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Motility of the pelvic colon

Part IV Abdominal pain associated with colonic hypermotility after meals[1]

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EDITORIAL SYNOPSIS This paper defines a syndrome of abdominal pain associated with colonic hypermotility after meals. These are patients with '*x*-ray negative dyspepsias', with discomfort, flatulence, and sometimes quite severe pain, particularly after food, in whom can be shown markedly overactive motility of the colon; these patients also develop exceptionally high pressures in the sigmoid colon. The movement of faeces through the colon is paradoxically slowed down by this abnormal colonic smooth muscle reaction. These patients constitute a subdivision of the clinical group often referred to as suffering from spastic colon.

It has been estimated that nearly a half of all patients attending a gastroenterological out-patient department remain undiagnosed even after the most intensive investigations (Avery Jones and Pollak, 1945). The majority of these patients suffer from attacks of abdominal pain which may be associated with a disturbance of bowel habit and aggravated by meals. It is commonly assumed that visceral pains of this type are muscular in origin as implied by such clinical labels as 'pylorospasm', 'spastic or irritable colon', or 'disordered gastrocolic reflex'. There is little or no evidence to confirm or refute these clinical impressions because there is no direct method of recording the electrical and mechanical activity of intestinal smooth muscle in man.

However, the recent development of methods for recording pressures within the lumen of the gut with fine tubes and radio pills has provided an indirect index of muscular activity which has proved useful in investigating these patients. It has been shown, for example, that the effect of the pressure waves recorded from the (sigmoid) colon is to delay the forward movement of the contents, that colonic movements are usually diminished or absent in diarrhoeal states but increased in constipation, and that meals usually stimulate muscular movements throughout the small and large intestines (Connell, 1959, 1961, 1962; Connell, McCall, Misiewicz, and Rowlands, 1963). Some patients show an exaggerated response to food and in this paper we describe a group of patients suffering from postprandial pain and distension of unknown aetiology who showed exceptionally high pressures in the sigmoid colon when they developed their typical symptoms after eating.

[1] Parts I, II, and III were published in *Gut* in 1961, 1962, and 1964.

METHODS AND PATIENTS

METHODS Three fine polyethylene tubes were passed into the sigmoid colon so that the recording tips were at 25, 20, and 15 cm. respectively from the anus. Pressures were recorded simultaneously from these three points by connecting the tubes to optical manometers recording on photographic paper (Rowlands, Honour, Edwards, and Corbett, 1953) or to electromanometers and direct writing systems (Schwartzer direct writing polyphysiograph). The tubes cause no sensation whatsoever and the patient lies comfortably in any desired position. After at least 30 and usually 60 minutes of recording, the patient ate lunch without interrupting the recording which was continued for a further 30 minutes at least. Small intestinal motility was also measured in one of the patients using a radio telemetering capsule (Connell and Rowlands, 1960).

Each tracing was analysed in the following way: 1, by measuring the height of each pressure wave and calculating the mean amplitude of all the waves; 2, by measuring the duration of each wave and calculating the percentage of the total recording time during which pressure waves occurred; and 3, by multiplying the mean amplitude by the percentage duration of activity, *i.e.*, $1 \times 2 =$ index of total activity. For each recording a separate analysis was made of the periods before and after eating, and the pressures from the sigmoid (pressure tube at 25 cm. from the anus) were tabulated separately from those of the rectum (tracing from tube at 15 cm. from anus).

PATIENTS Pressures were recorded in three groups of patients before and after a meal. The 17 patients in group A had duodenal ulcers but all were in remission at the time of study. The 34 patients in group B complained of

intermittent abdominal pain, distension, or discomfort often associated with an alteration in bowel habit. They were regarded as cases of spastic colon after all radiological, biochemical, and bacteriological investigations had proved negative. The 12 patients in group C complained of intermittent attacks of post-prandial abdominal pain, discomfort, and distension, usually relieved by passing flatus, and sometimes associated with minor alterations in bowel habit; all investigations were negative, including laparotomy in three. Unlike group B these patients' symptoms were brought on or aggravated by meals and every patient developed his usual symptoms during the study after eating. Eleven of the patients in group B thought that their symptoms were sometimes worse after eating but no patient in this group developed symptoms during the study. The main interest of this study centres around group C and the following case histories illustrate the type of patients in this group:—

Patient 1 This patient was a surgeon, aged 40. He had symptoms suggestive of a duodenal ulcer as a student but was completely fit during his Army service. In 1951 he began to suffer intermittent bouts of upper abdominal discomfort, characterized by a feeling of distension occurring during or immediately following a meal. This was worse after a large meal or after smoking, which also caused nausea. At times, the symptom was appreciated as severe abdominal pain which might be relieved by passing flatus or by lying down. Two barium meals and cholecystograms done at this time were negative as was a further barium meal done in 1955. By 1958 his symptoms had become more frequent and more severe. He still complained of hunger pains suggestive of an ulcer, but the main complaint was of visible distension and nausea occurring at meal times which was not only physically uncomfortable but also socially embarrassing. He was slowly losing weight. He had also had several attacks of

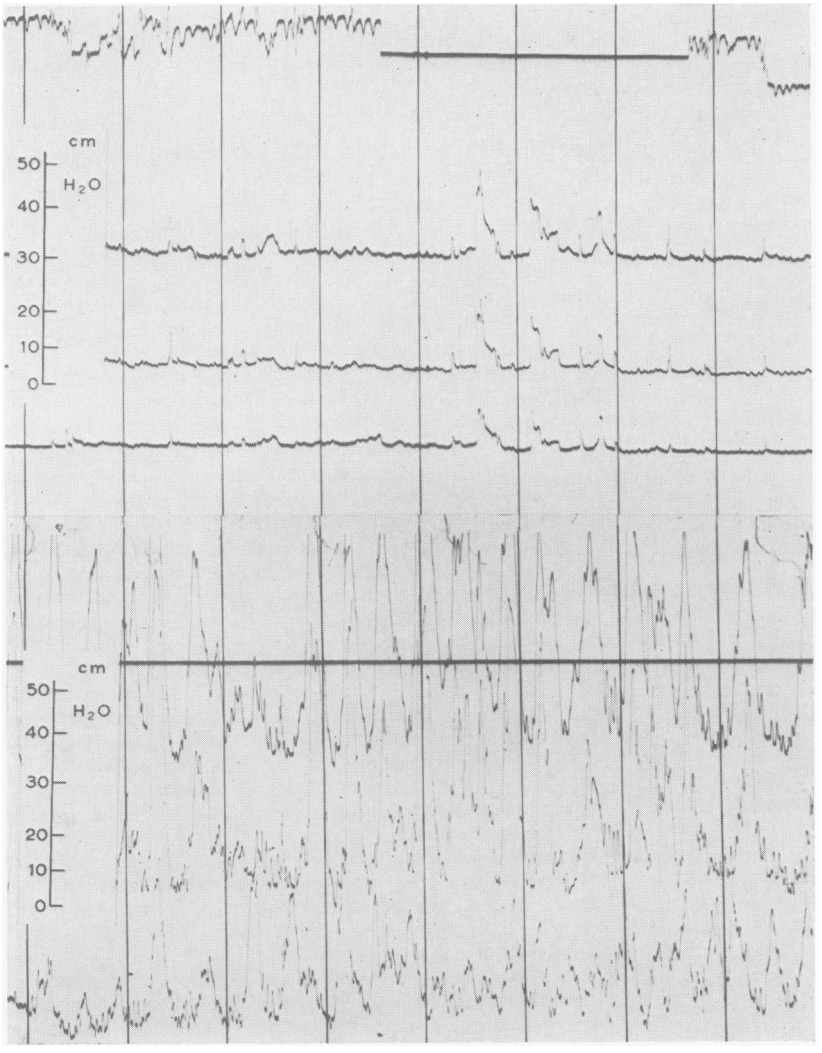

FIG. 1. *The motility of the sigmoid colon in case 1. Above: Motility before lunch. Below: Motility after lunch when symptoms were present. In each case upper trace is from sigmoid, lowest trace from the upper rectum, and the middle trace from the recto sigmoid. Vertical lines represent one-minute intervals.*

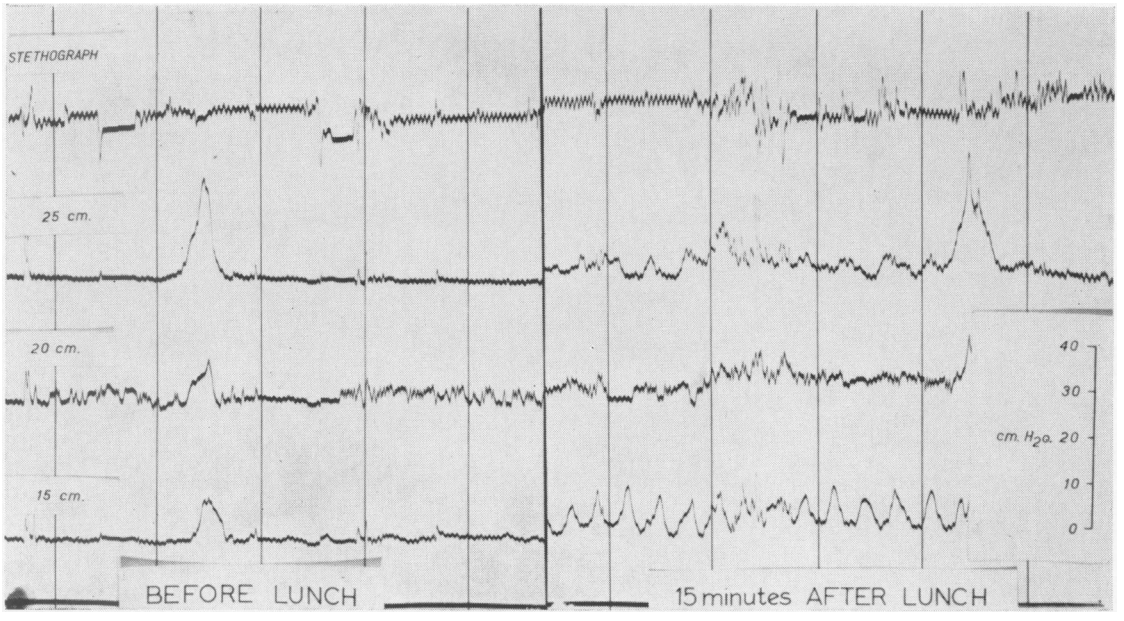

FIG. 2. *The motility of the sigmoid before and after lunch in a normal person.*

abdominal discomfort associated with diarrhoea lasting one or two days. Yet another barium meal in 1958 was done which produced very equivocal evidence of a duodenal ulcer. Follow-through of the barium revealed no abnormality in the small bowel. Sigmoidoscopy was also normal.

At this stage he was given a meal mixed with some barium to make it radio-opaque and its progress was followed fluoroscopically using an image intensifier while the motility of the colon was being recorded. Following the meal and smoking two cigarettes he developed a feeling of distension and mild colic. Screening showed no hold up of the food nor any precipitate emptying. The stomach air bubble was normal but some air appeared in the descending colon. The motility record, however, changed dramatically and gross colonic hypermotility was seen which began during smoking and was reinforced by the meal (Fig. 1). This increased activity is greatly in excess of the normal response to a meal (Fig. 2). Several months afterwards he had a further severe attack simulating intestinal obstruction for which a laparotomy was undertaken (Professor Sir J. Bruce) but this revealed no anatomical abnormality in the gastrointestinal tract. He has remained well for the past four years and attributes this to stopping smoking.

Patient 2 This patient was a successful Australian business man, aged 56. All his life he had had periodic bouts of abdominal discomfort, characterized by distension, mild colic, flatulence, and excessive flatus. In 1958 he had a diarrhoeal illness of obscure aetiology, following which his symptoms became more severe and he began to experience right-sided abdominal pain which sometimes radiated over the abdomen. The pain was worse after food and sometimes culminated in vomiting, but could be relieved by passing flatus or by defaecation. These symptoms were periodic and lasted two or three days with intervals of two or three months. He lost 40 lb. of weight in two years. During this period he consulted a number of senior physicians in various countries during a world trip but was reassured that his trouble was 'nerves' on each occasion. Two barium meals were reported as normal. Following an acute attack of pain he was admitted to hospital as an abdominal emergency but no abnormality was found. In February, 1960, following another acute episode, he had a resection of a volvulus of the sigmoid colon but no other abnormality was noted at laparotomy. Unfortunately, there was no improvement in symptoms following this operation and a subsequent barium enema aroused suspicion of a stricture at the site of bowel resection. This area of bowel was later resected, but without any relief of symptoms.

Subsequently he was admitted to Central Middlesex Hospital where he had a manometric study of colonic motility before and during an attack of pain precipitated by a meal containing items of diet claimed to have precipitated symptoms previously. The severe pain experienced coincided closely in time with colonic hypermotility (Fig. 3). The pain was relieved by a bowel action promoted by suppositories. Sigmoidoscopy was normal and a barium enema performed the following day showed no abnormality in the colon. During a subsequent attack of pain, a plain film of the abdomen was taken which revealed some distension of the small intestine in the left upper abdomen.

Patient 3 This patient, a director of a department of medical research, had a two-year history of periodic

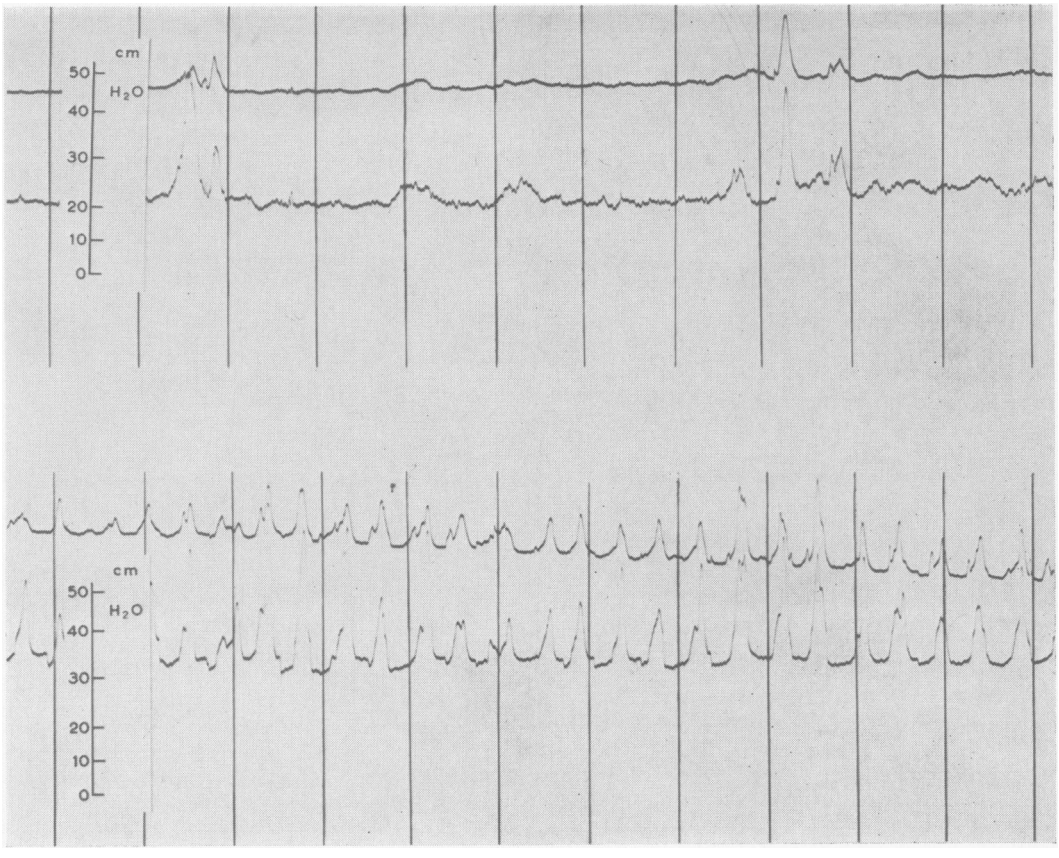

FIG. 3. *The motility of the sigmoid colon in case 2. Upper trace is motility before food, lower trace motility after eating at a time when symptoms were present. Records from 25 and 20 cm. from the anus.*

bouts of intermittent abdominal discomfort which was usually post prandial and most consistently produced by a good satiating meal rather than by a less attractive one. In this case, too, attacks were sometimes very severe and the pain which developed was associated with nausea and sometimes vomiting. Contributing to the discomfort was the urge to pass flatus without the ability to do so. The remissions and relapses were irregular. Relapses lasted a week to 10 days separated by remissions of between three and eight weeks. During the relapses the patient was pale, lost weight, and felt tired and generally unfit for concentrated work. Investigations, including barium meal, cholecystogram, sigmoidoscopy, and E.S.R, were all normal.

During a period of relapse, a colonic motility study was performed during which the patient was given an attractive meal. Following this he complained of mild discomfort which developed over a period of one hour into lower abdominal pain. These symptoms were associated with the colonic hypermotility illustrated in Figure 4.

Patient 4 This patient was a land agent, aged 40, leading a healthy, active, outdoor life but who for 10 years had suffered from intermittent attacks of abdominal discomfort. The attacks, which lasted several days, consisted of a feeling of distension sometimes sufficiently severe to be recognized as pain in the centre of the abdomen, often radiating to the side. It could be sufficiently severe to prevent sleep. Relief could be obtained by belching although he did not pass much flatus. Attacks were as likely to occur after light as after heavy meals and just as frequently on holiday as when at work. Barium meal and follow-through, cholecystogram, examination of the stool for pathogens, E.S.R., and blood count were all normal.

In this patient colonic hypermotility was seen following a meal which reproduced his symptoms (Fig. 5). A second study was undertaken and his symptoms were reproduced exactly by the gentle insertion of air into the stomach. The colonic hyperactivity began immediately following the introduction of the first 200 ml. of air into the stomach, and before any discomfort was noted. A study of the motility of the small intestine of this patient using a telemetering capsule also showed grossly exaggerated segmental contractions in the terminal ileum after eating (Fig. 6).

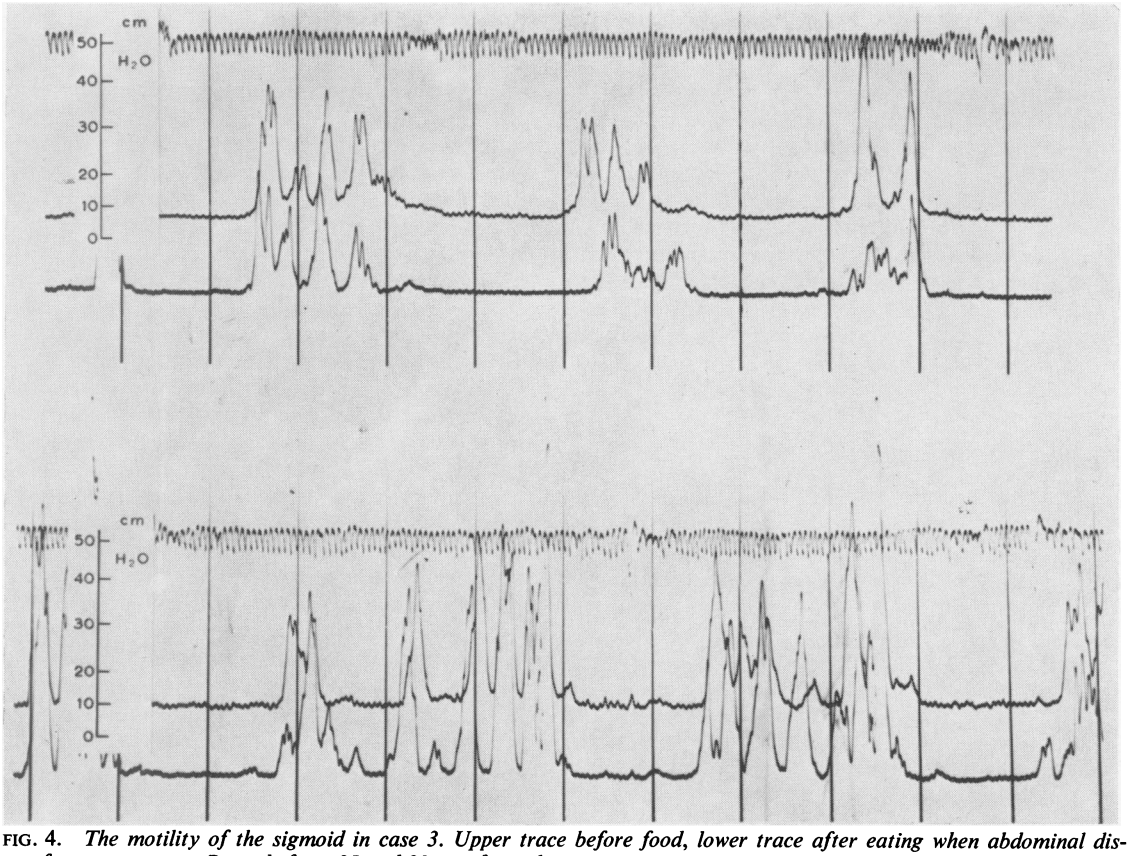

FIG. 4. *The motility of the sigmoid in case 3. Upper trace before food, lower trace after eating when abdominal discomfort was present. Records from 25 and 20 cm. from the anus.*

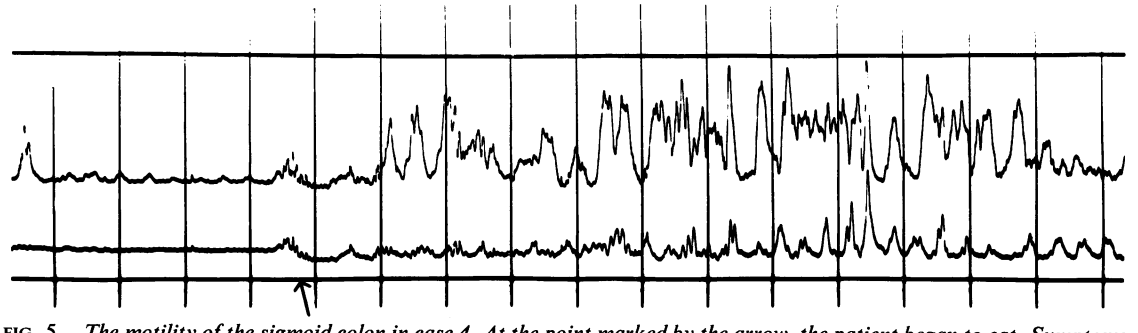

FIG. 5. *The motility of the sigmoid colon in case 4. At the point marked by the arrow, the patient began to eat. Symptoms began five minutes after beginning the meal. Records from 25 and 20 cm. from the anus.*

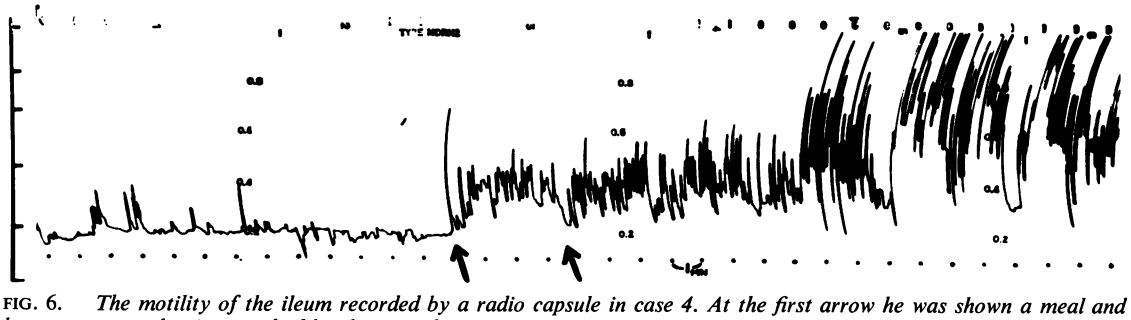

FIG. 6. *The motility of the ileum recorded by a radio capsule in case 4. At the first arrow he was shown a meal and began to eat at the time marked by the second arrow.*

RESULTS

Table I sets out the mean values for the duration of activity, the mean amplitude of the waves, and the index of total activity (= duration of activity × mean amplitude) of the three groups of subjects before lunch and in the first 30 minutes after lunch. Figure 7 shows the effect on the index of total activity for each patient in the three groups. The group who developed symptoms following lunch (group C) differed from the other groups in two important respects, *viz.*, the resting motility, especially the percentage duration of activity, was greater, and also the increase in total activity after eating was both proportionately and absolutely greater than in the other groups. In group C the resting level of motility was doubled after eating, and this could have occurred by chance less than one time in twenty.

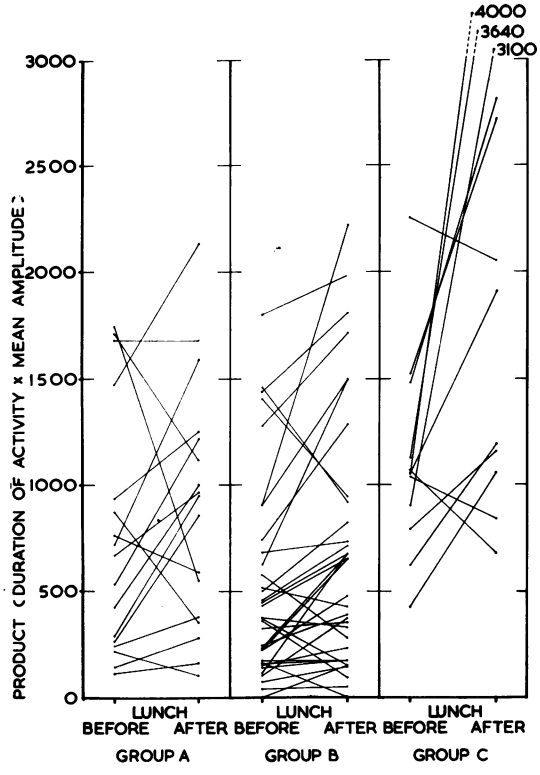

FIG. 7. *The estimate of total activity (duration of activity × mean amplitude) in the three groups of patients before and after lunch.*

The difference between group C and the other groups is even greater if the half-hour period after eating in which their symptoms were at a maximum is used for comparison. This occurred in the first half hour on eight occasions, in the second half hour on three occasions and in the third half-hour period after eating on one occasion. Table II presents the various parameters of motility measured during the half-hour period in which symptoms were maximal in group C, and during both the first half hour after eating and the second half hour after eating, in 12 patients in the other two groups for whom such data are available. It will be seen that there is no significant difference between the motility in the first and second half-hour periods.

TABLE II

SIGMOID ACTIVITY OF 12 PATIENTS WITHOUT SYMPTOMS IN THE FIRST AND SECOND 30 MINUTES AFTER FOOD COMPARED WITH THAT OF PATIENTS WITH SYMPTOMS AT THE TIME OF THEIR MAXIMUM INTENSITY

	Duration of Activity	*Mean Activity*	*Total Activity*
Without symptoms in first 30 min. after food	59·4	10·6	715
Without symptoms in second 30 min. after food	54·6	11·6	748
Group C (maximum symptoms)	92·2	24·5	2273

Two patients were examined on two occasions. One of them developed his symptoms and showed colonic hypermotility on both occasions. In the second patient symptoms occurred in the first test but not in the second, and his colonic motility value was much higher in the first study than in the second.

TABLE I

MOTILITY OF THE SIGMOID COLON IN THE 30 MINUTES BEFORE LUNCH AND THE 30 MINUTES IMMEDIATELY AFTER LUNCH

Group	*No. of Cases*	*Before Lunch*			*After Lunch*		
		Duration of Activity	*Mean Activity*	*Total Activity*	*Duration of Activity*	*Mean Activity*	*Total Activity*
A (duodenal ulcer)	17	55·5	12·6	753	61·4	13·5	892
B (spastic colon)	34	43·1	11·9	520	49·9	13·2	678
C (symptomatic patients)	12	77·4	14·7	1114	88·6	22·6	2096
A + B	51	47·2	12·1	597	53·7	13·3	749

TABLE III

MOTILITY OF THE RECTUM IN THE 30 MINUTES BEFORE LUNCH AND THE 30 MINUTES IMMEDIATELY AFTER LUNCH

Group	*No. of Cases*	*Before Lunch*			*After Lunch*		
		Duration of Activity	*Mean Activity*	*Total Activity*	*Duration of Activity*	*Mean Activity*	*Total Activity*
A	7	43·6	7·7	375	47·1	7·3	371
B	29	42·8	7·2	402	43·4	8·1	413
C	6	52·7	4·9	347	61·3	8·4	520

Table III presents the mean values for duration of activity, mean amplitude, and the index of total activity (duration of activity × mean amplitude) for the records from the rectum of the patients studied. The effect of eating is less marked, and even in the symptomatic group the augmentation of motility after eating is slight and could have occurred by chance. It seems probable, indeed, that any augmentation which did occur was the result of passively transmitted pressures from the sigmoid to the rectum.

DISCUSSION

Before attempting to assess the association of hypermotility and pain in these patients it is necessary to discuss the significance of the pressures recorded from the lumen of the sigmoid colon. When pressure tracings are made simultaneously, as in this study, from three segments 5 cm. apart the patterns of the pressures recorded are often completely different; there may be no waves at all in one segment while another shows great activity and the third shows just a few waves of low amplitude. The waves are hardly ever progressive from the upper segment to the lower nor simultaneous in all three segments. Hence the tips of the tubes must be recording from three separate segments which do not intercommunicate freely. These dissociated, independent, segmenting contractions must have the effect of delaying rather than facilitating the movement of faeces. They probably correspond to the so-called haustral contractions observed at length by radiologists of a previous generation before the dangers of excessive radiation were fully appreciated. Barclay (1935) and others have described how these colonic contractions mix and churn the contents but do not propel them forwards, and they noted that these contractions ceased immediately before the contents of a segment of colon were suddenly moved forwards by a mass movement. Similarly it has been shown that the pressure waves in the sigmoid colon are usually increased in constipated patients but diminished or absent in diarrhoeal states (Connell, 1962). In the absence of segmenting contractions only a small gradient of pressure is needed to empty the stomach or to expel contents from the small intestine (Posey and Bargen, 1951), and presumably this also applies to the colon if the faeces are fluid.

Thus the effect of the gastro-colic response in our patients who developed high pressures after eating would be to delay the movement of faeces through the colon. This of course is the reverse of what is usually meant by the gastro-colic reflex, *viz.*, the call to stool which is thought to be initiated by a mass movement. Although it is commonly stated that mass movements occur after meals the evidence for this is very slender, and Barclay himself said that there was no radiological proof that the entrance of the faecal mass into the rectum was brought about by a mass movement. On the other hand, there is no reason why the gastro-colic reflex should not initiate a mass movement at one time or in one part of the colon and segmenting or delaying contractions in another. In our patients the effect of the gastro-colic reflex was clearly to hold up the passage of faeces through the sigmoid. It is also possible and indeed likely that segmenting contractions were stimulated throughout the small and large intestine. The precise relationship between the post-prandial hypermotility in these patients and their symptoms remains speculative, because vigorous contractions certainly occur in many patients without symptoms of any kind. The most likely explanation, however, it that the exaggerated segmenting contractions constitute a functional obstruction, and indeed two of the patients were operated on for suspected obstruction.

In attempting to elucidate the mechanism of the symptoms it may be significant that patients who develop symptoms following food usually have a high level of motility under resting conditions. The most common time for symptoms to occur is in the evening when the level of colonic motility is probably at its highest due to local mechanical factors resulting from the accumulation of faeces and to emotional factors caused by the stresses of the day. One patient, for example, found that the symptoms were most likely to occur at a dinner at which he had to make a speech. The sight and taste of a meal augment the segmenting contractions and the effect of this gastro-ileo-colic response super-

imposed on a previously raised level of activity is to cause grossly exaggerated motility. It may be of importance that some patients complain that a good appetising meal is more likely to provoke symptoms than a plain one since the former would be expected to stimulate powerful colonic activity due to psychic stimuli. During the eating of the meal, air is swallowed in the normal way. Air is known to pass rapidly along the gastrointestinal tract (Morris, Ivy, and Maddock, 1947), but on reaching the colon, instead of being passed, it may be trapped by the exaggerated segmentation thus causing local distension of the gut which gives rise to discomfort or in the more severe cases, to pain. If the patient stops eating, retires from company, and lies down (all of which may reduce colonic motility) the symptoms usually disappear. Of two patients examined radiologically when symptoms were present, gas was seen in the colon in one and in the small intestine in the second, but it is difficult to evaluate the importance of this finding since it is not easy to obtain reliable quantitative data about the normal amounts of gas in the alimentary tract.

Clearly this explanation of a patient's symptoms could only be entertained after all the usual investigations had proved negative. Hypermotility of the sigmoid might well occur reflexly in association with any one of a large number of pathological lesions in the gut or abdominal viscera. There is also the possibility that it was the pain which caused the hypermotility rather than vice versa, but this explanation is unlikely in these patients because the hypermotility usually began some minutes before the discomfort was appreciated, thus the finding of sigmoid hypermotility is a useful diagnostic pointer when all other investigations are negative in patients suffering from abdominal distension or pain after eating and usually associated with a minor disturbance of bowel habit.

SUMMARY

Patients are described who suffer from a syndrome characterized by periodic post-prandial abdominal pain and distension sometimes associated with nausea and a minor disturbance of bowel habit, but with negative radiological findings.

Pressure records show that these patients have gross hyperactivity of the sigmoid colon at the time the symptoms occur, resulting from increased basal activity with a superimposed exaggerated response to food.

The motility response of the rectum to eating is slight.

The clinical significance of the sigmoid hypermotility and the mechanism of the symptoms are discussed.

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