given to the possibility of traumatic rupture as a result of self-interference. In these cases it may not be easy to obtain a history of the insertion of a foreign body into the rectum, and in all other respects the case may resemble spontaneous rupture. The point is illustrated by the following example:

A 45-year-old metal-polisher stated that he was perfectly fit until 13 hours before admission, when he suddenly developed severe abdominal pain and vomiting. The signs supported a diagnosis of peritonitis, and at laparotomy there were soft faeces in the peritoneal cavity. A clean longitudinal laceration in the sigmoid colon was found on its antimesenteric border. This was closed and a transverse colostomy established. The colostomy was closed 18 days later and he was discharged after a six-weeks stay in hospital. Not until after the laparotomy did it materialize that the sigmoid perforation was caused by the perverted use of a cricket-bat handle.

Treatment and Prognosis

Treatment of spontaneous rupture of the colon is fairly straightforward and follows well-established surgical principles. After adequate resuscitation the

abdomen is explored, the faeces are removed, and the peritoneum is cleaned. If the rupture is in the mid-sigmoid the affected loop is exteriorized as a colostomy; if in the rectosigmoid, the rent is sutured and a proximal colostomy performed. The customary post-operative regime for a case of general peritonitis is followed, but the possibility of impaction of faeces developing must be borne in mind. Later the colostomy is closed.

The condition is a very grave one. Eight out of 26 patients have died, and a mortality figure of 31% may underestimate the true position because the fatal cases are less likely to have been reported. Death has nearly always taken place during the first three days from shock or peritonitis, although Brearley's case survived until the eleventh day and died of secondary haemorrhage from the colostomy.

Stercoral Ulceration Leading to Perforation

In spontaneous rupture of the colon associated with constipation it is clear that we are dealing with an acute condition in which there is a sudden breach of bowel wall which was previously healthy. There is uniform agreement that the margins of the tear are normal except for some bruising, and this has been confirmed several times by histological examination. We now turn to a different condition in which constipation may also cause perforation of the colon. The pressure of firm scybala on the bowel lining may induce ischaemic necrosis and eventually perforation. The pathology of this interesting disorder has been studied by Grinvalsky and Bowerman (1959), who reported 10 cases of stercoral ulcers of the large bowel, in four of which perforation had taken place. They estimate the incidence of stercoral ulceration as 4.6% of all necropsies, and found it was almost confined to the elderly. The lesions sometimes cause severe rectal bleeding. The ulcers may be confined to the recto-sigmoid or have a more generalized distribution in the colon. They have an irregular outline conforming to the contours of the faecal masses, while the ulcer floor shows dark discoloration and thinning of the wall. Histologically there is denuding of the mucosa, ischaemic necrosis of the deeper layers, and minimal inflammatory change. The perforations are sometimes multiple.

We have met two examples of perforation of the colon of this type.

Case A.—A 54-year-old housewife gave an eight-years history of dyspepsia relieved by various alkalis. A barium-meal examination showed the presence of a duodenal ulcer, and she was advised to take aluminium phosphate. Three months later she was admitted to hospital 12 hours after the sudden onset of lower abdominal pain and repeated vomiting, with a pulse of 88, and a temperature of 98° F. (36.7° C.). There was tenderness without guarding in the left lower abdomen, and the rectum was loaded with scybala. She was given two suppositories and kept under observation. After 24 hours she had less pain. There was no change in the tenderness, the temperature was 100° F. (37.8° C.), the pulse 98, and neither flatus nor faeces had been passed. In view of the rock-like nature of the faeces a diagnosis of stercoral ulceration was made. At operation (P. L. B.) the site of the perforation was found to be on the mesocolic border of the sigmoid, and a faecalith 2.5 cm. in diameter appeared to be partly extruded between the two leaves of the sigmoid mesocolon. The margin of the perforation was gangrenous. The affected segment of colon was exteriorized as in Paul's operation. The post-operative course was complicated by a wound infection and right-

lower-lobe collapse. In due course the colostomy was closed and she was discharged after six weeks' stay in hospital. The specimen showed that other areas of stercoral ulceration were present in the sigmoid.

Case B.—A poorly nourished man of 68 came into hospital with a history and physical signs consistent with a diagnosis of a perforated duodenal ulcer of 10 hours' duration. For eight years he had suffered from bouts of abdominal pain relieved by alkalis. Unfortunately he was in a state of peripheral vascular failure which proved to be irreversible, and death took place within half an hour. Necropsy revealed faecal peritonitis. The left colon was loaded with scybala and was the seat of stercoral ulceration. Perforation of the rectosigmoid had taken place.

The part played by alkalis in producing constipation is an interesting feature of both these cases.

Summary

Four cases of spontaneous rupture of the colon and two cases of stercoral ulceration of the colon leading to perforation are described.

Both these conditions are related to severe constipation, often aggravated by the taking of alkalis.

Other factors that may play a part in some cases of spontaneous rupture of the colon are (a) sudden contraction of the abdominal muscles, as in straining at stool; (b) early diverticulosis; and (c) hernia.

The precise mechanism of rupture is unknown.

The diagnosis and treatment are discussed.

Both conditions are grave and the mortality is high.

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"A set of photographic copies of 39 mortality bills for 1603-4 has been added to the Guildhall Library's collection of London literature. The originals were recently acquired by Harvard University library. These particular bills appear to be unique and hitherto unknown. The numerous historians who have used bills, from Graunt and Petty in the seventeenth century onwards, were unaware of their existence. They form part of a series of which, so far as is known, the most complete set, ranging from 1581 up to 1858, is in the Guildhall Library. Issued under the auspices of the Company of Parish Clerks, they record, either weekly or yearly, the numbers and causes of deaths in London, and the christenings, and are a unique source of vital statistics." (*The Times*, March 22.)