LESIONS OF THE SMALL BOWEL

ARTHUR R. BLOOM, M.D.

Detroit

Until recently roentgenologists, internists, and surgeons have paid little attention to the appearance of the small bowel, observations having been concentrated on the esophagus, stomach, and colon. The reasons for this are as follows: 1. The pathologist has reported comparatively few organic lesions of the small bowel. 2. When performing exploratory operations, the surgeon has not ordinarily considered the jejunum or ileum as a possible locale for pathology. 3. The roentgenologist has failed to regard these organs with especial attention, not only because the appearances are less constant diagnostically than in the stomach and duodenum, but also because his attention has not been called to the small bowel as a possible site of disease. The fallacy of under-estimating the importance of the small intestine in this respect becomes readily apparent when one considers that from the standpoint of digestion it is the most important part of the gastro-intestinal tract.

The x-ray affords us definite means of recognizing lesions of the small bowel, but the roentgenologist must be able to evaluate the findings. Mills reported that in five years of observation 9.3 per cent of patients with gastro-intestinal disease presented some type of lesion of the small bowel. For the following two years the figure rose to 27.2 per cent. These figures are suggestive as to the incidence of disease in this location and the frequency with which it is overlooked. There is no reason, however, with necessary study, why the normal appearance of the small bowel could not be as well defined as that of other portions of the gastro-intestinal tract.

The method employed by Mills, Kornblum, and others calls for a bismuth meal with the regular breakfast about six hours before the patient reports to the x-ray laboratory. We prefer to give the first meal at the laboratory, because with this procedure it is possible to secure a clear visualization of the stomach and cap and to follow the course of the meal throughout the entire examination. The patient is observed at hourly intervals. In case of doubtful findings a special technic may be used. For this purpose a duo-

1 From the Roentgenological Department of the North End Clinic and the private practice of the author. Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30-Dec. 4, 1931.
denal tube is introduced into the jejunum, and a small amount of barium is administered slowly by gravity.

In order properly to evaluate any pathological change, it is necessary to define the normal appearance of the jejunum and ileum. Although they have no definite demarcation either anatomically or roentgenologically, the contours of the various segments are characteristic. The normal jejunum presents a typical featherly appearance (Fig. 1). It is cauliflower-shaped and irregular. A sharply defined shadow, as in A or B, is evidence of stasis, since normally the barium passes rapidly with the chyme. C, D and E represent the usual normal appearance, produced by the barium adhering to the folds of Kerkring or the valvulae conniventes.

Kerkring's folds are most marked in the upper third of the jejunum; they decrease in size and number until they reach the terminal ileum, where they are absent. More distally the loops of the small bowel are smooth and sausage-shaped.

The lower ileum is massed in a sort of puddle in the pelvis, as shown in Figure 2. The coils of the ileum are not as irregular as might be inferred from the films, but correspond to the attachment of the mesentery, which arises from the upper abdomen on the left side and extends downward and to the right. Because the mesenteric attachment of the ileum is longer than that of the jejunum, the position of the ileum is not as constant as that of the jejunum, being dependent on the habitus of the patient. In the presence of pelvic tumors, pregnancy, and other extra-gastro-intestinal masses
the loops become arranged around the mass, giving rise to definite displacement defects. Mesenteric or retroperitoneal masses may show a smooth circular area surrounded by loops of barium-filled bowel.

The lesions of the small bowel which are encountered may be classified as follows:

I. Congenital abnormalities
   (a) Atresia of the small bowel
   (b) Derangement of migration
   (c) Hernia

II. Functional stasis

III. Diverticula

IV. Intestinal obstruction
   (a) Acute
   (b) Chronic
      1. Postoperative adhesions
      2. Chronic peritonitis

V. Tuberculosis
   VI. Ulcers
   VII. Tumors
      (a) Benign
      (b) Malignant

VIII. Parasites
IX. Injuries
X. Foreign Bodies
XI. Changes due to drugs

I. Congenital Abnormalities: (a) Atresia of the small bowel is sometimes seen in very young infants. The characteristic symptoms are hematemesis, which occurs in 65 per cent of the cases, vomiting, distention, and failure to pass meconium. Fluoroscopic and roentgenographic examination after a barium meal will demonstrate the site of obstruction and differentiate it from hyperplastic pyloric stenosis. This differentiation is important, as the prognosis of atresia is very poor, although Sweet and Robertson have
reported a case with recovery and have found three others in the literature.

(b) Congenital anomalies resulting from derangement of migration, of descent, or of fixation of the gastro-intestinal viscera

are not infrequently encountered in the course of a routine examination. These changes are seldom serious but are of academic interest. Occasionally they cause symptoms by interference with normal function. We are all acquainted with such conditions as the non-descending cecum, non-rotated stomach, situs inversus, etc., but anomalies of the small bowel are also encountered. Rostowzew reported a case of left-side displacement of the colon and right-side displacement of the small intestine. In 1918, Harvey discussed this subject extensively.

Case 1: Mrs. J. W., aged fifty-one, complained of inability to catch her breath and a feeling of fullness in the epigastrium. The first attack of shortness of breath had come on twenty years earlier. The attacks were noticed on arising in the morning and lasted for half an hour. The feeling of fullness recurred about half an hour after eating, and the patient had to loosen her dress and lie down to obtain relief. Occasionally she suffered from palpitation. About seven years prior to examination she was jaundiced and was treated for gallbladder disease. Examination at that time showed the liver border to be about two fingerbreadths below the costal arch. X-ray revealed an eventration of the left dome of the diaphragm produced by the ileum (Fig. 3). The terminal ileum extended from the ileocecal valve directly upwards and to the left, rising above the splenic flexure. There were also a non-rotated stomach and a non-filling gallbladder.

(c) Hernias should probably be considered under this heading,
for although they do not constitute a congenital anomaly *per se*, some weakness must be responsible for their occurrence. As might be expected, these cases may present vague gastro-intestinal symptoms if there is partial obstruction. Case and Upson have reported the roentgenographic findings in internal hernia. Byron Jackson reported a case in which he demonstrated an internal hernia by x-ray, the chief complaint in this case being indigestion and pain, which was relieved by a change in posture. The roentgenographic findings in internal hernia consist of localizing masses of barium which can best be demonstrated in the direct lateral view. External hernias, though they may give characteristic x-

![FIG. 4. CASE 2: TWENTY-FOUR-HOUR FILM SHOWING ILEAL STASIS IN HERNIA](image)

ray findings, should be recognized before the radiologist is consulted.

**Case 2:** Mr. L. B., aged sixty-eight, complained of pain in the abdomen for the past year. The pains were cramp-like in character and lasted for two to three hours, accompanied by belching. They were relieved by a bowel movement. Physical examination revealed a large indirect inguinal hernia on the right side and some carious teeth. Complete gastro-intestinal x-ray examination showed ileal stasis in the loop of bowel in the hernia (Fig. 4).

**II. Functional Stasis:** Ileal stasis is frequently encountered in obstructive lesions of the colon, due to back pressure. This phenomenon must be given careful consideration in determining the site of obstruction. Several years ago, at Michael Reese Hospital, during examination of a patient who had symptoms of obstruction, it was noticed that the barium did not extend beyond the
middle of the jejunum. The patient was observed for several hours, but the opaque meal failed to advance any further, and a diagnosis of obstruction of the jejunum was made. At operation the surgeon failed at first to find any lesion. After careful progressive examination of the small bowel he discovered an incarcerated femoral hernia which had been overlooked on physical examination. Another type of ileal stasis is that commonly encountered in constipation and incompetency of the ileocecal valve. Delayed emptying of the stomach as a result of ulcers, cancer, or functional retention may produce an apparent stasis.

III. Diverticula of the Small Bowel: To judge from the literature it would appear that diverticulosis of the small bowel is rather uncommon. Spriggs found 0.7 per cent of jejunal and 0.7 per cent of ileal diverticulosis in 1,000 consecutive cases. Rothschild in 1925 was able to collect only 33 cases of jejunal diverticulosis from the literature. Case, in 1920, was the first to record the x-ray appearances of diverticula of the small bowel. Subsequently cases have been reported by Jenkinson, Swanberg, Bastrup, Hunt, Boling, Berry and others. These reports seem to suggest that the apparent low incidence is due to difficulty in diagnosis rather than to actual infrequency of occurrence. This difficulty arises from the fact that the pouches may be filled with food or the openings may be too wide to retain the barium. Before the use of the x-ray, diverticulosis had never been diagnosed preoperatively or ante-mortem. Many causes for the condition have been suggested, but all fall into the following groups: (1) increased abdominal pressure; (2) atrophy of the inner circular layer of musculature; (3) traction on the intestine by mesenteric vessels; (4) traction following adhesions.

According to many writers, the clinical history is vague and indefinite. A review of various case reports, however, shows that the symptoms, particularly of the jejunal type, in the presence of inflammation, resemble those of peptic ulcer. These are usually reported as heartburn and seasonal attacks of a burning or gnawing pain occurring one to two hours after meals and occasionally ameliorated by alkalies. There may be point tenderness in the upper left abdomen or in the mid-line. Probably because of this, most patients are referred to the radiologist with a tentative diagnosis of ulcer. In the absence of inflammation, the history is vague and indefinite, and the finding of the diverticulum is accidental. When diverticula become infected they present a potential menace, in the form of possible perforation, peritonitis, adhesions with obstruction, etc. Hirschman reports a case with cancerous changes.

The roentgenographic appearance is quite typical. In diverticulosis of the multiple type rounded areas of density varying in
size from a pea to a five-cent piece are observed throughout the abdomen. Less frequently, diverticula occur singly, the pouch varying in size from that of a five-cent piece to that of a plum. Stasis may be present from twenty-four to forty-eight hours. Although

FIG. 5. CASE 3: LARGE, SOLITARY DIVERTICULUM OF THE JEJUNUM (NO OPERATION)

FIG. 6. CASE 4: A. SOLITARY DIVERTICULUM OF JEJUNUM, CONFIRMED BY OPERATION. B. TWENTY-FOUR-HOUR FILM SHOWING STASIS

multiple diverticulosis is usually described as part of a generalized condition, in the experience of the author this has been true in but a portion of the cases.

Case 3: Mr. J. W., aged forty, complained of attacks of pain and vomiting of a year's duration. The vomiting was preceded by pain in the epigastrium. At—
tacks lasted from three to four days and were relieved by cathartics. There had been five attacks in the past year. Physical examination was essentially negative. X-ray examination showed a poorly filled cap before and after the administration of atropine, an increased prepyloric space, and a large round mass, which was probably a single large diverticulum of the jejunum (Fig. 5). No operation was done.

**CASE 4:** Mr. H. McN., aged twenty-nine, complained of sharp epigastric pain for the past year and a half, coming on one or two hours after eating, accompanied by nausea and belching. It was located to the left of the mid-line and was temporarily relieved by soda. Physical examination was negative. X-ray study revealed a large pocket in the region of the lesser curvature border of the stomach. When the patient was rotated this was definitely identified as a single diverticulum of the jejunum. It was markedly tender on palpation and there was stasis twenty-four hours later (Fig. 6). The appendix remained filled for one week and was tender. At operation, a single diverticulum at the mesenteric border of the jejunum, 40 cm. from the duodenojejunal juncture, was found. It was surrounded by adhesions which bound it down to the mesentery. The sac measured 3 x 2.5 cm. It was removed by resection through an elliptical incision. The appendix was also removed. The diverticulum was inflamed and a diagnosis of acute diverticulitis was made.

**CASE 6:** Mrs. F. K., aged forty-five, complained of stomach trouble for the past fifteen years. She had attacks of pain in the epigastrium and right upper quadrant lasting for a few months followed by intervals of freedom of several months. The pain was quite severe and was accompanied by vomiting. Seidlitz powders and pressure over the abdomen gave relief. The onset of the distress usually occurred about five hours after a heavy dinner, lasted the rest of the day, and was unrelieved by supper. The patient suffered from constipation. Physical examination was negative. X-ray examination showed a constant concave defect of the duodenum which was not produced by the gallbladder. There were numerous diverticula of the small bowel (Fig. 7), but none of the esophagus or colon. No operation was done. The symptoms were probably due to a duodenal ulcer.

**CASE 6:** Mrs. S. G., aged sixty-three, complained of pain in the epigastrium. The first attack dated back thirty years. It was very severe and lasted three-quar-
ters of an hour. The next attack occurred four years later. Since then there had been about six attacks. The latest attacks were accompanied by radiation of pain to both costal margins and the right scapula. There was chronic constipation. Physical examination revealed slight tenderness in the lower right quadrant. X-ray examination showed diverticula of the duodenum, small bowel (Fig. 8), and colon. Cholecystography showed failure of the gallbladder to fill. There was no operation, but all the symptoms could be accounted for on the basis of the gallbladder pathology. The diverticula were probably incidental findings. This is a case in which the diverticula were generalized.

IV. Intestinal Obstruction: (a) Acute intestinal obstruction is a fairly commonly encountered emergency. The symptoms—acute pain, vomiting, constipation, distention and shock—are familiar to all. X-ray diagnosis may be made either by the flat film or films taken after a barium meal. The first method is more simple and rapid, and, since an immediate diagnosis is essential, should be tried first. When it does not give the necessary information, the barium meal should be used.

Schwarz, in 1911, gave the characteristic signs as delayed emptying of the small intestine, dilatation of the folds of Kerkring, and the presence of gas and fluid in the small intestine. The flat film method was described by Case, first in his book in 1914 and later in 1915, 1920, 1923, and 1928. He uses a bedside unit to reduce the exertion of the patient to a minimum. If this is unsatisfactory, he gives the patient barium by mouth and takes films at intervals until he is able to arrive at a decision. The gas-filled bowel produces two types of outline: a herringbone appearance

**Fig. 8.** Case 6: A. Diverticula of Jejunum and Ileum. B. Stasis in Diverticulum at Five Hours

Diverticula also observed in colon.
and a stepladder arrangement. The former is due to the distended folds of Kerkring; the latter, to the normal position assumed by the small bowel when it is distended. After about eight hours fluid can be seen. Wangensteen and Lynch determined experimentally that in simple obstruction gas distention of the small bowel was present in four to five hours after intestinal occlusion, but later they showed that the flat film method was not satisfactory for the diagnosis of strangulation obstruction and stasis due to mesenteric occlusion (Carlson et al).

(b) Considerably less spectacular, but equally important, is the recognition of chronic obstruction. This is fairly common and may be due to tumors, diverticula, foreign bodies, or adhesions.

![Image: Numerous Diverticula of Small Bowel](image)

**Fig. 9. Numerous Diverticula of Small Bowel**

No diverticula elsewhere; no operation.

The last is the most common cause, since adhesions may follow an operation or a peritonitis after recovery from appendicitis, cholecystitis, or small perforating peptic ulcers. Chronic obstruction also occurs in chronic peritonitis. The symptoms depend upon the degree of obstruction. If this is only slight, there may be no complaints, although vague distress may be present in a later stage due to stasis and autointoxication. In the presence of more marked partial obstruction there are sharp attacks of gripping pain coming on at regular intervals. These occur when large boluses force themselves through the narrowed lumen. Normally the barium proceeds uninterruptedly from the duodenum to the terminal ileum in an orderly fashion and the small bowel is empty in from eight to ten hours. Occasionally a sprinkling of barium will
be seen throughout the small intestine. The last loops of ileum contain an accumulation of barium and appear like a puddle in the pelvis (Fig. 2). If the barium is halted in transit, chronic obstruction is suggested, particularly when there is dilatation of isolated loops of bowel and regurgitation of barium occurs. The appearance of the film depends on the site of obstruction.

Soper has described the roentgenographic appearance of adhesions of the intestine as of three grades. In Grade 1 the coils of ileum are matted together but cause no symptoms. In Grade 2, one or more bands are found which attach the coil of gut to some neighboring organ. This may not produce symptoms unless a trap is formed and acute obstruction results. In Grade 3, there are definite bands which bind down and constrict the terminal ileum. These always produce symptoms. Adhesions of all three grades may be seen in the same film. Fixation of the bowel can be determined fluoroscopically. With pelvic adhesions the ileum can not be brought up even with the patient in the Trendelenburg position. Hirschman has described a fluoroscopic sign of adhesions to the abdominal wall. This is demonstrated by examining the patient from the side and pulling up the abdominal wall; if adhesions are present, the loop of bowel is raised with the wall.

**CASE 7:** S. W., a little girl, aged six, complained of pain in the lower right quadrant, nausea, and anorexia, of six months' duration. She would awaken at 3 A.M. with abdominal pain, which was relieved by pressure. Physical examination after acute attacks revealed a soft abdomen with no areas of tenderness, and a normal temperature and blood count.
X-ray examination showed a dilated loop of small bowel on the left side of the lower abdomen (Fig. 10). There was a marked oscillatory movement of the barium within this loop. The same appearance was noted two, three, and four hours after the opaque meal was given. Roentgen diagnosis was adhesions of the small bowel. Operation revealed a loop of bowel which was obstructed, dilated, and discolored. The adhesions were severed, and the child made an uneventful recovery. The etiology of the obstruction was unknown except that the patient when younger had had a perverted appetite, eating chalk, paper, glass, and other foreign objects.

**Case 8:** Mr. F. F., aged forty-three, complained of generalized epigastric pain for the past fifteen months. The pain, which was of a gnawing and burning character, came on two hours after meals and was relieved by soda. The patient had passed some intestinal parasites several years previously. Physical examination showed marked tenderness over the epigastrium.

X-ray examination showed fixation of the right dome of the diaphragm, an irregularity of the prepyloric region, and a loop of small bowel in the left lower abdomen, which was dilated. The patient complained of pain directly over this area as the barium bolus passed this point. The roentgen diagnosis was that of adhesions of the small bowel (Fig. 11), prepyloric ulcer with an inflammatory mass, and subdiaphragmatic involvement. At operation the gallbladder, duodenum, and prepyloric region were found to be bound down by adhesions. There were also adhesions around the small bowel. There was no evidence of ulcer, although the stomach was not incised. Whether the adhesions were due to an undemonstrated ulcer or to the former presence of parasites could not be determined.

**Case 9:** Mrs. R. S., aged forty-six, complained of pain in the upper left quadrant radiating to the back, of eructation of gas, heartburn, and constipation for the past seven years. Pain was more marked after meals, occasionally occurring at night. Physical examination showed a long scar from a gallbladder operation two years before, and an umbilical hernia tugging at the scar. X-ray examination showed a normal stomach and duodenum. There were numerous isolated and dilated loops of small bowel all localized to the left side (Fig. 12). There was no operation. The adhesions were postoperative in origin.
Case 10: Mr. I. F., aged sixty, had had occasional attacks of nausea followed by vomiting twenty years before, but there was no history of heartburn or cramps at that time. He had suffered from constipation for several years. For four months prior to examination he had suffered from heartburn, pain in the epigastrium radiating beneath the sternum, bloating after meals, eructations of gas, nausea, and occasional vomiting. The symptoms began half an hour to two hours after meals and lasted for an indefinite period. Vomiting gave relief. Soda had given relief at first but was no longer effective. Physical examination showed some resistance in the epigastrium. Free acid in the stomach 14°; total 40°.

On x-ray examination the stomach was found to be dilated. There was hyperperistalsis but no obstruction. The cap was not visualized at any time. Dilated loops of small bowel were observed to the left and anterior to the stomach. The
upper loops were smooth (Fig. 13). There was ileal stasis at twenty-four hours. The diagnosis was prepyloric ulcer with adhesions; probably a former perforation.

Ascites produces a characteristic appearance due to the presence of fluid and chronic peritonitis. There is stasis in isolated loops of ileum which are discrete and separated, and which float on the fluid. The outline of the bowel is indistinct due to the presence of fluid.

There is also a type of intestinal stasis seen in malignant dis-
ease, distant from the small bowel, resembling the type associated with adhesions. In addition, there are irregular spastic areas. The appearance may be due to metastases causing a chronic peritonitis or to adhesions. Kornblum believes it may be produced by metastasis to the mesenteric nodes, which results in splanchnic disturbances similar in effect to those produced by drugs.

Case 11: Mr. M. T., aged eighty-one, complained of vomiting and pain in the abdomen for the past three days. The pain did not radiate and was not severe enough to keep him awake at night. Vomiting occurred two hours after meals, the vomitus consisting of unchanged food and a substance resembling coffee grounds. There had been no similar attack prior to this. Physical examination was negative. X-ray showed a large filling defect at the pyloric end of the stomach. The small bowel was dilated and showed areas of spasticity (Fig. 17). Post-mortem examination a few weeks later revealed metastatic tumors of the small bowel.

V. Tuberculosis: Tuberculosis of the bowel is fairly common. Rubin found 324 cases of macroscopic ulceration in 500 consecutive autopsies of patients dying of pulmonary tuberculosis. It occurs most frequently in patients having the caseous type of pulmonary lesions and less often in those having lesions of the fibrotic type. Occasionally cases of intestinal tuberculosis are seen without accompanying pulmonary involvement. The early diagnosis of gastro-intestinal tuberculosis can be made only by x-ray, as there are no characteristic symptoms. In the more advanced stages there are diarrhea, blood in the stools, pain which is constant rather than paroxysmal, loss of weight, temperature, and secondary anemia. Sometimes a perforation occurs. In the hyperplastic
type, the symptoms are due to the mechanical factors involved. They consist of loss of appetite, sense of fullness, constipation, and a palpable tumor. Fever is usually absent. Gershon-Cohen described the roentgenographic findings in various stages of ileocecal tuberculosis. These are, in the early type, spasm, hyperperistalsis, mass hypermotility, anastalsis, localized pain, localized tenderness, and incompetency of the ileocecal valve. In moderately advanced cases, the signs are irregularity, filling defect, and the so-called Fleischer sign, consisting in deformity of the ileum at the ileocecal junction. The terminal ileum takes on the appearance of an inverted cone with divergent walls resembling an inverted umbrella. In the advanced stage the lumen may be almost ob-

Fig. 18. CASE 12: RIGID TERMINAL ILEUM, PROBABLY HYPERPLASTIC TUBERCULOSIS (No OPERATION)

literated by hyperplastic tissue and there are marked irregularity and rigidity of the terminal ileum.

The following case gives a typical radiological appearance and conforms to the above classification. We therefore present it as a case of tuberculosis, though unequivocal proof is lacking. After three years the patient still has a palpable mass.

CASE 12: Mrs. B. S., aged seventy-two, complained of pain in the left lower quadrant for several years, habitual constipation, and vomiting. There was no bleeding. Physical examination showed an undernourished woman with a palpable mass in the lower left quadrant. X-ray showed the lungs to be fairly clear. The stomach and cap were normal. At twenty-four hours the small bowel was dilated and smooth, and there was a defect at the cecum (Fig. 18).

Obstruction may arise from inflammatory induration, thickening of the bowel wall, or a tuberculous peritonitis presenting the same appearance as described for other types of peritonitis. In
some cases, the adhesions produce a partial or complete obstruction.

Case 13: Mr. W. P., aged thirty-four, colored, had had a sudden attack of generalized abdominal pain and vomiting, lasting for three months, during which time he was confined to bed. As he was a painter, the condition had been diagnosed as lead poisoning. He had been free from symptoms until a year later when he had a recurrence. Since then he had had intermittent attacks. He had continuous constipation and had lost weight. Up to the time of examination, he had had continual pain in the upper right quadrant and midabdomen and had vomited frequently. Physical examination was essentially negative. The lungs were clear. The stomach was markedly dilated and contained considerable fluid. There were hyperperistalsis and marked dilatation of the descending duodenum with regurgitation (Fig. 19). At five hours there was 50 per cent retention in the stomach. The loops of small bowel were dilated. There was a smooth depression at the greater curvature border of the stomach (Fig. 20). Operation revealed a tuberculous peritonitis with adhesions. The sharp incurving of the stomach was due to rolled up omentum.

VI. Ulcers: All roentgenologists are familiar with the appearance of gastrojejunal ulcer following gastro-enterostomy or subtotal gastrectomy. The radiologic findings are narrowing of the stoma, a niche, and localized tenderness. Sometimes a jejuno-colic fistula is encountered. In such case, if an opaque enema is given, the barium enters from the colon directly into the stomach. Twenty-one cases were seen by the Mayos, of which 11 were diagnosed by x-ray. Robertson has described a typical case.

Idiopathic ulcers of the small bowel are rarely found at autopsy, and still more rarely by x-ray. Narrowing of the lumen, with dila-
tation of the proximal portion of the bowel, may be observed. The normal folds are diminished in size or obliterated. A niche may be seen, which will have local tenderness. This is to be differentiated from a solitary inflamed diverticulum, though differentiation is important only from an academic standpoint, as the history, symptoms, treatment, and prognosis are the same. In generalized ulceration there is marked hypermotility.

VII. Tumors: Tumors of the small bowel are rare. Raiford reports only 82 cases on record in the surgical pathological laboratory of the Johns Hopkins Hospital. Of this number 40 per cent were malignant and 60 per cent benign. In only 8 cases, or 10 per cent, was the diagnosis made by x-ray. Pack and Davis report that from 0.1 per cent to 0.5 per cent of all malignant tumors are situated in the small bowel. Newton and Buckley report two cases, one of which was recognized roentgenologically. Carcinoma, adenoma, and sarcoma occur most frequently. Other tumors encountered are lipoma, fibroma, cysts, and endothelioma. Carcinoid tumors are rare. Only about 70 have been reported.

The symptoms of these tumors depend upon whether or not they are malignant, whether they extend internally or externally, whether or not they produce obstruction or intussusception. Blood in the stool after a meat-free diet and loss of weight plus significant x-ray findings suggest malignant involvement; negative findings do not exclude a tumor.
In cases of obstruction or intussusception the symptoms are excruciating pain, vomiting, constipation, and shock; a mass can be felt; blood may be found in the stool. If the tumor extends peripherally, the symptoms are vague and suggest only an unexplained severe secondary anemia that presents no roentgenological findings. The radiographic findings in cases of obstruction will demonstrate the site of the lesion, with marked proximal dilatation. Without the knowledge of other findings, this cannot be differentiated from an obstruction due to adhesions. In some cases, particularly cases involving the terminal ileum, filling defects will be present, indicated by narrow, rigid, elongated areas of barium. When multiple defects are present, carcinoid tumors must be suspected. As reported by Soper, a pseudo diverticulum may appear at the site of the crater of an ulcerating carcinoma. The presence of polypi may be indicated by numerous grape-like negative areas. This condition, however, is usually not suspected until intussusception is present. The technic is the same as that used in other gastro-intestinal examinations, but frequent observations are made. Pesquera described a case of lipoma which was missed when the ordinary procedure was employed. It was recognized when the examination was repeated by introducing a duodenal tube into the jejunum and administering the barium directly.

VIII. Parasites: Archer and Peterson described the roentgenological findings of ascariasis. The appearance is that of a cylindrical filling defect 5 to 8 mm. in diameter and 15 to 20 cm. long, usually seen in the jejunum. In the central portion of the filling defect are string-like shadows which represent the barium-filled intestinal canals of the parasites. The observations are made one, two, and three hours after the barium meal. The patient must report six hours after fasting; otherwise the parasites will be filled with food and will not ingest the barium. Although this is an expensive method for the diagnosis of ascariasis, compared with stool examination, it is well worth while to keep the possibility in mind during a routine examination, since ascariasis may simulate tuberculosis, carcinoma, or other diseases of the gall-bladder and gastro-intestinal tract. Archer and Peterson state that they came across an Italian reference on the radiological appearance in tapeworm infestation, but the author has never seen any characteristic changes due to the presence of Taenia.

IX. Injury to the Small Bowel: If injury produces perforation of the gut without any apparent involvement of the parietes, examination of the patient in the upright position will reveal gas under the diaphragm, as in a perforated peptic ulcer. It is not advisable to give a barium meal in these circumstances, as the weight and bulk of the opaque media may accelerate any necrosis
present. Infrequently, as described by Inlow, a perforation develops some time after the injury. This results from necrosis and sloughing due to contusion when the bowel is crushed between the object causing the injury and the spinal column.

X. Foreign Bodies: Opaque foreign bodies in the small bowel may be seen. The majority pass on with little difficulty. The author observed one case in which a pin had penetrated the cecum and another in which a needle had punctured the duodenum. Both were found accidentally in the course of a routine examination. A very large foreign body, as a gallstone, may cause obstruction. The presence of phytobezoars is rarely recorded in the small intestine, but Lobingier reports a case of acute obstruction of the jejunum due to this cause.

XI. Effects due to Drugs: The effect of physiological doses of atropine is familiar to all. There is atony throughout the entire tract; the jejunum and ileum are dilated, and there is stasis resembling that seen in pathological cases of stasis (Fig. 21), with marked hypomotility. However, the effect is not constant. Recently there has been some discussion of the effect of ephedrine on the gastro-intestinal tract, while Pancoast and Hopkins have done an interesting piece of work on the effect of opium derivatives. They found no distinct uniformity of action; the effect produced by small doses was greater in some cases than that produced by large doses in others. A prolongation of the emptying time was observed, and a decreased motility in the small bowel. Kornblum observed similar effects from luminal. These drugs have an effect on the nervous mechanism of the intestinal tract; atropine inhibits the action of the vagus; morphine and luminal act centrally.
The roentgen appearances of the following conditions present in the small bowel are briefly discussed: congenital abnormalities, functional stasis, diverticula, intestinal obstruction, tuberculosis, ulcers, tumors, parasites, injuries, foreign bodies, and changes due to drugs. A plea is made to the roentgenologist to study the small bowel as carefully as other portions of the gastro-intestinal tract. Many obscure digestive symptoms may be thus explained.

BIBLIOGRAPHY


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