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CORRELATION OF THE RADIOLOGICAL AND OPERATIVE FINDINGS IN CHRONIC APPENDICITIS

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During the last few years great improvements have been made in the technique of radiological examination of the diseased appendix, and it has now become possible to confirm the diagnosis of disease of this structure with certainty in a high percentage of cases by radiological examination, and to predict the conditions which will be found on operation. In the majority of cases the diagnosis can be made on clinical evidence alone, and the radiological findings are confirmatory, but there is a small group in which clinical evidence pointing to the appendix as the cause of the symptoms is lacking or doubtful, and it is in these cases that the radiological findings are of the greatest importance. If an operation is to be based on these findings it is obvious that they should be as precise as possible.

It appeared to both of us that if a series of known cases of appendicitis examined by the same radiologist and operated upon by the same surgeon were collected, and the clinical, radiological, operative, and pathological findings correlated, it might be possible to associate certain radiological findings with definite pathological conditions, thereby not only establishing the diagnosis with certainty, but also materially assisting the surgeon in his choice of incision by indicating the probability of extensive adhesions, a retrocaecal appendix, etc.

The present series of fifty-eight cases were all patients in the Medical College Hospital, Calcutta, and were under the charge of the writers as surgeon and radiologist respectively. Only chronic or interval cases were utilized for the investigation, though in some cases an acute attack had occurred shortly before, and in others a recrudescence of acute symptoms was brought on by the examination, which was undertaken as early as was considered prudent.

Clinical Classification

The fifty-eight cases were divided into four clinical types.

Type A.—Cases with a history of one or more definite acute attacks, separated by intervals. In most of these evidence of acute inflammation was present in the form of fever in one or more of the attacks—thirty-one cases.

Type AB.—Cases in which one or more attacks of the "A" type were succeeded by a chronic condition, characterized by irregular attacks of pain of varying duration and by constant flatulent dyspepsia—six cases.

Type B.—Attacks of appendicular colic at irregular intervals, with no definite history of the first attack and no fever at any time. The duration of these attacks varied from a few seconds to hours, vomiting often occurred when the pain was severe, and flatulent dyspepsia was frequently present between the attacks. The pain was apt to be brought on by exercise—thirteen cases.

Type C.—Digestive symptoms of a vague character, such as flatulence, hyperacidity, indefinitely localized abdominal pain, poor appetite, and discomfort after food. These symptoms had usually been present for several years, but there was no history of acute attacks, and they resembled those of chronic cholecystitis. The stomach, duodenum, and gall-bladder were, however, found to be normal on x-ray examination. It was in these cases that the special points in the radiography of the appendix proved of such value in indicating the seat of the disease—eight cases.

RACIAL DISTRIBUTION

TABLE I

Race	A	AB	B	C	Total
Europeans	8	2	4	6	20
Anglo-Indians, Jews, and Armenians	10	3	9	2	24
Indians	13	1	0	0	14
Totals	31	6	13	8	58

These figures must not be taken as indicating that Indians do not suffer from the symptoms classified as the "B" and "C" types. They merely mean that Indians do not readily submit to operation for comparatively mild abdominal symptoms, so that only cases of the more severe types, classified as "A" and "AB," reach the surgeon.

Previous History

Chronic constipation was present in only eighteen of the fifty-eight cases; of these five were Indian cases and thirteen were Anglo-Indians and Europeans, figures which are in proportion to the totals of each race. It has been suggested that Indians who adopt European diet are more prone to develop the disease than those who adhere to the traditional Indian dietary. This is contrary to our experience in Calcutta, where very few Indians adopt

European diet, partly on account of the expense, and partly because they consider it less palatable and less suited to the climate. The average Bengali diet consists mainly of rice, vegetables, and fish, cooked in mustard oil; some unleavened bread and occasionally meat are taken by the well-to-do classes. All the Indian patients in this series used the ordinary diet of the country, and none had ever taken European diet. (Owing to the amount of cellulose in their diet chronic constipation is rare in Indians.)

Twenty cases gave a history of dysentery, recent or remote, an incidence much higher, of course, than would be met with in Europe. The bearing of this on diagnosis is so important that these cases will be discussed in more detail later, after the radiological findings have been considered. A history of dyspepsia preceding the attack of appendicitis was inquired for in all cases, but was only obtained in four cases, all of the "A" type.

Analysis of Symptoms

The classification of the cases into types was made after a careful investigation of the histories. Pain was of course the principle symptom in all types; in the attacks of acute inflammation which characterized types "A" and "AB" it was accompanied by vomiting, fever, and the presence of an inflammatory mass in one or more attacks, as shown in Table II.

TABLE II

Type	Number of Cases	Vomiting	Fever	Inflammatory Mass
A	31	21	22	12
AB	6	4	3	0
B	13	3	0	0
C	8	2	0	0

Of the Type A cases eleven gave a history of a mass forming during the attack, which in five cases was unresolved on admission; in two cases an acute attack was precipitated by the radiological examination, in one of which there was no history of a lump during the previous three attacks.

Interval symptoms were complained of in nineteen cases, as follows:

TABLE III

Type	Number of Cases	Constant Pain in R.I.F. apart from Appendicular Colic	Discomfort after Food and Flatulence
A	10	9	2
AB	4	2	2
B	5	0	5

In the Type C case the symptoms are continuous and of the same character as the interval symptoms in the other types.

Technique of Radiological Examination

(1) Preparation is essential to success. (a) A mild purgative such as pulv. glycyrrhizae co., or cascara evacuant, is taken thirty to thirty-six hours before the opaque meal; (b) light diet is taken after this, and it should be free from substances which create a large residue; and (c) eight to twelve hours before the opaque meal a hot high saline enema should be given.

(2) *The Opaque Meal* consists of any of the usual preparations. We use "bariomeal" in a pint of water.

No food is allowed until after the first x-ray examination, which takes place five hours later.

(3) *The First Examination*.—The following points should be noted: (a) The presence and extent of gastric residues. (b) Any obvious residue in an ulcer niche or in the duodenum. (c) The amount of residue in the small intestine and its character—for example, certain types of flocculent residue in the valvulae conniventes may indicate tabes mesenterica; an irregular collection of puddles in loops of small intestine may be due to obstruction. (d) Obvious spasm, and in some cases regurgitation, may sometimes be seen at the ileo-caecal valve. Normally at this period the caecum should be filled and the meal be somewhere in the vicinity of the hepatic flexure; but a large amount of variation is met with in this respect. It is rare to see the appendix at this time, chiefly because of the overlapping of the barium-filled small intestine. Any obvious displacement or irregularity must of course be noted.

(4) *The Motor Meal*.—This is the next step in the investigation. It should be bulky in nature, rice being excellent for the purpose.

(5) *The Second Examination* takes place nine hours after the original opaque meal was given. In our hospital series many of these cases have been examined at six and ten hours, but this seems to make little difference; the important point appears to be the four-hour interval between the motor meal and the next examination. At nine or ten hours, as the case may be, the small intestine should be clear, and no traces of the meal should be left. The presence of barium in the intestine at this time constitutes a positive *gastro-ileal reflex*. This must be carefully looked for, the patient being rotated to the lateral position and the pericaecal region screened, or if necessary radiographed. The head of the meal at this period should be near the splenic flexure or in the descending colon. The appendix is usually seen now. Its position is noted, as well as any obvious filling defect. This is also the moment for the following points to be noted: (a) Mobility of the caecum. (b) Character and position of the caecum—whether "sliding," "periwinkle" (Jordan), or dilated. (c) Spasm in the caecum or in the ileo-caecal valve if the gastro-ileal reflex is positive. Regurgitation at this point. In cases of tuberculous disease of the caecum spasm is a very marked feature, and a large gap in the filling is usually caused. (d) Tenderness or not on direct palpation over the visualized appendix, or in cases where the latter is not seen over the caput caeci. The colon should also be critically examined at this time, and any obvious signs of disease such as colitis noted. (e) The appendix itself may (1) be displaced; (2) be adherent at the tip, or throughout its length; (3) have an irregular lumen with, possibly, constrictions; (4) have a bulbous tip or be expanded elsewhere; (5) have a markedly constricted lumen; (6) have "kinks"; (7) be unusually long. After this examination the patient may go on to his ordinary diet.

6. *The Third Examination* is done at fifteen to sixteen hours after the opaque meal. Normally at this time the head of the meal should be in the sigmoid colon. Stasis should be looked for. If the appendix was not seen at the previous examination it may be seen now. Normally the caecum should be emptying, and often a retrocaecal appendix, which is bound down by adhesions, may be visualized, owing to the emptying of the caecum. This may in some cases be delayed until the next examination.

7. *The Fourth Examination* is done at thirty hours, when the caecum and appendix should normally be quite empty. Should a residue be present a further examination may be done at forty-two to fifty hours.

Summary of Chief Points in Examination

Direct evidence comprises the following features. (a) The visualization of an obviously irregularly filling appendix, with, possibly, a bulbous end or concretions. (b) Direct tenderness over this, which may be absent if the inflammatory process is quiescent. (c) Kinking or obvious adhesions, with or without the above signs. (d) Long retention of the meal in the appendix (thirty-six hours or more).

Indirect evidence is afforded by the following observations. (a) Fixation of the caecum. (b) Spasm of the caecum. (c) Positive gastro-ileal reflex. All these signs, particularly the last two, may be absent when the inflammatory process is quiescent. They may also be caused by typhlitis or colitis, which must be excluded by clinical and pathological tests. (d) Tenderness over the caput caeci, where the appendix is not seen. (e) Residues of long standing (thirty hours or more) in the caecum, probably due to hypotonia consequent on the prolonged spasm in this region. (f) Failure of the appendix to fill frequently occurs when the patient has had an acute attack recently, as the engorged mucous membrane may completely occlude the lumen. In such cases the indirect signs must be carefully looked for.

Analysis of the X-Ray Findings

In the first twenty-four cases of the present series, comprising eighteen "A" cases, three "AB" cases, two "B" cases, and one "C" case, the gastro-ileal reflex was not systematically tested for, as was done in the last thirty-four cases. The findings in the first series of cases are therefore not comparable in this respect with those in the second series, but for the sake of brevity the two series have been tabulated together, leaving the diagnostic value of the gastro-ileal reflex to be discussed in a separate section. The findings in the "C" type of case will be considered separately.

TABLE IV

Type	No.	Direct Signs								Indirect Signs				
		Not Visualized	Visualized	Irregular Lumen	Retrocaecal	Tender	Bulbous	Concretions	Kinks	36-hour Retention	Fixation of Caecum	Caecal Spasm	Gastro-ileal Reflex	Tender Caput Caeci
A	31	11	20	13	7	8	4	1	1	5	17	13	15	16
AB	6	1	5	4	1	4	2	0	0	2	1	2	4	2
B	13	2	11	7	3	5	1	1	1	7	4	5	9	3

Thus the frequency of indirect signs other than spasm and the gastro-ileal reflex is as follows: of thirty-one Type A cases twenty-four showed indirect signs (77 per cent.), and of nineteen Types A and AB cases ten showed indirect signs (52 per cent.).

This table brings out certain points very clearly: The failure of the appendix to fill in a higher proportion of the Type A (35.5 per cent.) than in the Type B cases (15.4 per cent.), the explanation of which obviously is that engorgement of the mucous membrane by recent inflammation is commoner in the "A" type, obliteration of the lumen by chronic fibrosis being of frequent occurrence in both types. The "AB" type, as would be expected from the clinical history, conforms to the "B" type. Secondly, the higher incidence of the indirect signs in the "A" type. Thus fixation of the caecum occurred in 55 per cent. of "A" cases, 31 per cent. of "B" cases, and 26.3 per cent. of the "AB" and "B" cases

TABLE V

Case No.	Direct Signs	Indirect Signs other than G.I.R.*	Local Disease	Adhesions	Recent Inflammation
A CASES:					
1	+	+	+	+	0
2	+	+	+	0	+
3	+	+	+	+	0
4	+	0	+	+	0
7	+	+	+	+	0
8	N. V.†	0	+	+	+ (?)
9	+	+	+	+	0
10	+	+	+	0	+
11	N. V.	+	+	0	+
12	N. V.	+	+	0	+
13	+	+	+	+	+
14	N. V.	+	+	+	+
17	N. V.	0	+	+	+ (?)
20	+	0	+	+ ‡	0
21	N. V.	0	+	+ ‡	0
22	+	+	+	+	+
23	+	+	+	+	+
24	N. V.	+	+	+	+
25	+	0	+	+	+
29	N. V.	+	+	+	+
32	+	+	+	0	0
33	N. V.	+	+	0	+
36	+	+	+	+	+
39	+	+	+	+	+
41	+	0	+	0	0
45	+	+	+	+	0
49	+	+	+	0	+
51	N. V.	+	+	+	+
52	+	+	+	+	+
53	N. V.	+	+	0	+
54	+	+	+	0	+
Group Total 31	20, N. V.††	24	31	21	21
AB CASES:					
15	+	+	+	+	+
18	+	0	+	+ §	0
19	+	0	+	0	0
26	+	0	+	0	0
38	+	+	+	+	0
47	N. V.	+	+	+	0
B CASES:					
5	+	0	+	+ §	0
6	+	+	+	+	0
27	+	+	+	0	Colitis
28	+	+	+	0	0
30	N. V.	+	+	0	Colitis
31	+	0	+	0	0
34	+	0	+	0	0
37	+	+	+	0	Colitis
42	+	0	+	0	0
44	+	0	+	0	0
46	N. V.	0	+	+	0
48	+	+	+	+	+
55	+	+	+	+	+

* Gastro-ileal reflex. † Not visualized. ‡ Mechanical obstruction.
§ Old adhesions.

taken together. Tenderness over the caput caeci occurred in 51.6 per cent. of "A" cases, 23 per cent. of "B" cases, and 26.3 per cent. of "AB" and "B" cases. A thirty-six-hour caecal residue was present in 48.4 per cent. of "A" cases, 38.4 per cent. of "B" cases, and 36.8 per cent. of "AB" and "B" cases together. Spasm of the caecum was observed in 42 per cent. of "A" cases, and in 37 per cent. of "AB" and "B" cases together.

Spasm of the caecum is closely akin to the gastro-ileal reflex, which, as will be shown later, occurs in a high proportion of all types of case. The first three signs are therefore to be regarded as the most useful "indirect" signs; they were found in 77 per cent. of the "A" cases and in 52 per cent. of the "AB" and "B" cases taken together.

Correlation of Radiological and Operative Findings

The radiological findings in each case were then correlated with the conditions found at operation, with the results summarized in Table V, in which fixation of the caecum, tenderness of the caput caeci, and thirty-six-hour retention in the caecum are classed together as "indirect" signs.

It will be seen that in the thirty-one Type A cases indirect signs were present in twenty-four, and at operation adhesions or recent inflammation were encountered in twenty-three of these. Of seven cases in which no indirect signs were reported the *x*-ray findings were of doubtful reliability in two (marked "?"), in two others the appendix was mechanically obstructed in a peritoneal pouch with no apparent peritoneal inflammation, and in one no adhesions or recent inflammation were found, leaving only two cases (Nos. 4 and 25) in which the *x*-ray and operative findings did not correspond. The opposite condition—indirect signs present but no findings at operation to account for them—occurred only once (No. 32), but the finding of pus and mucus microscopically in the stools supplied the probable explanation.

The six cases of Type AB show the same close correspondence. In the thirteen Type B cases we find indirect signs present in seven, in three of which a complicating unhealed chronic colitis was revealed by the presence of pus cells in the stools, so that it was not surprising to see no adhesions at operation; and in three adhesions or a buried retrocaecal appendix were found, leaving only one case of discrepancy (No. 28). Of the five cases in which adhesions were found their presence was indicated by indirect signs in three instances.

The inference appears to be that the most important factor in the causation of indirect signs is the presence of recent peritoneal inflammation in or in the neighbourhood of the appendix.

The Gastro-ileal Reflex

This sign, first described by Sir W. Macewen in 1904, and again by Hurst in 1909, was fully worked out by A. Bruce MacLean on 300 consecutive cases examined radiologically.¹ It was sought for in thirty-four cases of the present series, with the results shown in Table VI.

TABLE VI

Type	No.	Present with Indirect Signs	Present with Direct Signs	Present with Both Groups	Present Alone	Absent	Total Present
A and AB	16	6	2	6	1	1	15
B	11	1	3	3	1	3	8
C	7	3	0	2	1	1	6
Totals	34	10	5	11	3	5	29

This sign was present in twenty-nine of thirty-four cases (85 per cent.), and was the only radiological sign in three cases. In the five cases in which it was absent other signs, direct, indirect, or both, were present, so that radiological diagnosis was still possible. The value of this sign appears to be equally great in all types of case, but it is not absolutely pathognomonic of appendix disease, as it may be met with in other inflamed conditions of the caecum, such as chronic dysentery, which must be excluded by clinical and pathological examination.

The Direct Signs

Table VII shows the abnormal direct signs observed and the operation findings in these cases. It will be seen that in every case in which abnormal radiological signs were present in the appendix marked pathological changes were found at operation.

TABLE VII

Case No.	Irregular or partly seen Lumen	Tender	Bulbous	Concretions	Kinks	36-hour Retention	Findings
A 2	0	+	+	0	0	+	Recent inflammation
" 3	0	+	0	0	0	0	Adhesions and distended lumen
" 4	+	0	0	0	+	0	Adhesions, kinked
" 7	+	+	0	0	0	0	Fibrosis of walls
" 9	0	0	0	0	0	+	Adhesions and scarring
" 10	+	+	0	0	0	0	Recent inflammation
" 13	+	+	0	0	0	0	Adhesions and recent inflammation
AB 15	0	+	0	0	0	+	Adhesions, catarrh and concretions
" 18	+	+	0	0	0	0	Adhesions, fibrosis
" 19	+	+	+	0	0	0	Multiple strictures
A 20	+	0	0	0	0	0	Fibrosed, atrophic
" 22	+	0	0	0	0	0	Stricture, lumen nearly obliterated
" 23	+	0	0	0	0	0	Recent inflammation, obstructed lumen
" 25	+	0	0	0	0	0	Adhesions, recent inflammation
AB 26	+	0	+	0	0	+	Obstruction and recent inflammation
A 32	+	+	+	0	0	0	Kinked and fibrosed
AB 38	+	+	0	0	0	0	Adhesions, fibrosis
A 39	+	+	0	0	0	0	Chronic inflammation and concretions
" 41	Wide lumen	0	0	0	0	0	Dilated lumen and catarrhal inflammation
" 45	+	0	0	0	0	0	Kinked, bulbous, and chronic inflammation
" 49	+	0	0	0	0	+	Concretions and recent inflammation
" 52	0	+	+	+	0	+	Adherent, kinked, recent inflammation
" 54	+	0	+	0	0	+	Recent catarrh, concretions
23	18	12	6	1	1	7	
B 5	+	0	0	0	0	+	Adhesions, constriction
" 6	+	+	0	0	0	0	Adhesions, fibrosis
" 27	+	+	0	0	+	+	Chronic inflammation and concretions
" 28	+	+	0	0	0	0	Chronic inflammation and concretions
" 30	0	0	0	0	0	+	Kinked and full of concretions
" 31	+	+	0	0	0	+	Chronic inflammation and concretions
" 34	Long retrocaecal	0	0	0	0	+	Retrocaecal, chronic inflammation, very long
" 42	Long, narrow lumen	0	0	0	0	0	Chronic inflammation, lumen nearly obliterated
" 44	0	+	+	0	0	+	Marked catarrh
" 48	+	0	0	0	0	0	Retrocaecal, adherent, fibrous
" 55	Retrocaecal	0	0	0	0	+	Retrocaecal, adherent, catarrh
11	9	5	1	0	1	7	

The appendix was diagnosed radiologically as lying in the retrocaecal position in eleven cases in this series, and in eight of these the organ was found at operation to be tied down by adhesions outside or behind the caecum.

Direct examination of the appendix has gained much in accuracy since the introduction of the mag. sulph. method,² which enables the appendix to be defined in every case in which it is not occluded by inflammation or fibrosis, and its position, contour, mobility, and emptying rate estimated. The present series of cases was completed

incidence of indirect signs, as would any other inflammatory condition of the caecum.

Type C Case

An analysis of the symptoms and findings in the eight cases of the "C" type is given in Table VIII. As in all these cases the symptoms suggested gall-bladder disease a complete radiological examination of the gastrointestinal tract and a cholecystogram were made, and then the special examination for the appendix.

TABLE VIII

Case No.	Symptoms and Duration	Not Visualized	Visualized	Irregular Lumen	Tender	Bulbous	Concretions	36-hour Retention in Appendix	Fixation of Caecum	Caecal Spasm	Gastro-ileal Reflex	Tender Caput Caeci	36-hour Retention in Caecum	Findings and Result
16	Dyspepsia, flatulence, vague abdominal pain 3-4 years. G.B. fills poorly		+	0	0	0	+	+	0	0	0	0	0	Concretions and chronic inflammation. G.B. normal, but slight return of G.B. symptoms later
35	Bilious vomiting, slight pain in R.I.F. 9 mos. G.B. normal			Details not available										Concretions and catarrh. An ascariis infection treated later. Cure
40	Vague lower abdominal pain 5 years. G.B. normal	+	0	0	0	0	0	0	+	0	+	+	0	Long, kinked, adherent appendix. Cured
43	Flatulent dyspepsia 1½ years. G.B. normal	-	+	+	+	0	0	+	0	+	0	0	0	Long appendix with marked histological changes. Cured
50	Flatulent dyspepsia. Dull pain in R.I.F. 4-5 years. G.B. normal	+	0	0	0	0	0	0	+	0	+	+	+	Retrocaecal adherent appendix. Cured
56	Pain after food and flatulence some years. G.B. normal		+	+	+	+	0	0	0	0	+	0	+	Concretions, but no marked histological change. Slight return of symptoms later
57	Hyperacidity 7 years. G.B. normal	+	0	0	0	0	0	0	0	+	+	0	+	Concretions, adhesions, and congested mucous membrane. Cured
58	Flatulent dyspepsia 7 years. G.B. normal		+	+	0	0	0	0	0	+	+	0	+	Chronic catarrh. Relieved but not quite cured. Residual symptoms probably due to old, unhealed dysenteric lesions

before this method was published. In the fourteen cases in which the appendix was not visualized at any stage the conditions found were as follows:

Dense adhesions ...	...	...	...	...	3
Recent inflammation ...	...	...	...	...	4
Partial obliteration of lumen by fibrosis ...	...	...	...	...	3
Partial obliteration and recent inflammation...	...	...	...	...	2
Old adhesions and recent inflammation ...	...	...	...	...	1
Filled with concretions...	...	...	...	...	1

It is doubtful whether the new technique would have been more successful in visualizing the appendix in the presence of such gross pathological changes, except perhaps in the three cases in which dense adhesions were the cause of non-visualization, but in one of these an acute attack had recently occurred, and in another the examination brought on an acute attack. In all the other cases, with one exception, indirect signs were present on which the diagnosis could be based.

Dysentery as a Complicating Factor

Twenty cases in the series gave a history of dysentery, in two of which the attack had occurred within the preceding year, and in four was of the mild relapsing type. The incidence was 25 per cent. of the European cases, 37.5 per cent. of the Anglo-Indians, and 42 per cent. of the Indians. In no case were there any clinical signs of the infection, but microscopical evidence of unhealed lesions was found in eight cases, in the form of mucus, pus cells, or red blood corpuscles in the films of the stools. The radiological findings in these cases were carefully studied to ascertain whether any special signs could be associated with this condition. Well-marked indirect signs were present in seven of the cases, and direct signs of an abnormal appendix in six, in no case differing from those found in other cases. There were also six cases in which microscopical evidence of infection was present without any history of dysentery; in four of these indirect signs and in two the usual direct signs were present. The conclusion is that unhealed dysenteric lesions cause a high

incidence of indirect signs alone were found in four cases, direct signs alone in one case, and both sets of signs in three. In all the cases the appendix was found at operation to be diseased; in the five in which marked pathological changes were found its removal led to complete cure; in three in which the changes consisted only of chronic catarrh the symptoms, though much improved, were not quite cured, suggesting that the gall-bladder, though radiologically and at operation practically normal, was also at fault. In any case the radiological examination was of the greatest value in locating the main cause of trouble.

Conclusions

1. The cases were divided into four types: Type A, cases with definite acute attacks; Type AB, cases in which one or more attacks of Type A were succeeded by recurring appendicular colic or vague digestive troubles; Type B, cases of appendicular colic with no history of an acute attack; and Type C, cases with vague digestive troubles giving no history of an acute attack or of appendicular colic.

2. No definite evidence was found that race or diet has any influence on the incidence of appendicitis.

3. The radiological technique and possible findings are summarized.

4. A higher incidence of indirect signs was found in the Type A cases than in Types AB and B taken together—77 as against 52 per cent.

5. Out of thirty-one Type A cases indirect signs were present in twenty-four, in twenty-three of which adhesions or recent inflammation were found at operation. Of thirteen Type B cases indirect signs were present in seven, in three of which they were due to adhesions, and in three to an unhealed colitis.

6. The gastro-ileal reflex was present in 85 per cent. of the cases in which it was tested for, and was the only radiological sign in three cases. When it was not present other radiological signs of a diseased appendix were found. Its value appears to be equally great in all types of case,

but it is not absolutely pathognomonic of chronic appendicitis, as it may occur in other inflammatory conditions of the colon.

7. In every case in which direct signs were present the appendix was found at operation to be diseased.

8. Non-visualization of the appendix during the radiological examination was invariably found at operation to be associated with obliteration of its lumen by recent or old inflammation.

9. Unhealed dysenteric lesions caused a high incidence of indirect signs.

10. In the eight Type C cases radiological evidence of an abnormal appendix was found in every instance and confirmed at operation.

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² Wood, Franklin G.: *Ibid.*, 1935, i, 640.

BENIGN NEOPLASMS OF THE BRONCHUS WITH RECORDS OF NINE CASES

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In 1929 Myerson¹ wrote:

"Within the past few years the number of neoplasms that have been observed and completely removed by means of the bronchoscope has appreciably increased; with the more general recourse to bronchoscopy in obscure conditions of the chest this is to be expected. Benign neoplasms are benign only in the histological sense. As they grow they cause obstruction of the air passages and interfere with the pulmonary function and the vital capacity of the patient, so that the recognition and removal of one of these neoplasms constitutes a life-saving measure."

In 1933 Wessler and Rabin² reported seventeen cases, and noted that not more than thirty reports of such cases had appeared in the literature. In this article we record nine cases which we have observed bronchoscopically and treated in our clinic.

Compared with the malignant new growth the benign one is uncommon, nevertheless not so rare as the literature would lead one to believe. In the past four years and a half we have bronchoscoped 150 cases of new growth, and of these nine have been benign or supposedly benign. This gives a figure of 6 per cent. As Myerson rightly points out, these benign tumours are benign in their histology only; in their mechanical effect on the lung they are a very grave menace to the patient, and if left to follow their course and grow they will cause permanent damage to the bronchi and lungs, and give rise to complications which will endanger and often terminate the life of the patient. The sooner they are recognized and removed the smaller will be the amount of permanent damage done to the lung. To be prepared to recognize these growths in their early stage careful consideration must be given to the symptoms and signs which they may produce.

Symptomatology

In most series of cases reported in the literature, as in our own series, the incidence in the two sexes is more or less equal. In malignant cases the incidence markedly predominates in the male. In our first series of fifty cases recorded in the *Journal* two years ago³ only 8 per

cent. were in women, and of these one was benign. It is therefore obvious that although the incidence of benign growth is somewhat the same for both sexes, a growth found in a woman has a greater probability of being a benign one than in a male. Most of the cases present symptoms before the end of the third decade, although they may not be recognized until the fourth or fifth decade.

At first, when the growth is very small, it produces no symptoms at all, except perhaps a cough which has no particular characteristic to associate with the lesion; occasionally at this stage an asthmatic wheeze may be present which, if the chest generally is clear of added sounds on auscultation, should suggest the possible presence of an intrabronchial foreign body. Paul⁴ reports such a case in which "asthma" was the prominent symptom for a long period.

Whilst the tumour remains small and causes no obstruction no symptoms will occur unless the tumour bleeds, and this is a very frequent occurrence, and often the first symptom for which the patient consults his doctor. The haemoptysis is often repeated. It occurred in six of our nine cases, and in twelve out of seventeen in Wessler and Rabin's series. The latter authors consider that the haemoptysis in these cases is of a characteristic type, and describe it as of sudden onset, without any warning, and unassociated with other symptoms of pulmonary or bronchial disease, with a strikingly abrupt cessation without any subsequent period of streaking or staining of the sputum, as is commonly the case when blood is derived from actual disease of the lungs. They offer the following explanation for this type of bleeding. Haemorrhage from a benign tumour occurs in a main bronchus and the blood exudes from very small submucous vascular spaces. It is possible that bleeding of this character is slow, and that the blood is expectorated before it can pass down into the smaller bronchi; this is also prevented by the presence of the occluding tumour below the point of bleeding. All the blood is promptly expectorated, and little or none is aspirated into the smaller tubes. With a more brisk haemorrhage, especially when there is not complete bronchial occlusion, it is possible for the blood to be aspirated and to undergo changes resulting in the expectoration of dark blood for some days.

If the tumour does not grow haemoptysis may remain the only symptom for many years; in one of our cases it had remained the sole symptom for more than twenty years. The haemoptysis may be quite slight or so severe and frequent as to exsanguinate the patient. As the tumour grows the danger to the patient increases, for when it reaches a size big enough to occlude the bronchus complications of bronchial obstruction will arise. The first may be a simple atelectasis of the lobe or of the whole lung distal to the occlusion. The atelectasis is often of sudden onset, accompanied by pain, cough, and dyspnoea, and with physical signs in chest which are frequently mistaken for those of consolidation. Wessler and Rabin report five cases in which the first symptom was a pneumonia, and suggest that this was in fact the onset of atelectasis. It must be remembered that this type of onset is also not uncommon in malignant tumours, being purely a mechanical happening.

Burrell and Trail⁵ report a case of benign new growth causing an atelectasis of the left lung. Ashbury⁶ reports a case in which a patient on three occasions had a massive collapse of the lung due to a benign growth. This onset was present in two or possibly three of our cases, the atelectasis being of the right upper lobe in Case 8, whilst in Case 3 there is little doubt that the preliminary pneumonia was in fact a collapse. Usually the onset of obstruction is slow and gradual, with the