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ROENTGENOLOGIC AIDS IN THE DIAGNOSIS AND MANAGEMENT OF INTESTINAL OBSTRUCTION

THE clinician must decide, in each individual case, whether the services of the roentgenologist are required, either for diag-

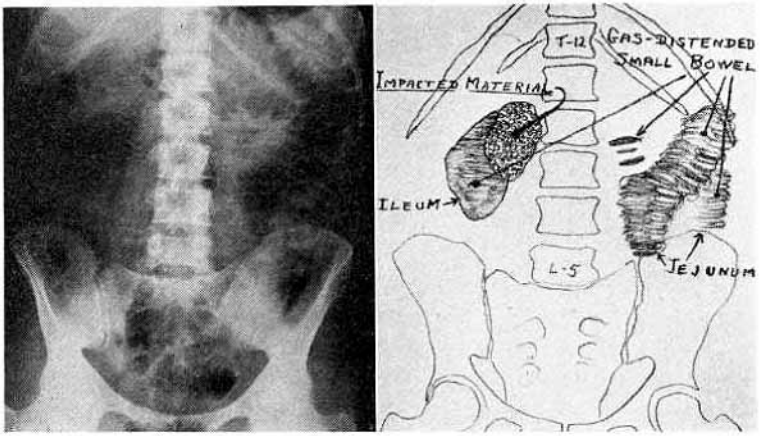

Fig. 411.—Case I. Mrs. S. E., aged thirty-nine years, ventral projection of the abdomen with patient prone. Note the distended small intestine outlined by gas, the jejunum on the left side of the abdomen showing well-marked valvulae conniventes, the large loop of ileum in the right side of the abdomen identified by the lack of mucosal folds. The patient had a laparotomy three years ago and adhesions are responsible for the present obstruction. They have been present for a long time, without clinical evidence, and the immediate precipitating cause of symptoms is visualized in the roentgenogram and is apparently a large piece of some undigested material, impacted at the site of an adhesion. When this film was made the patient was in great distress, with all the signs and symptoms of intestinal obstruction.

nosis, or in connection with management after a diagnosis has been established. In our own experience the clinician has not

always used good judgment in this matter. It is with the hope that increased information will result in a keener realization of the limitations and capabilities of roentgen methods, that this report is presented.

Where a question of bowel obstruction is involved, the roentgen examination starts with the making of a simple "scout film" of the abdomen (see Figs. 411, 412 and 417). Fre-

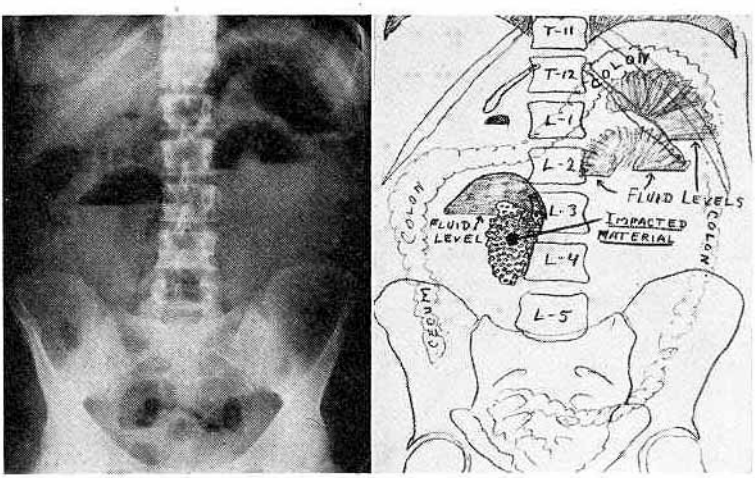

Fig. 412.—Case I. Ventral projection with patient sitting. Because the beam of x-rays was horizontal, fluid levels are visualized in the distended loops of obstructed small intestine. The actual point of obstruction is visualized in these films where the mass of undigested material is lodged, in the caudal end of a gas-distended loop of ileum, at the right border of the shadows of lumbar vertebrae L-3 and L-4. Such a film as this one immediately placed the obstruction in the ileum and not in any part of the colon. Had it not been for the availability of the Miller-Abbott tube, this patient would have needed immediate operation.

quently nothing further is needed, for gas is an excellent "contrast medium," sometimes fully as effective as the barium meal. The simple "scout film" may indicate the location and nature of the obstruction.

In general, films made with a "horizontal x-ray beam" (so-called "horizontal ray") are more apt to give complete information than films made on the conventional x-ray table with "vertical ray."

Figure 420 illustrates the value of the horizontal ray roentgenogram in cases of rupture of a hollow viscus, through visualizing the abnormal collections of gas in the peritoneum.

Where the condition of the patient makes it inadvisable for him to sit up, the required results may be obtained by turning him on his side (either side), the film being propped up on its edge, either in front of or behind the abdomen. Gas collections and fluid levels thus become quite apparent, whereas they might fail of visualization in "vertical ray" films.

Surgeons are well aware of the benefits to the obstructed patient of Wangensteen suction[1] through rectal tubes, stomach tubes and duodenal tubes. But these benefits, definite though they may be, are as nothing compared with the spectacular results that are obtainable with the Miller-Abbott method of intubating the intestinal tract.

In 1934, Miller and Abbott[2] described a special (double-lumened) rubber tube, and a method of its use, which made the intubation of the small intestine a practical procedure. Their method makes it possible to relieve the symptoms of intestinal obstruction for the period during which the intubation is maintained.[3] During such period the patient is permitted unlimited fluids by mouth, and even selected nutriment can be utilized. The resulting relief of the patient's discomfort and toxic manifestations is spectacular in the extreme.

In a typical case (Case I, Figs. 411–416) the patient arrives at the hospital with distended abdomen and the alarming clinical picture of more or less neglected bowel obstruction. (In these cases medical aid is rarely called for until an undesirable period of time has elapsed.)

If "scout films" (Figs. 411, 412) indicate that the obstruction is in the small intestine the patient is a candidate for the Miller-Abbott management. While it is possible to intubate the colon with the Miller-Abbott tube, thus decompressing the segment of colon proximal to an obstruction, the procedure is not justified unless under exceptional circumstances. Appendicostomy or cecostomy is practically always to be preferred.

The patient swallows the leading end of the Miller-Abbott

tube, with its balloon deflated, and fluoroscopic observations are made until the end of the tube has reached the descending portion of the duodenum. It is sometimes possible to hasten or facilitate the passage of the pylorus by suitable positioning of

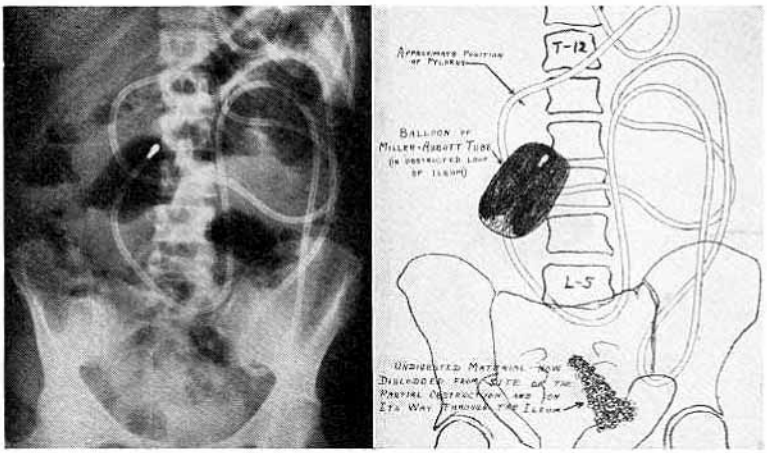

Fig. 413.—Case I. Ventral projection with patient sitting, after passage of the Miller-Abbott tube. The balloon was left uninflated until fluoroscopy showed the advancing head of the tube in the descending portion of the duodenum. Progress to that point was slow and required about one hour, with a certain amount of manipulation under fluoroscopic guidance, to hasten the passage of the pylorus. After distention of the balloon, progress was very rapid. The principal lumen of the Miller-Abbott tube was kept connected to Wangensteen suction apparatus. When the measuring marks on the Miller-Abbott tube showed a distance of 3 feet beyond the pylorus, the patient became perfectly comfortable. By this time all gas collections in the small intestine had disappeared except the collection of air in the distended balloon of the Miller-Abbott tube. About 2 pints of corrosive, odorous, brownish liquid had been recovered through the principal lumen of the tube. Note the shadow of the obstructive material, apparently dislodged from the obstructed loop of the ileum and shown by this roentgenogram as it was on its way through the terminal ileum.

the patient and regulation of the rate at which the tube is swallowed.

As soon as the head of the tube has reached the descending portion of the duodenum, the balloon is inflated. At once the progress down the intestinal tract becomes more rapid. The Wangensteen suction jar, which has been connected to the

principal lumen of the tube from the very beginning, now begins to collect increasingly large quantities of the corrosive fluid which has occupied, together with gas, the obstructed loops. And very shortly the patient comments gratefully upon relief of

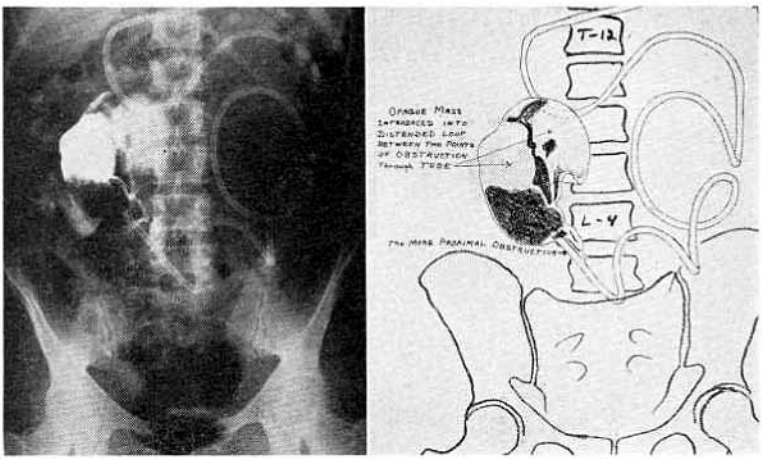

Fig. 414.—Case I. Ventral projection twenty-four hours after Figs. 411, 412 and 413, patient prone. As long as the Miller-Abbott tube remains *in situ*, the patient can be allowed unlimited fluids and selected nutriment. At the time of the making of this roentgenogram, the distal end of the tube was but 3 feet past the pylorus; yet it was very near the ileocecal valve (subsequent operative finding). In the present case, the length of tube beyond the pylorus varied from 3 feet to 5 feet, but regardless of this measurement the distal end of the tube was seen to remain in the same loop of ileum, between the two constricting bands indicated in the diagrams. Dissecting room studies give an entirely erroneous impression concerning the length of the small intestine. During life the length of the small intestine varies from hour to hour, and the variability is so great that the Miller-Abbott tube has frequently reached the cecum in normal subjects when as little as 4 feet past the pylorus. Even shorter measurements have been obtained. The barium which is visualized in the present roentgenogram was administered through the principal lumen of the Miller-Abbott tube. The more proximal obstruction is quite thoroughly visualized. The more distal obstruction is indicated but not visualized.

distention and pain and disappearance of nausea. Even on the hard-surfaced *x*-ray table these patients will sometimes fall asleep about the time the Wangensteen collects the last big loopful of poisonous material.

Patients thus "decompressed" by peroral intubation of the

obstructed bowel are readily prepared for operation and soon become much better surgical risks than they would be otherwise. It is also to be expected that the cause of the obstruction, and its degree, may frequently have been ascertained through the *x*-ray studies.

When the time has arrived for withdrawal of the Miller-Abbott tube, it is but necessary to deflate the balloon and take

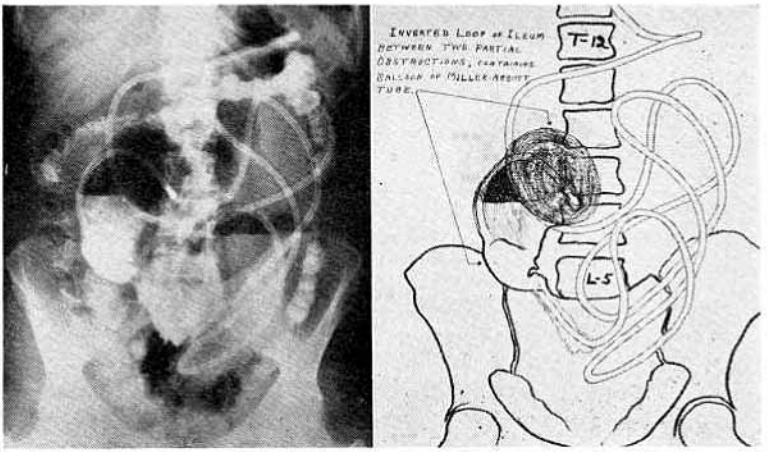

Fig. 415.—Case I. Roentgenogram forty-eight hours after Fig. 411, 412 and 413, patient sitting. Approximately half of the barium has passed the obstruction and is distributed along the colon. The patient remains clinically well, except that she complains of soreness in her throat where the tube irritates the mucosa. Shortly after the making of this roentgenogram, the Miller-Abbott tube was removed. This was accomplished by deflating the balloon, withdrawing the tube gently until resistance was encountered, and then anchoring the tube and waiting ten minutes or more for additional "slack" to develop. By repeating this procedure at intervals of ten to fifteen minutes, the tube was recovered in about forty minutes, without inconvenience to the patient.

up slack, by gentle traction, at intervals of ten to fifteen minutes. The tube should be reanchored at the mouth or cheek after each such "take-up." During the intervals between these partial removals, the bowel apparently slides over the deflated balloon, making it possible to withdraw another coil or so at each succeeding maneuver. Recovery of the entire tube is usually accomplished in three or four such installments.

Among the various possible causes of an acute bowel ob-

struction none are more interesting and elusive than the ones caused by lodgment of undigested or incompletely digested food material, or objects such as gallstones, at some more or less narrowed point in the small intestine. In our present Case I, the obstruction occurred at the second of two kinks, caused by adhesions, a few inches apart in the lower ileum.

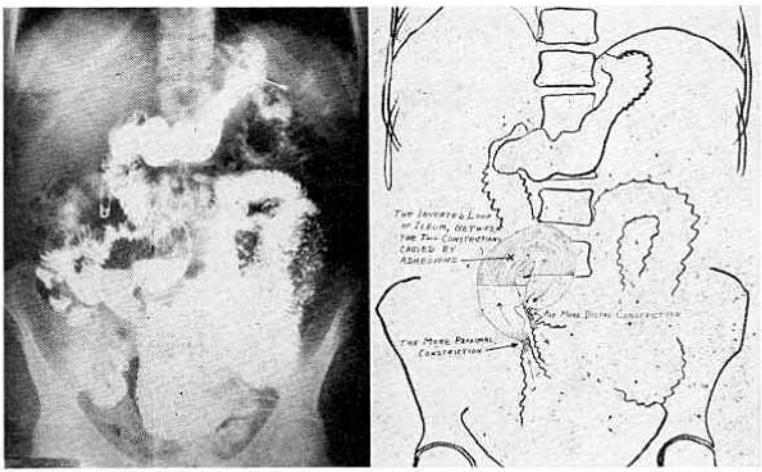

Fig. 416.—Case I. Ventral projection five days after passage of Miller-Abbott tube and three days after removal of same. Barium administered by mouth reveals normal stomach and duodenum, and a normal small intestine down to the points of obstruction in the ileum, previously demonstrated. At operation three weeks later, the findings were exactly as demonstrated in this roentgenogram. A somewhat dilated loop of ileum, inverted, constituted a sort of volvulus between points of narrowing, caused by adhesions to the ventral abdominal wall. As shown by the earlier roentgenograms, it was into this loop of ileum that the balloon of the Miller-Abbott tube became inserted. The balloon passed the proximal obstruction, but never passed through the distal obstruction.

These kinks were not obstructive until a large chunk of undigested material became lodged. After this impacted material had become dislodged, the obstruction temporarily disappeared, though the adhesions and kinks were unchanged.

The anatomy and physiology of the small intestine are more accurately known today than ever before, due to the use of the Miller-Abbott tube. Some of the data are most surprising,

and of great interest to the surgeon. Conceptions of the length of the small intestine based upon measurements at autopsy or in the anatomic dissecting room, are found to be inapplicable to the living subject. Through interaction of its muscular elements the small intestine is constantly changing its length, but is at all times much shorter during life than after death. The obstructive kinks in Case I, Figs. 411–416, were in the lower

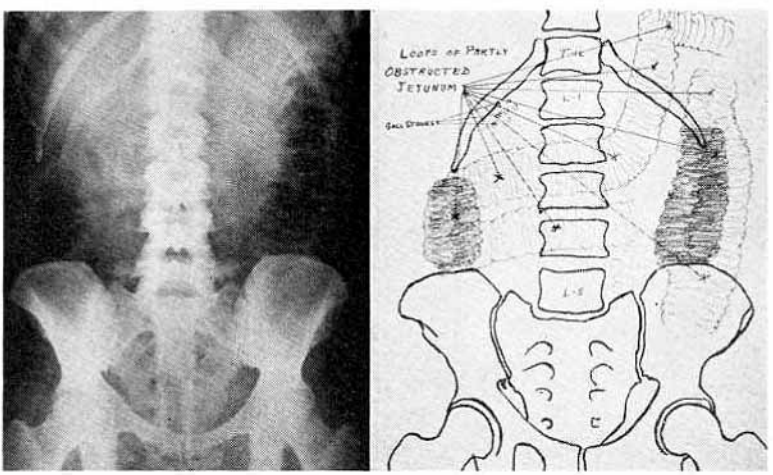

Fig. 417.—Case II. Ventral projection of abdomen, patient prone. The patient, Mrs. E. F., aged thirty-two years, has had attacks characteristic of gallstone colic, but no present clinical symptoms suggestive of high intestinal obstruction. The abdomen is soft. There is fever with oscillation from 99° to 102° F. The blood picture is essentially normal, except for a very slight shift to the left in the differential white blood count. On the basis of the present roentgenogram a definite diagnosis of partial obstruction at middle of small intestine is made. The gallbladder is full of gallstones which are visualized by their opaque centers.

ileum, yet measurements on the Miller-Abbott tube (Figs. 413–415) and the appearance of the barium visualized coils (Fig. 416) might have suggested a much higher site for the obstruction. Actually the advancing balloon of the Miller-Abbott tube may reach the cecum when but 3 or 4 feet of the tube are past the pylorus.

If, after the balloon of the Miller-Abbott tube has been fairly started down the jejunum, the progress of the tube is im-

peded by anchorage to the patient's mouth, the small intestine telescopes itself above the balloon, its muscular elements being able apparently to shorten, very markedly, the section of bowel that has engulfed and passed over the balloon. Under such circumstances the small intestine must alter its distribution in the abdomen to a marked degree and it has occurred to us that some clinical uses might be found for this maneuver, for example in cases of intussusception or retroperitoneal hernia. It

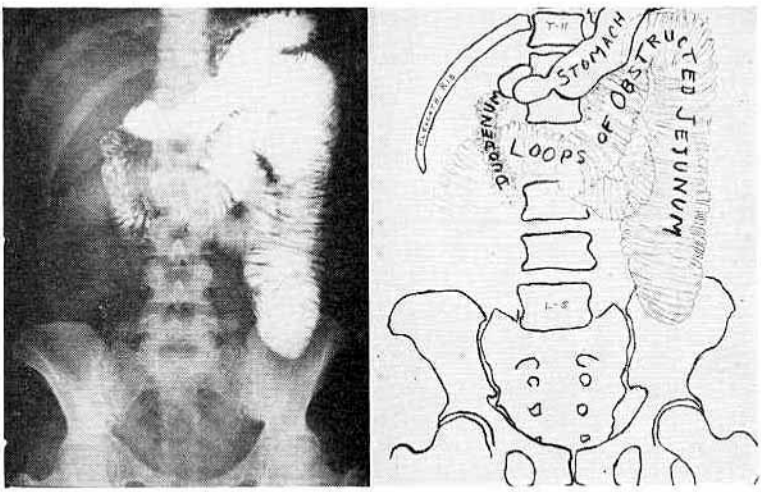

Fig. 418.—Case II. Ventral projection of abdomen, patient prone, twenty minutes after ingestion of opaque meal. Note the characteristic mucosal markings of jejunum. The small intestine is much shorter during life, and particularly in the absence of anesthesia, than was believed to be the case before the advent of roentgen methods of study (compare Case I). The surprising outcome in this present case is demonstrated in Fig. 419.

may be that in our Case I, the dislodgment of the undigested matter from the obstructing kink in the bowel was accomplished through the peristaltic effort of the bowel to "climb over" the balloon.

From the very beginning it has been obvious that the application of the Miller-Abbott tube to clinical cases and problems can be accomplished successfully only with the help of the radiologist. The enthusiasm and energy of Pendergrass and his associates in the department of radiology were doubtless

essential to the original development of the method by Miller and Abbott. In much the same way the method will come into full use, for the benefit of the patient, only where a radiologist is willing and anxious to deliver a full measure of cooperation. For it is no simple matter to manage these cases during the actual progress of the intubation. Too early inflation of the

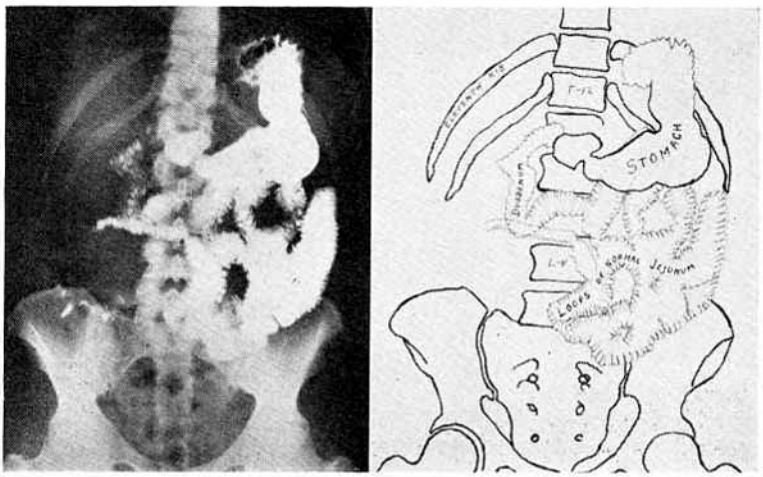

Fig. 419.—Case II. Ventral projection of abdomen, patient prone, thirty minutes after ingestion of opaque meal. The small intestine pattern has become normal. The obstruction has become spontaneously relieved. The patient is convinced that her temporary obstruction was produced by a large piece of unchewed food. This is not an altogether untenable hypothesis, although some organic narrowing is frequently present at the site of lodgment of such a piece of food material. If the above theory is the correct one, the case is akin to those in which a large gallstone produces intestinal obstruction in the midportion of the small intestine, after having ulcerated into the small intestine from the gallbladder, and after having passed some distance down the small intestine from point of entrance. A number of cases of such obstructions by gallstones have been reported in the literature. We ourselves have had several such cases.

balloon (before it is well into the descending portion of the duodenum) will result in its regurgitation through the pylorus into the stomach. Precious time may be lost unless frequent observations (fluoroscopic) are made during the early stages of the process, in order that the leading end of the tube may be properly presented at the pylorus, through posturing of the

patient or regulation of the rate at which the tube is being swallowed. Finally, the combined effort and thought of the surgeon and an interested radiologist may be necessary if a correct

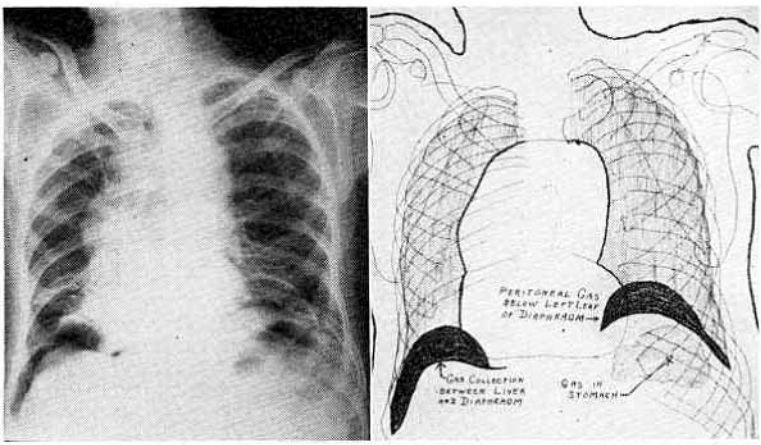

Fig. 420.—Case III. Mr. A. N., aged seventy years, ventral projection of thorax, patient sitting. This film was exposed because a "scout film" of the abdomen, vertical *x*-ray beam, patient supine, had indicated the possibility of "ruptured hollow viscus" with free gas in the peritoneal cavity. Subsequent postmortem examination revealed perforation of the colon secondary to ulcerative colitis.

diagnosis is to be arrived at preoperatively in the course of these procedures.

SUMMARY AND CONCLUSIONS

1. "Scout films" (roentgenograms made without the administration of opaque media, or any other special preparation of the patient) are often of great value in cases of suspected, or known, bowel obstruction or ileus. Frequently such film studies will locate the obstruction and reveal its nature. In cases where rupture of a hollow viscus has occurred, the film may reveal the condition by visualizing the abnormal gas content of the peritoneal cavity, particularly if the film was made with a horizontal *x*-ray beam.

2. The Miller-Abbott tube enables the surgeon to prepare a case of small bowel obstruction for operation, by intubation and drainage of the obstructed segment.

3. Clinical experience with the Miller-Abbott method of intubating the small intestine will add much to the surgeon's knowledge of the morphology and function of that part.

4. The active cooperation of the radiologist is needed for the successful application of the Miller-Abbott method to the clinical problem of small bowel obstruction.

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