Maingot's Abdominal Operations

Volume I

Ninth Edition

Maingot's Abdominal Operations

Volume I

Edited by

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Rodney Maingot
(1893–1982)

Rodney Maingot was born in Trinidad. He spent his medical student days at St. Bartholomew's Hospital Medical School, London, and qualified in 1916. He joined the Royal Army Medical Corps and served as Captain in Egypt and Palestine, being twice mentioned in despatches. On demobilisation he returned to St. Bartholomew's to continue his surgical training and gained his FRCS in 1920. He was appointed to the Consultant staff of the Royal Free Hospital, London, which he served for many years with great distinction. In addition, he was Consultant Surgeon at the Southend General Hospital, where his Saturday clinics and operating sessions attracted visitors from all over the world. During World War II he served as Regional Consultant to the Emergency Medical Service.

Rodney Maingot's fame was as a surgical teacher and he was particularly interested in the abdominal cavity. Biliary surgery was his particular metière, but he also made great contributions to the surgery of hernia and was especially proud of his "Keel repair" for large incisional hernias. He lectured with distinction, and his clear, beautifully illustrated talks took him to many parts of the world. He was particularly well known and popular in the United States. His reputation was spread even more widely through his numerous textbooks, characterised by their clear writing, superb illustrations, meticulous production, and detailed, indeed encyclopaedic, knowledge.

Rodney was especially proud of his *Abdominal Operations*. The First Edition appeared in 1940; it boasted 1385 pages and, apart from short contributions by two internists (Dr. R.S. Johnson on postoperative chest complications and Dr. L.T. Bond on sternal puncture), the whole massive work was entirely the effort of this remarkable man. Some of the figures by Miss Pauline Larivière, a pupil of Max Brödel, live on today.

A Second Edition appeared in 1948. Now Rodney had collected eight contributors: five from the United Kingdom, two from the United States, and one from Australia. For the Third Edition, in 1955, there were now 24 contributors. Those from the United States included such famous names as Brunschwig, DeBakey, Cooley, Dragstedt, Harrington, and Pack. The United Kingdom contributors included two future Presidents of the Royal College of Surgeons—Russell Brock and Cecil Wakeley. The succeeding editions contained increasing numbers of contributors whose names formed a veritable *Who's Who* of international surgery. The Seventh Edition, published in 1980 when Rodney was in his ninth decade, found him still actively concerned with editing and writing this monumental work, as well as carrying out an extensive and personal correspondence with his numerous contributors all over the world.

The last few months of his life were passed in poor physical health but he remained in full mental vigour right until the end. Shortly before he died, I visited him with David Stires of Appleton-Century-Crofts. He fully realised that he would never live to see the Eighth Edition, nor indeed to have the strength even to undertake the task. The fact that *Abdominal Operations* was not only to continue but was to bear his name, gave him immense pleasure and satisfaction.

Maingot's introduction to the first edition had a first paragraph consisting of one sentence:

> This book is intended to present detailed consideration of the technique of modern abdominal operations.

This aim, we hope, lives on today.

Harold Ellis

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Preface

Under the editorship of Rodney Maingot, *Abdominal Operations* achieved, over a period of 45 years and seven editions, a pride of place in the libraries of general surgeons throughout the world. It was our privilege to take over as editors for the eighth edition, but rapid advances in abdominal surgery have made a new edition necessary after only four years.

In updating these volumes, we have recruited a number of new contributors replacing those who have retired or who are, sadly, no longer with us. Our new authors are all surgeons in active clinical practice who have been chosen because of their internationally acknowledged expertise in their specialized fields. The majority are drawn, once again, from the United States and the United Kingdom, but also represented are Australia, Holland, Hong Kong, Israel, South Africa, and Switzerland. We are indebted to our contributors, both old and new, for their splendid efforts.

The general format of the book remains unchanged. Descriptions of the techniques of the major abdominal operations within the repertoire of the general surgeon persist as the nucleus. However, we have not merely produced another surgical atlas: rather, we have attempted to synthesize a complete expression of the science and art of abdominal surgery. We have included concise accounts of modern diagnostic procedures, relevant pathologic anatomy, pre-operative assessment, indications for and choice of operation, post-operative care and complications and their management. The majority of the text and illustrations has been carefully revised. Where possible, overlap and repetition have been minimized. What had previously been considered as individual chapters have, wherever possible, been fused into broader topics with a cohesion that parallels the surgeon's interest. Indeed, the number of chapters have been reduced in this edition from 94 to 81.

This edition is directed to sophisticated students of surgery, whether in training or in practice where the learning process continues. As editors, we hope that we have satisfied the desires and needs of our audience.

Harold Ellis
Seymour I. Schwartz

Contents

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SECTION I

Diagnostic and Interventional Procedures

1. Diagnostic and Interventional Radiology

Jovitas Skucas

CONVENTIONAL RADIOLOGY OF THE ACUTE ABDOMEN

Noncontrast radiographs of the abdomen, often called "plain films" or "conventional films," continue to serve as the initial imaging modality in a patient with an acute abdomen. Such noncontrast radiographs outline only gross differences in density, such as between gas, fat, soft tissues, and calcium. They cannot be used to differentiate small contrast changes between soft tissue, such as are readily detected by computed tomography (CT), yet these conventional radiographs may be diagnostic or will suggest the next examination (Fig. 1–1).

The Acute Abdominal Examination

Noncontrast radiographs can be obtained with the patient supine, prone, standing, or in a decubitus position. Likewise, the x-ray beam can be horizontal, vertical, or at angle. From experience, it has been found that a certain combination of radiographs, obtained in a specific sequence, serves best as the optimal survey for suspected abdominal disease. Such a survey, known as the "acute abdominal examination," should be the initial radiographic examination for the acutely ill adult patient who presents with signs and symptoms pointing towards intraabdominal disease. This examination should be obtained for those patients in whom clinical suspicion suggests bowel obstruction, ischemia, intra- or extraperitoneal infection, significant trauma, or for the evaluation of obscure clinical findings pointing towards the abdomen. Miller has shown that this examination detects even 1 ml of free gas in the peritoneal cavity.

Because some of these patients cannot cooperate readily by suspending respiration, the examination should be performed with relatively high-power x-ray generators and fast screen-film combinations. Approximately 60 to 70 kVp results in optimal film contrast. In general, these examinations should be performed in an x-ray room dedicated to chest and abdominal radiography. The use of portable x-ray equipment should be discouraged; the power output of portable x-ray generators is so low that a long x-ray exposure is usually necessary and the resultant motion of these sick patients leads to suboptimal examinations.

The acute abdominal examination for those patients who are able to stand is performed as follows:

The patient is placed upon the x-ray table in a left lateral position for approximately 10 minutes. Even if the examination is rushed, this time should not be less than 5 minutes. A left lateral decubitus radiograph is then obtained. The radiograph should be positioned so that the right flank (upper side) of the abdomen is visible. The film density should be such that the right flank is sufficiently well seen for adequate evaluation. The radiograph should be centered upon the right iliac crest. The main purpose of this radiograph is to help detect a pneumoperitoneum (Fig. 1–2).

After the decubitus radiograph has been obtained, with the patient still on the left side, the table should be tilted into an upright position. The examination should thus ideally be performed on a tilting x-ray table. If a nontilting table is used, the patient should stand up. A posterior-anterior (PA) radiograph of the chest is obtained next. If required, the lateral chest radiograph can also be obtained now. It is

Figure 1–1. A nasogastric tube was passed in this patient with a known gastric carcinoma. The patient had not had any prior resection. A supine radiograph of the abdomen reveals the tip of the tube (*arrow*) outside of the stomach. The tube had perforated through a necrotic portion of the tumor and was lying in the peritoneal cavity.

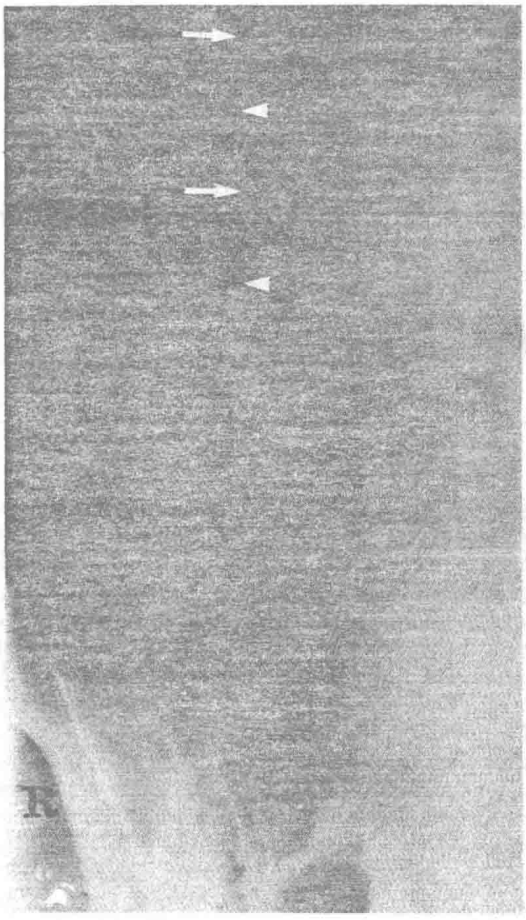

Figure 1–2. The left lateral decubitus radiograph reveals considerable fluid (*arrows*) and gas (*arrowheads*) in the peritoneal cavity. Although a large pneumoperitoneum can be identified with the patient prone or supine, a small pneumoperitoneum is apparent only if the patient is in a decubitus or upright position and a horizontal x-ray beam is used.

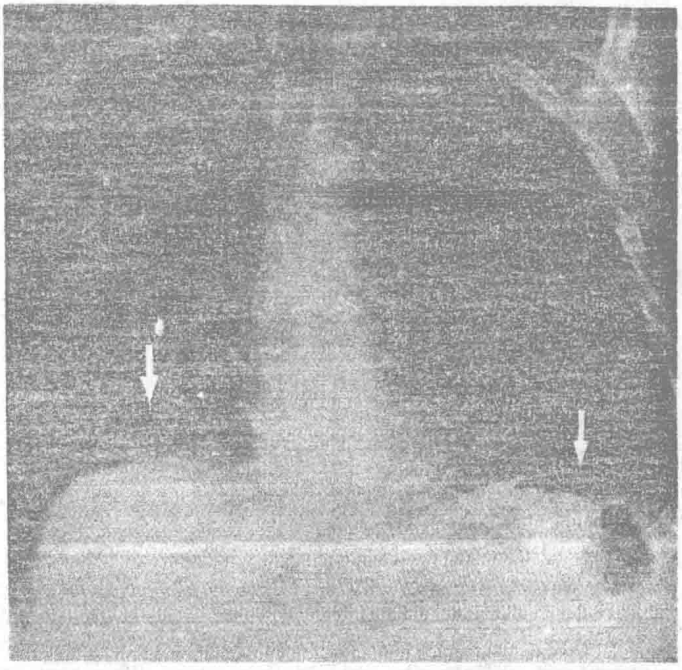

Figure 1–3. Intraperitoneal gas is present beneath both hemi-diaphragms (*arrows*). The pneumoperitoneum was secondary to a perforated duodenal ulcer. Even 1 ml of pneumoperitoneum can be identified with a correctly taken chest radiograph.

important that the diaphragm be included on both radiographs. The technique used for these radiographs should be that used for chest radiography; although the visualized portion of the upper abdomen will, of necessity, appear essentially white, both radiographs are excellent tools for visualizing a small pneumoperitoneum (Fig. 1–3).

With the patient still upright, a radiograph of the abdomen is obtained (Fig. 1–4). The film density should be optimal for visualization of the abdominal soft tissues and the radiograph centered so that the symphysis pubis is included on the bottom of the film.

The patient is then placed supine, and with a vertical x-ray beam a supine radiograph of the abdomen obtained. Here also the symphysis pubis should be included (Fig. 1–5).

For all of the above radiographs a 35 × 43 cm (14 × 17 inch) film size should be used. With some individuals two radiographs turned crosswise are necessary to ensure that the entire abdomen is included.

For those patients who are not able to stand the sequence of filming is modified as follows:

The first radiograph, consisting of the left lateral decubitus view, is obtained as described previously. The second

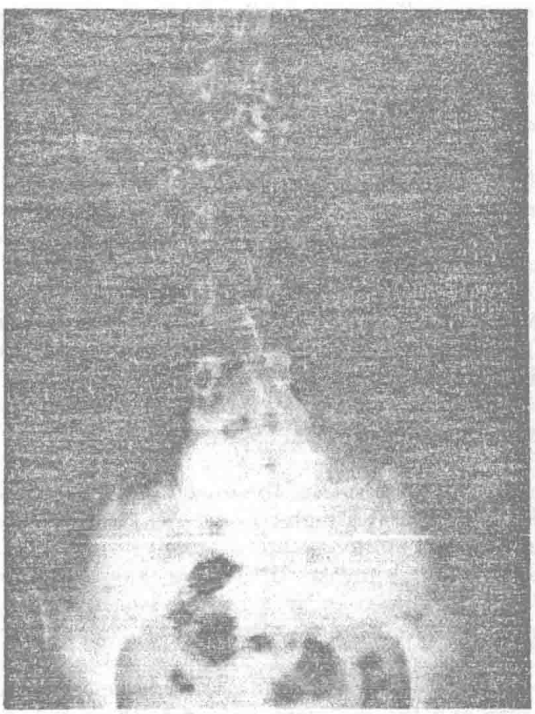

Figure 1–4. A radiograph obtained with the patient upright reveals extensive pancreatic calcifications. The hazy outline to the abdomen is caused by ascites.

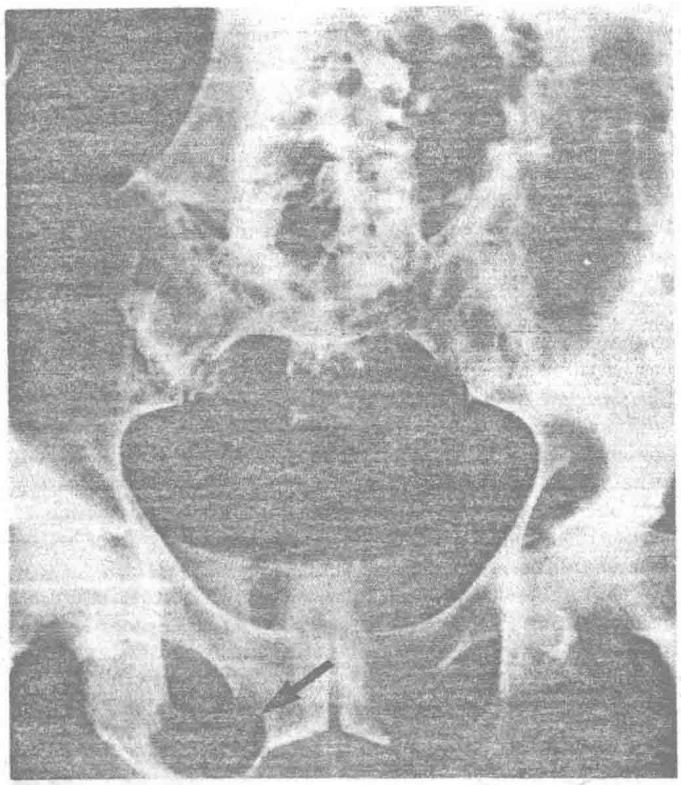

Figure 1–5. This patient has a small bowel obstruction secondary to an incarcerated right inguinal hernia (*arrow*). The loop of small bowel caught within the hernia can be identified only if the radiograph is centered to include the symphysis pubis.

(*Source: From Miller RE, Skucas J: The Radiological Examination of the Colon. The Hague: Martinus Nijhoff, 1983, p 5, with permission.*)

radiograph is likewise a left lateral decubitus but is exposed so that the soft tissues of the abdomen are optimally seen. As a result, the right flank area will be unduly dark and identification of a small pneumoperitoneum difficult. This radiograph is used primarily in identifying gas-filled fluid levels and in judging the degree of bowel distention; it serves essentially the same purpose as the upright radiograph of the abdomen in patients who can stand.

With the patient in a supine position, a vertical x-ray beam is used to obtain radiographs of both the chest and abdomen. The symphysis pubis should be included on the abdominal radiograph.

In a busy radiology department the examination can be started by having the patient lie on the left side while still on a stretcher outside of the x-ray room. The 10 minutes of waiting time is necessary because small amounts of gas filter slowly into the uppermost part of the peritoneal cavity. If a radiograph is obtained as soon as the patient assumes the decubitus position, a small pneumoperitoneum can be missed. Both the decubitus and the upright chest radiographs are designed to detect a pneumoperitoneum; it has been found that occasionally one or the other will not reveal small amounts of free gas. The use of both simply improves the accuracy in detecting a pneumoperitoneum.

The left lateral decubitus position (left side dependent) is used for several reasons; in a patient with a posterior gastric or duodenal perforation into the lesser sac, the gas can pass through the foramen of Winslow into the greater peritoneal cavity, collect along the right flank, and thus be detected. In a left lateral decubitus position, gas in the peritoneal cavity is adjacent to the liver and is relatively easy to identify; if the patient were in a right lateral decubitus position, intraperitoneal gas along the left flank is readily confused with gas in the splenic flexure or the left colon.

The right lateral decubitus radiograph can be helpful in those patients in whom left colonic obstruction is suspected. Although colonic obstruction can be localized from this radiograph, in general, if obstruction is clinically suspected, a barium enema should be performed; the enema not only will show whether an obstruction is present but also will identify the site of obstruction and often will suggest a specific diagnosis.

The upright chest radiographs are obtained so that the x-ray beam is parallel with the uppermost margin of the diaphragm. A small pneumoperitoneum can be missed if the x-ray beam is at an oblique angle. The upright view of the abdomen, on the other hand, should have the x-ray beam centered at the midabdomen. This radiograph should have a density optimal for visualizing the abdominal structures. The diaphragmatic region will be dark, and one should not rely upon this radiograph to detect a small pneumoperitoneum.

Radiographs of the chest should be obtained even when symptoms point toward the abdomen. The disease can originate in the chest. A radiograph with the patient upright is preferred over a supine position; the practice of tilting a patient semi-upright and then using a horizontal x-ray beam for the chest radiograph should be discouraged because such a technique can result in a pneumoperitoneum being missed.

The acute abdominal examination is obtained as the initial radiographic investigation when the patient is first seen or in the follow-up of a known serious condition. This examination is not needed when the patient's status is known and a single radiograph will answer the question being asked. Thus, when a patient with a known bowel obstruction is being observed, the examination can be modified and some of the radiographs eliminated. If the study is being obtained to see whether the degree of bowel distension has changed, at least one of the radiographs should be obtained with a horizontal x-ray beam. It is difficult to judge bowel distension with a vertical x-ray beam because fluid within bowel can mask even marked distension. Likewise, the presence of bowel wall edema and infiltration is best evaluated with a horizontal x-ray beam.

If the abdominal cavity was entered at surgery, a pneumoperitoneum can persist for days. The rate of absorption of air varies considerably among patients, and if extensive fibrosis is present, air can remain in the peritoneal cavity for several weeks. Thus the presence of a pneumoperitoneum after surgery by itself is of little prognostic significance. If the patient's postoperative condition deteriorates, serial acute abdominal examinations should be obtained every 12 or 24 hours as necessary. If there is a leak from a hollow viscus, the amount of gas in the peritoneal cavity will increase, whereas a normal postoperative course should lead to a decrease in the amount of free gas as the gas is gradually absorbed. In order to achieve a quantitation of the amount of intraperitoneal gas present, the acute abdominal examina-

tion must be obtained the same way each time by having the patient in the appropriate position for the specified period of time. Standardization of this examination is thus important.

Sequence of Radiographic Procedures

The number and type of radiographic procedures required will depend on each patient's clinical presentation and suspected diagnosis. A certain sequence in the performance of these examinations has been found useful.

Ultrasonography, nuclear medicine, and noncontrast conventional radiographic examinations do not interfere with each other or with any subsequent examinations and thus should be obtained first. If both arteriography and an intravenous urogram are required, the two examinations can be combined. The contrast used for arteriography is the same as in urography, and the renal excretion of contrast at the end of arteriography can be utilized to obtain a urogram. Similarly, many patients undergoing abdominal CT receive an intravenous contrast agent; although the kidneys are usually well defined with CT, if it is apparent that a urogram will be necessary, the appropriate radiographs can be obtained immediately after the tomographic examination. In general, abdominal CT examinations cannot be performed on the same day as barium studies. Depending upon the indication, many patients undergoing CT examinations are required to drink large volumes of a dilute iodinated contrast agent in order to opacify the bowel. This fluid not only precludes subsequent upper gastrointestinal (GI) and small bowel examinations but also hinders cleansing of the colon for a barium enema. If, on the other hand, the barium examinations are performed first, the resultant barium artefacts render CT examinations and ultrasonography useless for 1 or more days.

An oral cholecystogram and an upper GI examination can be performed on the same day. If it is necessary to constrict the gallbladder during cholecystography for better visualization, instead of a fatty meal, intravenous cholecystokinin should be used. The upper GI and small bowel examinations can then be performed immediately after.

An intravenous urogram and a barium enema likewise can be performed the same day. If a colovesical fistula is suspected, however, leakage of small amounts of barium into the bladder can be missed if the bladder is already partially filled with another contrast agent. In this clinical setting it is best to perform the two examinations on separate days.

If it is believed that both an upper GI examination and a barium enema will be necessary, some radiologists prefer that the former examination be done first. The reason is that the preparation for an upper GI examination is essentially nothing by mouth for 8 or so hours. If this examination is performed in the morning, the colon-cleansing regimen can be started that same afternoon and result in elimination of the previously ingested barium. Fluoroscopy immediately prior to a barium enema the next morning allows the radiologist to gauge the degree of colon cleansing. If, on the other hand, the barium enema is performed first, a colon cleansing regimen would be necessary not only the day prior to the barium enema but also afterwards to eliminate the barium for the subsequent upper GI examination. Thus, if the upper GI examination is performed first only one colon cleansing regimen is required, leading to greater patient comfort.

Adynamic Ileus

A number of conditions, such as peritonitis, shock, inflammation, and abdominal surgery, can result in adynamic ileus. The resultant ileus can be diffuse and involve both the small and large bowel, or it can be localized to one segment of the bowel. Some disorders are associated with both adynamic ileus and mechanical obstruction, making the interpretation of abdominal radiographs difficult.

Radiology of Adynamic Ileus

Whenever adynamic ileus is clinically suspected, the acute abdominal examination outlined previously should be obtained. This study not only shows the degree of bowel distension but also provides information on complications such as gas within bowel wall or in the portal venous system or the development of a pneumoperitoneum.

Generalized adynamic ileus results in bowel distention involving both the large and small bowel (Fig. 1–6). The bowel dilatation, however, is usually not as prominent as with mechanical obstruction (Fig. 1–7). In some patients the dilated colon will overshadow the underlying small bowel and suggest

Figure 1–6. This patient had generalized peritonitis secondary to a ruptured gallbladder. The radiograph reveals numerous dilated loops of small bowel and colon. The pattern is typical of adynamic ileus; with small bowel obstruction, less colonic gas should be present; with colonic obstruction, the colon should be more distended.

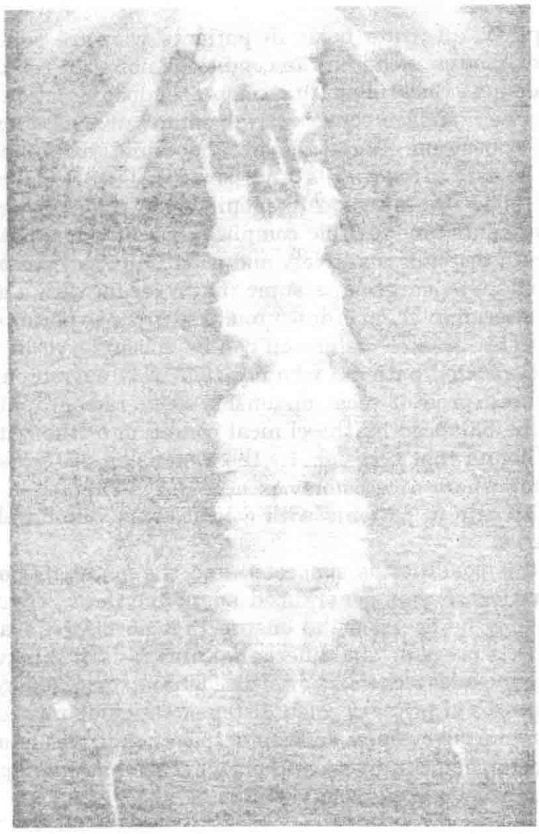

Figure 1–7. This patient with tuberculous peritonitis reveals numerous loops of bowel floating in the midabdomen. Little colonic gas is present. Without colonic distension the adynamic ileus in this patient is difficult to differentiate from small bowel obstruction.

distal colonic obstruction. With the patient supine, the ascending and descending portions of the colon tend to be filled with fluid and partially collapsed, thus making identification difficult. The transverse colon, cecum, and portions of the sigmoid colon tend to be distended with gas and prominent. If a prone position is assumed by the patient, the transverse colon now becomes filled with fluid and partially collapsed, and the ascending and descending portions of the colon are better identified. In general, in adynamic ileus the gas present within the bowel tends to be more prominent than the fluid.

A horizontal x-ray beam with the patient either upright or in a decubitus position reveals numerous gas-fluid levels both within the large and small bowel. Within the same loop the gas-fluid levels can be at different heights, a finding seen both with adynamic ileus and mechanical obstruction. This finding thus cannot be used to differentiate between the two conditions. With the patient in a decubitus position, horizontal beam radiography can reveal very long gas-fluid levels if the longitudinal axis of the bowel lumen happens to be horizontally placed, a finding not uncommon in the ascending and descending portions of the colon. In typical adynamic ileus some degree of gastric dilatation is also common unless a nasogastric tube is in place.

The acute abdominal examination in adynamic ileus may also show other ancillary signs suggesting the diagnosis. As an example, with peritoneal irritation there is decreased diaphragmatic motion, atelectasis of the lung bases is not unusual, and pleural effusion can be present. If significant pulmonary consolidation develops before the adynamic ileus, the possibility that the ileus is secondary to a pneumonia should be considered.

Adynamic ileus is not a disease but a manifestation of a severe insult. In some patients the adynamic ileus can be readily explained either by recent surgery or other known abnormal conditions. In others, however, bowel distention develops with no known underlying etiology. If both clinically and from the acute abdominal examination colon obstruction cannot be excluded, a single-contrast barium enema can be performed if the patient does not have significant peritoneal irritation. Only enough barium should be instilled so that the radiologist can say with confidence that no obstruction is present; care must be taken not to fill too much bowel with barium, because patients with adynamic ileus can retain the barium for days and sometimes weeks. In general, careful fluoroscopic control of barium instillation allows the fluoroscopist to exclude mechanical obstruction and diagnose adynamic ileus with reasonable certainty.

Associated Conditions

Bowel distension is common after abdominal surgery, even if the bowel has not been handled. The resultant adynamic ileus can last for days, with the bowel gradually returning to a normal appearance.

Mesenteric ischemia is not an uncommon cause of adynamic ileus. In the appropriate clinical setting, adynamic ileus in an elderly patient should raise the suspicion of an underlying ischemic process.

Acute gastroenteritis or an inflammation involving any of the adjacent structures can likewise result in adynamic ileus (Fig. 1–8). Chronic use of some pharmacologic agents, such as the narcotic derivatives, can lead to bowel hypotonia and a pattern of adynamic ileus, although a more common presentation is constipation and colonic ileus. An electrolyte imbalance, such as hypokalemia, can also result in bowel hypotonia and gastric dilatation. In a hypertensive patient who is on medication known to induce hypokalemia, if the acute abdominal examination reveals a pattern of adynamic ileus, the possibility of electrolyte imbalance should be suspected.

Patients with long-standing diabetes mellitus, especially if the diabetes is under poor control, can develop a pattern of adynamic ileus. Both the small and the large bowel are involved. Similar to hypokalemia, occasionally massive gastric dilatation is present.

Some patients with acute intermittent porphyria have episodes of both small and large bowel distension; in some of these patients the colon distension predominates to the point that impending perforation is suspected. Usually the differential diagnosis includes mechanical bowel obstruction and a vascular crisis. If no significant peritoneal irritation is clinically present, a barium enema should exclude mechanical obstructions.

Patients with sprue can have dilated loops of small bowel. An occasional such patient will present primarily with marked colon dilatation.

Children and adults occasionally develop idiopathic primary pneumococcal peritonitis. The radiographic appearance

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