6. Appendicitis

GENERAL CONSIDERATIONS

It is essential that the earliest signs and symptoms of appendicitis be appreciated clearly; the view is accepted by most surgeons of experience that every patient with acute appendicitis should be operated on within the first twenty-four hours from the onset or as soon thereafter as possible. There are three reasons why cases come to attention later than this: the patient may think that the symptoms are not serious enough to need medical advice, the medical adviser may think that the symptoms are not typical of appendicitis or not serious enough to demand operation, or there is over-reliance on blood tests or misleading radiological evaluations. The remedy for the first situation is the education of the public; in the second situation the reader is reminded that the so-called typical symptoms of appendicitis as given in the textbooks sometimes indicate a somewhat advanced stage of the condition, and that it is impossible to say at the beginning of an attack whether it is likely to be mild or severe in type. Only better understanding of the pitfalls of overemphasis on blood tests and radiological interventions can address the third.

It is desirable, and in many cases possible, to diagnose appendicitis before peritonitis has set in, or at least before there is any more than that slight amount of irritation of the peritoneum that is commonly associated with any inflammatory process within the gut.

Pathological condition in relation to symptoms. The different grades of inflammation of the vermiform appendix have for many years been well
described and understood, though there is still a lack of appreciation of
the pathological condition often coexistent with the initial symptoms or,
at any rate, with the initial complaint. Mild inflammation of the mucous
membrane, parenchymatous inflammation of the whole wall, gangrene
of the interior lining or of all but the peritoneal coat—any of these may
c o-exist with symptoms so slight (but not indefinite) that they may be
overlooked by the patient and thought to be of slight significance by the
unobservant onlooker. Even rupture of the appendix due to local gan-
grene may not cause the patient to become bedridden or to seek medica-
tal advice, so long as local adhesions prevent the extension of the mis-
chief. When the appendix ruptures into the general abdominal cavity
in the absence of any protective adhesion, or when, after being localized,
the inflammatory process extends, not even the most stoical or insensi-
tive patient can refrain from seeking advice and taking to bed.

Obstruction of the lumen of the appendix, either by a concretion,
stricture, kink, tumor, or adhesion, is usually accompanied by more
acute and severe symptoms. So definite is the difference that some de-
scribe two forms of the disease—acute appendicitis and acute appendi-
cal obstruction. So far as this differentiation tends to emphasize the
usually greater urgency of symptoms with obstruction of the lumen of
the appendix, it serves a useful purpose, but to treat the obstructive
form as a different disease is unnecessary.

When the appendix has ruptured, the pathological condition is not
merely appendicitis but peritonitis—local, diffuse, or general, as the
case may be—and diagnosis is to that extent more complicated. It is fre-
cently only by careful attention to the history that one can determine
the true cause of such peritonitis.

Anatomical position of the appendix in relation to symptoms. The ver-
miform appendix, though usually described as being situated behind
the ileocecal junction with the tip directed toward the spleen, is not al-
ways found in that situation. To know the common positions is of great
importance in diagnosis, for the signs and symptoms may thereby vary
considerably. The accompanying diagram shows the more common po-
sitions (Fig. 14). For descriptive purposes it is well to recognize the as-
cending appendix, the iliac appendix, and the pelvic appendix. How-
ever, because of differences in degree of embryological rotation of the
cecum, the appendix might lie in any position, even in the left upper
quadrant! When the appendix lies by the side of the ascending colon or
in the iliac fossa, there will be the most definite local signs, while if it is
situated behind the cecum or behind the distal portion of the ileum and
the common mesentry, the inflammatory process will be somewhat
masked by the gut lying in front. If the appendix hangs over the right
brim of the true pelvis, the disease may give rise to few signs in the
suprapubic region of the abdomen, resulting in a dangerous condition
to which we shall call attention below.

Many of the mistakes made in the diagnosis of appendicitis are due to
a failure to realize the very great difference in signs and symptoms that
follow from the varying positions and relations of the appendix.
Diagnosis of appendicitis before perforation has taken place

In any case of suspected appendicitis, one must consider the following carefully:

1. The history immediately prior to the onset of pain
2. The symptoms of the attack and the local signs
3. The order of occurrence of the symptoms

The local conditions are more variable and notable after perforation has taken place, but there are definite indications even before perforation.

THE HISTORY

There is frequently a history of indigestion, "gastritis," or flatulence for a few hours and sometimes a day prior to the onset of the attack. In a patient who has never or seldom been subject to pain after taking food, this history should be sufficient to put one on guard. It may be elicited that frequent slight attacks of pain have been experienced in the appendicular region.

A history of unusual irregularity of the bowels is often obtained. Sometimes there is constipation, at other times diarrhea, especially in children. The occurrence of diarrhea is likely to mislead. In some cases an inflamed pelvic appendix may irritate the rectum by contiguity. This early diarrhea has to be distinguished from the late variety due to irritation of the rectum by pelvic peritonitis or a pelvic abscess. The latter is manifested by frequent small movements, often consisting mainly of mucus and without truly voluminous diarrhea.

THE SYMPTOMS AND LOCAL SIGNS OF THE ATTACK

The signs and symptoms (Fig. 15) are as follows:

1. Pain (epigastric or peri-umbilical, then right iliac)
2. Vomiting, nausea, acute loss of appetite

3. Local tenderness (per abdomen or per rectum)
4. Local rigidity of muscles (inconstant)
5. Local distention (inconstant)
6. Superficial hyperesthesia (inconstant)
7. Fever (inconstant)
8. Constipation (inconstant)
9. Testicular symptoms (uncommon)

Pain. The pain in the majority of cases is first referred to the epigastric or umbilical region and only later localized in the right iliac fossa. Occasionally the initial pain is felt "all over the abdomen," though that is more usual in cases with perforation. Sometimes the pain is hypogastric from the first. The initial pain is usually vague, resembling excessive flatulence or indigestion and very frequently producing the sensation that passage of stool or flatus might relieve the discomfort—the so-called downward urge. The downward urge is a very common phenomenon, but even if stool or gas is expelled, the discomfort remains unrelieved. When the appendix is retrocecal in position, the initial pain may be felt in the right iliac region. Therefore, though the pain com-

![Diagram](image_url)

Fig. 15. The common position of initial referred pain, the position of deep tenderness (nearly always to be elicited when the abdominal wall is not rigid), and the iliac triangle of hyperesthesia found in some cases of appendicitis.
monly starts in the upper or central part of the abdomen, this is not invariable.

The early pain of appendicitis is visceral rather than somatic in origin and is thus a referred type of poorly localized discomfort. First and most important is the exaggerated peristalsis of the appendix, excited by the relative or absolute obstruction to its lumen by a concretion, kink, or swollen mucous membrane; bacterial proliferation causes the accumulation of irritating products, which leads to a distention of the appendicular lumen.

The epigastric pain is most acute and distinct in those cases where there is considerable obstruction to the appendicular lumen. The localization of the pain to the right iliac region usually takes place some hours after the onset of the diffuse pain in the epigastric or umbilical region.

Vomiting, nausea, and anorexia. Vomiting generally occurs in the early stages of the attack, but usually a few hours after the initial pain. Many patients do not vomit but instead have a sensation of nausea. Loss of appetite or revulsion for food may be regarded as a lesser degree of the same sensation and often of equal value in diagnosis. Anyone in previously good health who suddenly loses appetite and complains of abdominal pain should be carefully watched for appendicitis. The degree of nausea and the frequency of vomiting in the early stages appear to depend on the amount of distention of the inflamed appendix. Vomiting is more prone to occur in children or in patients whose digestive tract is easily deranged. So frequent is anorexia or nausea, at least to some degree, that the presence of hunger should raise a question of the diagnosis of acute appendicitis.

It may be taken as a general rule that the severity and frequency of the vomiting at the onset of an attack of appendicitis indicate the degree of distention of the appendix and consequently the immediate risk that perforation may occur. Vomiting before the onset of pain is extremely rare in acute appendicitis and should lead to suspicion of a different diagnosis.

Local tenderness. Local tenderness over the site of the appendix is frequently absent at the onset of the attack, and for some time the local symptoms are masked by the more general abdominal pains. When the latter have subsided, the local tenderness is usually easily elicited. Occasionally, even careful palpation cannot detect any spot of local tenderness in the iliac fossa during the initial stage of appendicitis. Early deep tenderness can most often be detected just below the middle of a line joining the anterior superior iliac spine and the umbilicus, corresponding roughly to the position of the base of the appendix (McBurney's point), but tenderness over this spot is not constant. The site of the pain on pressure varies according to the position of the appendix and is obtainable when that viscus is not adherent to any surrounding part. The spot of maximum tenderness may sometimes be accurately located by gentle percussion over the affected region. Tenderness elicited by light percussion is a remarkably reliable indication of parietal peritoneal irritation. In the case of an appendix situated in the pelvis, a rectal examination will frequently elicit pain when the finger presses on the inflamed organ, while at the same time abdominal tenderness may be absent. Tenderness of the abdominal wall is less marked in cases in which the inflamed appendix lies behind the cecum or behind many coils of small intestine.

Whatever the constellation of signs and symptoms, the clinical diagnosis of acute appendicitis cannot be made unless tenderness (no matter how slight) can be demonstrated in some location.

Hyperesthesia. Local hyperesthesia of the skin of the abdominal wall is an occasional but inconstant accompaniment of an inflamed, unperforated appendix. It is usually confined to the right side. The areas affected nearly always lie in the area of distribution of the nerves from the tenth, eleventh, and twelfth dorsal and first lumbar spinal segments.

Rigidity. Local muscular rigidity over the inflamed area is frequently present but is by no means a constant finding in the initial stages. There are several grades of muscular rigidity. The extreme degree is that in which the particular section of the abdominal wall is persistently stiff and will not move on respiration; in a lesser degree, the muscles stiffens almost as soon as the hand touches the skin; and in the least degree, the rigidity occurs only (and that to a slighter degree) when the fingers are
pressed more deeply into the iliac fossa or toward the appendix. In most cases extreme muscular rigidity coincides with commencing peritonitis, and even slight degrees, when persisting, are due to irritation of the parietal peritoneum. It is a common experience to find no local muscular rigidity in a case of appendicitis without any peritonitis. In making this statement, it must be understood that great care should be taken to exclude the rigidity that many patients develop as a result of nervousness and apprehension or that may be induced by a rough or cold examining hand. Certainly, with an unperforated appendix situated in the pelvis, rigidity of the abdominal wall is nearly always absent. Failure to realize this important fact is responsible for many delayed operations and lost lives. An appendix may be on the point of bursting into the general peritoneal cavity without a single adhesion to limit infection, though at the same time the abdominal wall may be flaccid and allow free manipulation without any rigidity. This fact must be known to every surgeon of experience, but in general it is certainly not fully appreciated. Rigidity is taught to be one of the earliest signs of acute inflammation of the appendix, whereas, in quite a large proportion of cases, it is almost completely absent in the earliest stage, and in some cases it is absent even though pelvic peritonitis exists.

When the inflammation of the appendix has caused edema of the contiguous portions of the abdominal parieties (whether posterior, lateral, or anterior), muscular rigidity is the rule.

Rigidity of the psoas should always be tested for by extending the right thigh with the patient on his or her left side. Rigidity of the quadratus lumborum should be present with an inflamed ascending appendix. It is difficult to ascertain but may be surmised if deep resistance is felt on pressing the fingers forward from beneath the lower posterior costal margin.

**Fever.** Fever may not be present at the beginning of the attack but frequently develops before twenty-four hours have passed. Before rupture has occurred, the temperature is not usually much above normal, 2°F or 3°F being the average elevation. Mistakes are liable to be made due to the fact that the temperature is not elevated at the time of the onset of the pain. In any suspected case, the temperature should be taken every two to four hours; if it rises in a gradual manner, it is a point in favor of appendicitis. If at the very beginning of any attack of acute abdominal pain the temperature is considerably raised (i.e., 103°F or 104°F) or if a rigor has accompanied the onset of pain, the presumption is against appendicitis. Temperatures of this degree are not uncommon once perforation has occurred, but it is to be kept in mind that perforation is extremely uncommon earlier than twenty-four to thirty-six hours after the onset of symptoms.

**Constipation.** Though the patient frequently complains of constipation, especially during the early phase of visceral pain, numerous cases occur, particularly in children, in which diarrhea ushers in the attack.

**Pulse.** The pulse is only slightly if at all accelerated in the early stage; it may be normal in every way, even though the temperature is raised. Any continued or decided acceleration of the pulse either corresponds with the occurrence of local peritonitis or indicates an appendix distended with infective material.

**Distention.** When the appendix is acutely inflamed, gaseous distention of the cecum is sometimes present; this local distention is probably the result of a reflex adynamic ileus. It is more likely to be present when the appendix is retrocecal in position and closely embedded in the wall of the cecum. It gives rise to a local swelling with a tympanitic note on percussion. Diffuse and severe distention is encountered only in late cases of perforation.

**Testicular symptoms.** In the male, testicular symptoms are sometimes produced by an inflamed appendix even when unperforated. There may be pain in either the right or the left testicle or in both, or the patient may say that the right testicle was retracted at a certain stage of the disease. It is likely that this is a pain referred from the appendix, since the tenth dorsal spinal segment apparently supplies both viscera.
stimulation of the genitofemoral nerve by inflammatory exudate might account for testicular retraction.

THE ORDER OF OCCURRENCE OF THE SYMPTOMS

This is of the utmost importance in diagnosis. The march of events is as follows:

1. Pain, usually epigastric or umbilical
2. Anorexia, nausea, or vomiting
3. Tenderness—somewhere in the abdomen or pelvis
4. Fever
5. Leukocytosis

The symptoms almost always occur in the above order, and when that order varies, the diagnosis should be questioned. Moreover, leukocytosis is rightly put last in this sequence, for it probably means that local peritonitis has begun; nowadays acute appendicitis should be diagnosed in many instances before there is demonstrative leukocytosis. If fever precedes the onset of pain, or if vomiting accompanies or precedes the first bout of pain, it is generally not appendicitis with which we are dealing.

It is a fact worthy of remembrance that an acute attack of appendicitis often starts in the middle of the night and may awaken the patient out of sleep.

There are two or three facts about the rectoceleal appendix that need special mention. Pain is usually less and is often from the first felt only locally. Vomiting is not so frequent, and generally the muscular rigidity over the diseased focus is less than would be expected for so advanced a lesion.

The diagnosis of appendicitis in the stage prior to perforation depends, therefore, upon certain constant and other inconstant features. Epigastric pain, nausea or vomiting, right iliac pain, and low-grade fever, in that symptom sequence, are almost constant, and local tenderness—either on deep pressure in the right iliac region, in the flank, or by rectal examination—is invariable except in the first several hours of the attack. Local rigidity is common but not constant. The other symptoms mentioned above are inconstant, while the pulse rate is usually normal.

Occasionally, the presence of a calcified appendicolith on a plain film may be helpful if the clinical picture is consistent (Plate 2). An ultrasonographically demonstrable, thick-walled appendix may sometimes aid in diagnosis but is not an invariable finding in acute appendicitis (Plate 3A). Recently, some have advocated CT scan, but the true place of this modality in appendicitis remains unproven. In the young woman in whom adnexal pathology cannot be differentiated from acute appendicitis, pelvic ultrasound may be very useful. If clinical findings are equivocal, laparoscopy is indicated and may be both diagnostic and therapeutic.

In those rare cases in which, owing to a developmental anomaly, the cecum and appendix lie in the left instead of the right iliac fossa, the local symptoms and signs will be found on the left side. This condition is sometimes accompanied by dextrocardia, the existence of which should make one particularly careful in investigation of abdominal pain.

Diagnosis after perforation has occurred

A number of cases of acute appendicitis come to the surgeon after the appendix has perforated at the site of a patch of gangrene. One reason for this is that practitioners fail to realize that the symptoms of appendicitis as often described are those that accompany late appendicitis with perforation. Local abscess means perforation of the appendix. There are still too many cases that do not reach the surgeon until an abscess or peritonitis has developed. It must be allowed that in a few cases the first symptoms that the patient complains of seem to be those due to a perforation, but these cases are the exceptions.

The symptoms and course of illness consequent on appendicitis with perforation of the appendix are those already described, with the addition of the symptoms due to local or diffuse peritonitis. Perforation with
the presence of a mass or with generalized peritonitis usually does not occur until at least forty-eight hours after the onset of symptoms. There are usually an accentuation of pain and renewal of vomiting when the perforation occurs, but the exact symptoms vary according to the position of the appendix and the nature of the protective peritoneal reaction.

Around the perforation itself, a localized abscess may form, but sometimes a piece of omentum may seal the opening or, more rarely, the infection may spread quickly and widely without the formation of any or many adhesions, especially in babies. A definite lump is almost invariably indicative of a perforation. In the absence of a perforation, a lump rarely is caused by a thick and edematous cecum or a cancer.

There are two main divisions of the pathological states consequent upon perforation, depending upon the position of the appendix itself:

1. When the appendix is above the brim of the true pelvis—the iliac appendix
2. When the appendix lies wholly or partly in the true pelvis—the pelvic appendix

THE PERFORATED ILIAC APPENDIX

Perforation of an appendix lying in the iliac fossa leads to rigidity of the overlying part of the muscular wall of the abdomen. When seen a little later, a lump (mass) may be felt and the rigidity may have lessened. Later still, there may be simply a tender lump.

In addition, there will be fever (higher, as a rule, than before perforation) and certain localizing signs varying according to the position of the appendix (Fig. 16).

1. When the appendix perforates retroceccally, there may be a mass that may be resonant on percussion, owing to the intervening cecum. One rarely perceives a mass sooner than seventy-two hours after the onset of symptoms and sometimes not until the patient is anesthetized, because abdominal rigidity obscures the lump. The infection will cause inflammatory edema of the iliacus and quadratus lumborum and adjacent parts, and tenderness will be elicited on pressing the fingers forward below the right costal margin at the outer border of the erector spinae. A perforated retrocecal appendix is particularly likely to be missed in stout elderly patients in whom the condition may not come to the surgeon's attention before definite swelling is palpable.

2. The appendix may lie in a position parallel with the cecum and ascending colon but lateral to them. The symptoms are then similar to those just described, except that rigidity of the lateral and anterior abdominal walls is more evident and any lump is more easily felt because the cecum does not mask it.

3. The conditions resulting from perforation of an appendix lying in the iliac fossa on the iliacus or psoas are reasonably characteristic. Immediately after the perforation there will be intense rigidity of the abdominal wall over the right iliac region and great tenderness on pressure over the same area. (Very rarely, chiefly in patients suffering from
severe toxemia, rigidity that had at first been present disappears on perforation of the appendix.) After a certain time, if there is suitable resistance to the infection, the peritoneal reaction becomes limited and the rigidity usually diminishes somewhat, allowing the palpating hand to feel a tender lump—due either to a small local abscess or to a mass of omentum wrapped round the inflamed, perforated appendix. Obviously, if the infection is not walled off, generalized peritonitis rather than a mass may result.

There are two special symptoms that may help to achieve exact localization in this region. The irritation and reflex rigidity of the iliopectineus frequently cause the patient to hold the right thigh flexed, or, with a lesser degree of irritation, pain may be felt if the right thigh is fully extended as the patient lies on his or her left side. This sign is sometimes of great value.

In a few cases, irritation of the lateral femoral cutaneous nerve as it crosses the iliacus is evidenced by pain and hyperesthesia along the distribution of that nerve (the lateral thigh).

4. When the appendix lies so that the tip is directed medially, the result of its perforation varies greatly according to whether it is behind or in front of the ileum. If it is behind the ileum, localization of the inflammatory process usually results, but the swelling is not so readily felt since the ileum covers and masks it. But tenderness and rigidity may be present and an indefinite lump may be felt, while the test for psoas irritation may help in diagnosis.

The ureter crosses the pelvic brim in close relationship to the medially directed appendix. Occasionally, pain on micturition may be produced, presumably by irritation of the ureter.

It is well to call attention to the lack of physical signs and the paucity of symptoms that may accompany an attack of acute gangrenous appendicitis when the appendix is fixed behind the end of the ileum. In the early stages of the attack, the ileum is irritated and the bowel contents pass on quickly, giving rise to the passage of several small motions; in the later stages, after the appendix has perforated, the subsequent symptoms of obstruction of the lower ileum may mislead the observer as to the cause of the trouble.

It will be noted that this is another example of the extra difficulty and danger in diagnosis when the appendix is close to or against a nondemonstrative area of the peritoneum.

If the appendix perforates while lying in front of the ileum, there is great danger of very extensive peritonitis, but if the infection becomes localized, diagnosis is fairly easy, for the formation of pus close to the abdominal wall leads to local boardlike rigidity and exquisite tenderness over the affected area. Psoas irritation will be absent.

THE PERFORATED PELVIC APPENDIX

The early symptoms of an attack of appendicitis when the appendix is situated in the pelvis are similar to those that ensue when it is situated above the pelvic brim, except that rigidity of the right iliac region of the abdominal wall is seldom present in the early stages, and the pain is more frequently felt in both left and right iliac fossae. Pain is not so readily localized in the right iliac fossa but is often felt on deep pressure at the brim of the true pelvis, and the epigastric pain may dominate the scene for a longer time.

The perforated pelvic appendix is one of the most easily overlooked and therefore one of the most dangerous conditions that may occur in the abdomen. The reason appears to be as follows. While the appendix is unruptured and tense, the pain due to the distention and peristaltic contraction is definite and severe and is felt chiefly in the epigastrum or the umbilical zone. When rupture occurs, the epigastric pain diminishes and local pelvic peritonitis results on the right side of the pelvis or at the bottom of the pelvic pouch of peritoneum. This is usually unaccompanied by rigidity of the lower abdominal muscles, and since the pain of appendicular distention has ceased and the pain due to pelvic peritonitis at this stage is frequently very insignificant, the patient may seem better, and the examination of the abdomen may give little indication of the trouble in the pelvis. Sooner or later—usually within three or four days—either the peritonitis becomes definitely localized into a pelvic abscess of considerable dimensions or the inflammation may track upward toward the general abdominal cavity and give rise to generalized peritonitis with increasing pain, distention, and rigidity of the abdominal wall. If, because the patient came late for advice or sufficient
attention was not paid to the preliminary symptoms, the prerupture stage of the inflamed pelvic appendix is missed, it is essential to diagnose the ruptured appendix as soon as possible after rupture before peritonitis has extended too far upward into the abdominal cavity. For this purpose it is important to pay attention to the anatomical position of the pelvic appendix, which lies in relationship with one or more of the following—the pelvic wall, the rectum, and the bladder. Irritation of the bladder or rectum may be signified by frequency of micturition or pain accompanying it, or by diarrhea or tenesmus, respectively. But more important is the fact that usually a tender swelling can be felt against the right pelvic wall by the finger inserted into the rectum. Moreover, when the ruptured appendix is adherent to the fascia covering the obturator internus and the subjacent fibers of the muscle are affected by the inflammatory edema, rotation of the flexed thigh so as to put the muscle through its extreme movements (especially internal rotation) will cause hypogastric pain. In performing this maneuver it is essential that the thigh be flexed so as to relax the psoas muscle.

By a careful consideration of the history and of the points just mentioned, it should be difficult to miss the early inflamed pelvic appendix. The appendix that is most likely to give rise to doubt in diagnosis is one situated high up in the right posterior quadrant of the pelvis, for in this situation there may be no localizing signs and it may be difficult to feel the viscus or elicit the tenderness per rectum.

The later symptoms resulting from rupture of a pelvic appendix are either those of a large pelvic abscess or those of advanced pelvic and hypogastric peritonitis, with increasing toxemia. Tenderness and rigidity of the whole lower abdominal wall, distention, vomiting, and increased pain all give a clear picture of peritonitis.

It is noteworthy that as the peritonitic inflammation spreads upward from the pelvis, it frequently does so on the left side first. This is probably because, as the pelvis fills with pus, the anatomical path of least resistance is by the side of the sigmoid colon.

When a pelvic abscess has formed, there are usually all the symptoms of suppuration—fever, anorexia, and leukocytosis—while locally there are tenderness and slight distention in the hypogastrium. Rigidity of the lower abdominal wall is quite frequently absent even when a pelvic ab-

cess is present. Rarely, the temperature may be normal even in the presence of an abscess. An ultrasound scan is occasionally of value in localizing an abscess in the pelvis, whereas CT is usually more definitive.

Per rectum, the bulge of the abscess can usually be detected, and pain is produced by pressing on the bulging mass.

In women, the intervention of the uterus makes bladder symptoms less likely to supervene in cases of appendicular suppuration. The normal menstrual flow may be increased by the pelvic congestion, and the menstrual period may be precipitated thereby.

There is a less common condition of intestinal obstruction that may be produced by pelvic appendicular suppuration at a late stage. Either or both the sigmoid colon and the small intestine may be obstructed within the pelvis. This is most likely encountered in the aged or debilitated patient in whom the early stages of the disease were not detected. But if the inflamed pelvic appendix were diagnosed in the early stage, there would never arise any such dangerous late complication. In early diagnosis and operation lies the prevention of such conditions.

RECURRENT ACUTE APPENDICITIS

While there is agreement that chronic appendicitis will not cause prolonged abdominal pain lasting for weeks or months, it is clear that patients occasionally experience recurrent attacks of acute appendicitis from which they recover. The individual attacks do not differ from those of classic acute appendicitis. Because of the recurrent nature of the attacks, barium enema and CT examinations (Plate 3B) are often performed on such patients and sometimes demonstrate a characteristic extrinsic compression of the medial aspect of the cecum caused by a small abscess. Such patients are often thought to have regional enteritis but are cured completely by appendectomy.
7. The differential diagnosis of appendicitis

Diagnosis of appendicitis is usually not especially difficult. A considerable number of the acute abdominal emergency patients admitted to a hospital have appendicular inflammation. So frequent is this condition that it would almost appear that some do not trouble to attempt a differential diagnosis. This is a serious mistake.

The typical case presents with epigastric pain, followed by vomiting, succeeded by localizing of the pain in the right iliac fossa, where tenderness can always be noted and rigidity of the overlying rectus often can be made out. This picture is sufficiently characteristic, even without the presence of slight fever, to make the diagnosis very probable. But there are difficulties that have to be discussed. Acute appendicitis can mimic virtually any intra-abdominal process; therefore to know acute appendicitis is to know well the diagnosis of acute abdominal pain.

SYSTEMIC CONDITIONS OR INFECTIOUS CONDITIONS THAT SIMULATE UNRUPTURED APPENDICITIS

Influenza. It is important first to make quite sure that one is dealing with a primarily abdominal condition. In the course of a definite attack of influenza, abdominal pain may ensue, and during an outbreak of the disease, there is grave danger that occasionally an attack of appendicitis may be overlooked and attributed to “abdominal influenza.” But seldom in influenza is the abdomen alone attacked. Pain and tenderness in the right iliac fossa are sometimes present in influenza, though the abdominal pain is more likely to be general. Backache, headache, and pain in the eyeballs are more likely to be felt in an attack of influenza, and vomiting may precede the abdominal pain—a sequence seldom seen in appendicitis.

Diaphragmatic pleurisy. One must always exclude diaphragmatic pleurisy as a result of early basal pneumonia or pulmonary infarction before diagnosing appendicitis. Pain, tenderness, and muscular rigidity may all be noted in the right iliac region in thoracic disease, but sometimes firm, continued pressure will enable one to feel deep into the iliac fossa without causing any increase of the pain. In cases of appendicitis, pressure over the left iliac fossa applied by fingers pressed deeply in and directed toward the right side (Rovsing’s sign) will sometimes cause pain in the appendicular region—a sign that is absent in cases of pleurisy or pneumonia. In thoracic disease, the respiration rate is usually increased, and, more importantly, the abdominal wall moves freely with respiration. Of course, a careful examination of the chest, together with a chest X-ray if necessary, is the method of discrimination.

Spinal disease. Spinal disease may cause pain referred to the appendicular region. This is especially true early in the course of shingles (herpes zoster) before the typical cutaneous lesions appear. An examination of the spinal column and neurological system can easily and quickly be made and soon determines any lesion.

Typhoid. Typhoid fever, still prevalent in some parts of the world, is another general disease that is occasionally mistaken for appendicitis because of the abdominal pain and tenderness that are sometimes localized in the right iliac fossa. In most cases, however, there are general symptoms that enable the diagnosis to be made. Headache, general malaise, enlargement of the spleen, and the presence of a roseola should make one suspect typhoid. In children, in whom the general
symptoms of typhoid fever are often slight, and occasionally in adults attacked by the ambulatory type of the disease, mistakes might be made.

If the symptoms have been present for a week when the patient is first seen, the agglutination reaction may be positive in respect to *Salmonella typhi* or *S. paratyphi* A or B. A blood culture of a typhoid patient might prove positive if taken within the first week of the disease. One must voice a warning against treating any doubtful case as typhoid without making a rectal examination. The irregular fever, tympanitic abdomen, and vague hypogastric pains that accompany a pelvic abscess may be and have been mistaken for typhoid fever, but a finger inserted into the anal canal will serve to distinguish the condition unless the abscess is due to leakage of a typhoid ulcer.

Other more common types of salmonellosis or shigellosis that are now generally acquired from contaminated food may produce nausea, vomiting, abdominal pain, and diarrhea. The last is usually profound, and the temperature is often 102°F to 103°F from the onset, serving to distinguish this condition from acute appendicitis.

**Acute porphyria.** In certain predisposed persons and under special circumstances, the hemoglobin of the red blood cells may be broken down, with the formation of an abnormal amount of porphobilinogen and the ultimate excretion of certain porphyrins in the urine that, on standing, turn a dark brown or reddish brown color. These abnormal biochemical changes may be accompanied by alarming abdominal or neurological symptoms, particularly by severe attacks of acute intestinal colic; this has sometimes led to the erroneous diagnosis of acute appendicitis. Only the hepatic types of acute intermittent or cutanea tarda hereditary porphyria and hereditary coproporphyria are associated with attacks of abdominal pain.

Acute porphyria occurs chiefly in those who have inherited a predisposition to it, and symptoms more commonly arise in the third and fourth decades of life. It has become more common during the last twenty years, during which there has been a greatly increased use of certain drugs, particularly the barbiturates and the sulfonamides, which have a tendency to precipitate attacks. The attack often follows drug taking or the administration of an anesthetic. The taking of alcohol may also cause an attack. Acute porphyria is more common in women and is especially common in South Africa.

The abdominal symptoms consist of severe colicky pain, vomiting, and constipation. The pain is central but may radiate widely. It has been mistaken for biliary colic. As a rule there is no distention, tenderness, or muscular rigidity, but the intensity of the pain, felt around the umbilicus, in the back, and sometimes in the limbs, may be alarming. In severe cases there may be muscular weakness, and mental symptoms, such as hallucinations. Slight fever and jaundice may occur, and there may be a leukocytosis.

Even before the urine turns brown, the porphobilinogen may be detected in urine by chemical means. If porphobilinogen is present, it is specific for acute intermittent porphyria and for the cutanea tarda hereditary form during an acute attack. In patients with hereditary coproporphyria, there is an increased excretion of coproporphyrin III in the stool and the urine, which can be found by appropriate testing.

Acute porphyria may stimulate acute appendicitis or even intestinal obstruction, but the pain does not localize in the right iliac fossa, and as a rule there is no distention. Careful inquiries should be made as to any similar attacks in the patient or in any of her relatives.

**MINOR ABDOMINAL DISTURBANCES AND GASTROENTERITIS**

In the early stages of appendicitis, before there is any or much congestion or inflammation of the peritoneum, and when muscular rigidity is usually absent, appendicitis is often mistakenly diagnosed as "gastroenteritis" or "gastritis."

It is not facetious or cynical to say that the diagnosis of gastritis or gastroenteritis is usually made in the emergency ward by a young physician who is "not impressed" by a patient's abdominal pain or physical findings. The failure to impress reflects the erroneous idea that an "acute abdomen" (or one requiring a surgeon) is so catastrophic that the patient must complain of severe pain and have boardlike rigidity of
the abdomen. In my experience, the diagnosis of gastroenteritis in the emergency ward is so often incorrect as to raise a serious question whenever the emergency physician comes to this conclusion. The diagnosis is usually made in a patient with abdominal pain, nausea, vomiting, diarrhea, or any combination of these that cannot be attributed to a more definite condition by the examining physician. My teaching for many years has been that the emergency room physician should be uncomfortable with the diagnosis of gastritis or gastroenteritis because such a diagnosis is often an excuse to give an undiagnosed condition a name.

Acute gastritis—which may be caused by bacteria such as Helicobacter, viruses, excessive alcohol intake, or a variety of drugs—is usually marked by intense nausea and vomiting. While a dull, gnawing epigastric discomfort is often present, it is not localized and does not become so, nor are abnormalities present on careful examination of the abdomen.

Viral or bacterial (Campylobacter, Shigella, Salmonella) infections of the more distal portions of the gastrointestinal tract are more frequently associated with fairly profound diarrhea. Tenderness and rigidity are usually minimal or absent. If a smear of the loose stool shows sheets of leukocytes, the conclusion that enteritis is present is on firmer ground than when gastroenteritis becomes an exclusionary diagnosis.

As in adults, the diagnosis of gastroenteritis in children should not be made with peace of mind. Any child previously in good health who is suddenly taken with abdominal pain and loss of appetite, has nausea or vomits, and at the same time shows definite deep tenderness in the right iliac fossa, even if the pulse is normal and the temperature is not elevated, is most probably suffering from appendicitis.

**Infective hepatitis.** It is well to remember also that some patients who suffer from infective hepatitis complain of abdominal pain with anorexia and nausea in the early stage of the disease, and it is easy for this to give rise to a suspicion that the appendix may be diseased. As a rule, however, the pain does not localize in the right iliac fossa. Inquiry may be made as to the prevalence of other cases of hepatitis, and, of course, when the jaundice appears, the problem will be solved.

**CONDITIONS THAT MAY SIMULATE APPENICITIS**

*Diabetes.* In an acute crisis of diabetic ketosis there may be severe abdominal pain and sometimes rigidity of the abdominal wall simulating a local inflammatory lesion such as appendicitis. The finding of sugar and acetone in the urine will at once put the observer on guard. If the abdominal symptoms do not rapidly subside under treatment for the ketoacidosis, further examination should elicit the true cause of the condition, for a diabetic patient *may* develop intra-abdominal lesions. The latter may indeed precipitate the ketoacidosis.

**COMMON ABDOMINAL OR RETROPERITONEAL CONDITIONS THAT MAY SIMULATE APPENDICITIS**

When the local signs and symptoms of appendicitis are well developed (pain, tenderness, hyperesthesia, rigidity), there are many conditions that have to be excluded and for which it may be mistaken. When the local signs are very clear, the appendix is usually either perforated or in danger of perforating. To catalogue the diseases that *may* simulate or be simulated by appendicitis is to enumerate all the chief acute abdominal diseases. This is obviously of little practical value. It will be better, therefore, to give only the more common conditions causing mistakes and to group them according to the position of the appendix (see Table 3).

When the local manifestations have spread widely and the patient first comes under observation with generalized peritonitis, it is necessary to distinguish the condition from all the various causes that may lead to such a pathological picture.

Late cases with extensive peritonitis must be distinguished from:

1. Acute intestinal obstruction (Chap. 13)
2. Thrombosis or embolism of mesenteric vessels (p. 195)
3. Acute pancreatitis (Chap. 9)
4. Pneumococcal peritonitis (p. 235)
5. Pylephlebitis (p. 96)
6. General peritonitis (ruptured gastric, duodenal, typhoid ulcers, etc.; p. 231)
TABLE 3. CONDITIONS THAT MAY SIMULATE APPENDICITIS

The ascending appendix (retrocecal or paracolic):

- Cholecystitis
- Inflamed duodenal ulcer
- Perforated gallbladder
- Perinephric abscess
- Hydronephrosis
  - Pyonephrosis
  - Pyelitis
  - Stone in the kidney
  - Torsion of the omentum

Iliac position of appendix:

- Leaking duodenal ulcer
- Crohn's disease
- Cecal or ileocecal carcinoma
- Tuberculous ileocecal glands
- Stone in ureter
- Yersinia infections
  - Inflamed Meckel's diverticulum
  - Fossa abscess
  - Tuberculous hip disease
  - Rupture of rectus muscle
  - Simple ulcer of the cecum

Pelvic position of appendix:

- Intestinal obstruction
- Diverticulitis with abscess
  - Perforation of a typhoid ulcer
  - Gastroenteritis

In women:

- Ectopic gestation
- Twisted pedicle of an ovarian cyst of
  - a hydrosalpinx
  - Rupture of a pyosalpinx
  - Salpingitis
  - Ruptured follicular cyst (Mittelschmerz)
  - Ruptured corpus luteum cyst

Before diagnosing appendicitis in tropical climes, one would also have to exclude:

- Amoebic typhlitis
- Hepatitis
  - Leaking liver abscess
  - Malaria

Differential diagnosis of the perforating or perforated ascending appendix

The gallbladder, the duodenum, and the kidney are the viscera in anatomical proximity to the ascending appendix, and inflammation of them or their surroundings may cause difficulty in diagnosis.

THE PERFORATED APPENDIX

Cholecystitis. Cholecystitis may very closely simulate appendicitis. Pain, vomiting, fever, constipation, and local tenderness on the right side of the abdomen are present in both cases. An enlarged, inflamed gallbladder frequently comes down into the right lumbar region but more usually enlarges in the direction of the umbilicus. In thin patients without rigidity of the abdominal wall, diagnosis is usually easy, for the tender, rounded gallbladder may be felt, or perhaps even be seen, moving with respiration. The pain of cholecystitis is usually a little higher than that of an ascending appendicitis, and there may be pain of a segmental nature referred to the right subscapular region, especially if a stone is impacted in the cystic duct. There may be resonance of the ascending colon over an inflamed retrocecal appendix. There is rarely resonance in front of an inflamed gallbladder, which is usually on a plane anterior to the cecum, colon, and appendix. In very stout patients and in those with very rigid abdominal muscles, it may on occasion be almost impossible to determine whether the appendix or gallbladder is at fault, unless the previous history is clearly indicative of one or the other condition.

When, with cholecystitis, a stone is simultaneously impacted in the cystic duct, the constant pain accompanied by retching, with deep tenderness in the right hypochondrium and right subscapular region, are sufficiently diagnostic and clearly differentiate the condition from appendicitis.

Inflamed duodenal ulcer. Periduodenitis around an inflamed duodenal ulcer should be distinguishable by the characteristic history elicited upon by careful questioning. The pain of duodenal ulcer comes two or three hours after taking food or at night and is relieved by taking food.

Pyelitis. Acute right-sided pyelitis is frequently mistaken for appendicitis, and occasionally operations are unwisely undertaken because insufficient attention is paid to the symptoms. The points in differential diagnosis can be tabulated as follows shown in Table 4.

The reader will note that it is unusual for a rigor to occur in a case of appendicitis. If a rigor or rigors do occur in a patient who is undoubt-
TABLE 4. DIFFERENTIAL DIAGNOSIS OF ACUTE PYELITIS AND APPENDICITIS

<table>
<thead>
<tr>
<th>Acute pyelitis</th>
<th>Appendicitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial rigor common</td>
<td>Rigor unusual</td>
</tr>
<tr>
<td>Temperature of 103°F or more</td>
<td>Temperature as high as 103°F</td>
</tr>
<tr>
<td>Pain on micturition</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Increased frequency of urination</td>
<td>Urinary symptoms inconstant</td>
</tr>
<tr>
<td>Abdominal muscles often lax</td>
<td>Local rigidity frequent</td>
</tr>
<tr>
<td>Pus or bacteria in urine</td>
<td>Usually no pus or bacteria in urine</td>
</tr>
</tbody>
</table>

Edly suffering from appendicitis, then it is possible, nay likely, that there is an immediate danger of portal pyemia. At the operation, special attention should be paid to the condition of the tributaries of the superior mesentric vein, and, during convalescence the possibility of hepatic abscess should be borne in mind.

In case of acute pyelitis there is usually turbidity or opalescence of the urine, which may acutely have developed an offensive odor. One must not forget also that an inflamed appendix lying in front of the renal pelvis may actually cause an acute pyuria without a bacilluria.

If the urine is carefully examined as a routine, there will seldom be any difficulty in diagnosis.

Hydronephrosis. Acute right-sided hydronephrosis is sometimes misdiagnosed as appendicitis with abscess formation. A hydronephrosis forms a rounded, tense, tender swelling that occupies the lateral aspect of the abdomen and can be felt well back in the loin. The swelling is sometimes freely movable and usually round in shape. It may be possible to feel a depression (corresponding with the hilum) on the medial side. The pain is sometimes of the type of renal colic and there are usually urinary symptoms—scanty urine, pain during or frequency of micturition, etc. It may be possible to ascertain a history of previous attacks. Rigidity of the abdominal wall over the swelling is usually absent.

Pyonephrosis. Acute pyonephrosis forms a swelling similar to a hydronephrosis, but it is usually more tender and more fixed, and the general signs of constitutional disturbance are much greater—for example, high fever and other symptoms of toxemia. There may be pus in the urine if the ureter is not completely obstructed.

Stone in the kidney or ureter. In those unusual cases in which appendicitis is accompanied by pain in the right testis, it may closely simulate renal colic. An X-ray film may show the stone and differentiate. In about 20 percent of cases, small ureteric calculi do not show on an X-ray film, and an intravenous pyelogram or ultrasound scan of the kidney must then be done. In one patient under my care, acute pain in the right loin radiating to the right testis, accompanied by fever and some muscular rigidity, caused me to diagnose renal colic. A radiograph showed a large shadow a little external to the normal line of the ureter. Operation revealed a normal kidney and ureter but a very inflamed appendix with a large, calcareous calculus in the mesoappendix. Fortunately such cases are rare, although recently it has been recognized that the presence of a characteristic laminated calculus in the region of the right iliac fossa in a patient with a compatible history usually helps clinch the diagnosis of acute appendicitis.

Pertonephric abscess. A suppurating retrocecal appendix may form an abscess in the neighborhood of the kidney and may be difficult to distinguish from a peritonephric abscess of metastatic origin. But the latter is insidious in origin, while appendicitis usually has an acute history of onset. In both cases there will be pain on pressing forward in the erector-costal angle below the last rib. Some patients with an inflamed retrocecal appendix present atypical symptoms, have no initial epigastric pain, do not vomit, and present no rigidity over the inflamed area. These cases, however, are much more rapid in development than the usual metastatic pertonephric abscess. A small retrocecal or retroileal abscess of appendicular origin may be easily be overlooked (Fig. 17).
**APPENDICITIS: DIFFERENTIAL DIAGNOSIS**

**Fig. 17.** Those sites where an abscess resulting from appendicitis may sometimes be overlooked.

*Torsion of the omentum.* Torsion and strangulation of the whole or of a portion of the omentum may simulate appendicitis. The part affected is usually to the right of the midline, and pain and tenderness will be noted to the right of the umbilicus. Vomiting is less common than in appendicitis, but differential diagnosis before operation may be impossible. The pain due to torsion of the omentum is usually relieved when the patient lies down. Sometimes there may be a history of undue exertion, and there may be a doughy tumor felt in the midline or on the right side of the abdomen.

**Differential diagnosis of the inflamed iliac appendix**

Inflammation of the iliac appendix is the easiest condition to diagnose, though there are many pitfalls.

**THE INFLAMED ILIAC APPENDIX**

*Perforated duodenal ulcer.* A perforated duodenal ulcer is frequently misdiagnosed as appendicitis. The escaping contents travel down to the right iliac fossa and give rise to all the signs of inflammation of the appendix. It may be possible to obtain a typical duodenal or appendicular history. The initial pain at onset is greater in the duodenal condition, and there will also be definite right hypochondriac tenderness. Pain felt on the top of the right shoulder would be more suggestive of a perforated duodenal ulcer. If there is any obliteration of liver dullness in the absence of general abdominal distention, a duodenal (or gastric) perforation is almost certain. The presence of free air on X-ray is virtually pathognomonic, because free air almost never is encountered in acute appendicitis, even with perforation.

*Crohn's disease.* Crohn's disease (regional enteritis) may closely simulate acute appendicitis and appears to have become more frequent during the past few years. There may be abdominal pain, vomiting, and local tenderness in the right iliac fossa, and sometimes a palpable lump may be felt. Unless the patient has been previously under treatment, the condition may be impossible to differentiate before the abdomen is opened. The key to differential diagnosis is the almost invariable history of previous attacks. The presence of a mass, especially if it is known to have been present before the attack, points strongly to Crohn's disease. If the condition is subacute, then the history of attacks of colicky pain, the occasional bouts of diarrhea, and (if a barium meal has been given) the very characteristic radiographic picture of a narrowed end of the ileum will reveal the true state of affairs. As mentioned before, distinguishing between recurrent attacks of acute appendicitis and Crohn's disease may be impossible. Although barium studies should differentiate these conditions, the correct diagnosis has frequently been made only after opening the abdomen for a supposed attack of appendicitis. In recent years, acute ileitis caused by *Yersinia* organisms has been differentiated from Crohn's disease and may account for a large number of the cases previously called acute Crohn's disease. Differentiation from acute appendicitis prior to operation is usually impossible, but cultures
of ileal lymph nodes or complement fixation tests will disclose the true
d state of affairs. Most cases of acute Crohn's disease do not become
chronic and therefore, in my opinion, most of them are likely to have
been instances of Yersinia or some other infection. It is important to
point out, however, that acute appendicitis caused by Crohn's disease
may be the initial manifestation of that chronic process.

Carcinoma. Carcinoma of the cecum may cause subacute attacks of se-
vere pain and local right iliac tenderness, but the pain is more gripping
and persistent than in any but the most acute attacks of appendicitis.
Cecal carcinoma occasionally causes acute appendicitis by occluding
the orifice of the appendix. Carcinoma of the cecum or of the ascending
colon may become adherent to the anterior abdominal wall and may
closely simulate an appendicular abscess. The age of the patient (usually
over fifty), previous attacks suggestive of obstruction, and noticeable
loss of weight may put one on guard, and the history of progressive ane-
mia and of attacks of diarrhea would favor cancer of the cecum.

Ileocecal tuberculosis of the nonobstructive type may cause symp-
toms similar to those of carcinoma.

Nonspecific adenitis of the ileocecal glands may simulate the earliest
stage of appendicitis by giving rise to colicky abdominal pain and local
tenderness in the right iliac region, but the condition does not progress
and there should not be vomiting or local resistance. Again, many of
these cases are now known to have represented instances of Yersinia
infection.

Psoas abscess and tuberculous hip disease may cause irritation of
the iliopsoas, with flexion or limitation of extension of the right thigh
and tenderness, resistance, and fullness in the right iliac fossa, but the
general onset and subacute nature of the illness, together with careful
examination of the spine and hip, in most cases easily establishes the
diagnosis. A radiograph should be taken if doubt exists.

Stone in the ureter. As already mentioned, a stone passing down the
ureter causes pain, not always typical of renal colic, referred approxi-
mately to that section of the ureter in which the stone is lodged. Quite
frequently this causes a diagnosis of appendicitis to be made. Urinary
symptoms (frequency and pain), pain in the testicle, absence of rigidity
over the painful area, and a previous history of attacks suggestive of
renal colic should put one onto the right line of diagnosis; and if expert
assistance is available, radiography may serve to demonstrate a calculus.
Fever is unlikely to be present in the case of ureteral stone. It is well to
remember that, until the stone is passed, the presence of blood in the
urine may be intermittent rather than continual.

Meckel's diverticulum. Inflammation of a Meckel's diverticulum gives
rise to symptoms that may be almost indistinguishable from those of
acute appendicitis. Since the diverticulum is usually nearer the center
of the abdomen and is not usually adherent anywhere, the pain may be
central and poorly localized for a longer period. It should be empha-
sized that Meckel's diverticulitis is not common.

Rupture or hematoma of the right rectus muscle. Rupture of the lower
segment of the right rectus muscle may also lead to local signs similar to
those caused by appendicitis, but the history of the onset should serve
to distinguish the conditions. Rupture of the rectus is prone to follow a
great or sudden muscular effort or may be due to a severe bout of
coughing. Vomiting and intestinal symptoms will be absent. Severe
bleeding from the torn deep epigastric artery may cause shock; an ultra-
sonic examination will demonstrate the hematoma and the more expen-
sive CT scan will show a gap in the rectus muscle as well as the
hematoma. In patients taking anticoagulants, hematoma may occur ei-
ther spontaneously or with only the slightest exertion. The signs and
symptoms are identical to those of rupture of the muscle.

Simple ulcer of the cecum. These lesions may cause inflammation or
perforation that is indistinguishable from acute appendicitis.
Differential diagnosis of the pelvic appendix

Differential Diagnosis in the Male

Inflammation of an appendix situated in the pelvis gives rise to many mistakes in diagnosis. In women there is some excuse for this, but in men there are comparatively few conditions that cause severe acute pelvic pain, and mistakes should not occur so frequently. The chief conditions for which it may be mistaken are:

1. Obstruction of the large bowel (carcinoma, volvulus)
2. Obstruction of the ileum
3. Diverticulitis
4. Perforation of a typhoid ulcer
5. Stone in the lower part of the ureter
6. Gastroenteritis
7. Pelvic abscess

Obstruction of the large bowel. Obstruction of the large bowel, causing hypogastric symptoms, is commonly due to carcinoma of the sigmoid or rectum or to volvulus. The onset of both of these conditions is usually preceded by a time of subacute obstruction with attacks of abdominal pain and distention, and in both cases 'distention is an early feature of the acute attack'. In pelvic appendicitis the sequence of symptoms is fairly constant, but distention is not an early symptom. In both cases, rectal examination will reveal pelvic tenderness, while in appendicitis there is often a tender lump in the right side of the pelvis, and the thigh-rotation test may be positive. In appendicitis also there is not complete obstruction. Fever is usually absent in obstruction and present to some extent in appendicitis.

Obstruction of the ileum. Obstruction of the ileum accompanied by tenderness in the hypogastrium is frequently due to adhesions caused by previous abdominal operations of any kind. Distinction is made chiefly by noting that in obstruction there is greater acuteness of pain, which is of a spasmodic nature, and by observing the frequency and character of the vomit, which in obstruction gradually becomes yellowish and finally feculent—a change that never happens in appendicitis until extensive peritonitis has developed. In intestinal obstruction, the pain is seldom localized in the right iliac fossa, as in appendicitis, but after distention has supervened diagnosis is much more difficult. In small-bowel obstruction also, the temperature is usually normal at onset and the patient does not frequently become febrile, as is usual in appendicitis. Frequency of micturition or pain during the act may occur in appendicitis owing to irritation of the bladder. Sometimes also with a retroileal situation of an inflamed appendix, there may ensue an obstruction, of the lower ileum, especially in the aged, in whom acute appendicitis often goes unnoticed or undiagnosed in its early stages.

Diverticulitis. Diverticulitis of the pelvic colon may cause either obstructive or inflammatory symptoms. When causing obstruction, it closely resembles carcinoma, but when local inflammation and abscess result, the symptoms and signs are very similar to those of pelvic appendicitis.

In fact, it is well to regard sigmoid diverticulitis as left-sided acute appendicitis. Pathogenetically, the two diseases often arise from the same mechanism, namely, obstruction of a diverticulum of the colon. Symptomatically, the sequence of symptoms so characteristic of acute appendicitis is usually observed in diverticulitis, but with a few modifications worthy of note: (1) the early visceral pain is of the same character but is more likely to be hypogastric in sigmoid diverticulitis and epigastric in appendicitis; (2) anorexia, nausea, and vomiting usually follow the initial pain but are somewhat less prominent than in appendicitis; (3) as in appendicitis, there is usually a shift of pain and tenderness, but in this case to the left iliac fossa or left suprapubic area, although on occasion only pelvic tenderness is evident; (4) a more pronounced change in bowel habit, most often diarrhea, occurs in diverticulitis; (5) fever and leukocytosis are more pronounced in most cases of diverticulitis; (6) and finally, a mass in the left iliac fossa or in the cul-de-sac of Douglas is a common finding in diverticulitis. It should, of course, be emphasized that diverticulitis is chiefly encountered in older persons, although I have made the
diagnosis in a twenty-four-year-old man and have cared for a ninety-year-old patient with acute appendicitis. Previous attacks of diverticulitis are often reported but may occur many years apart. When the sigmoid colon is redundant and lies well to the right or when the appendix points well to the left, the confusion in diagnosis can be considerable.

It has recently been pointed out than an “attack” of diverticulitis (i.e., an episode), which can be diagnosed clinically, is almost always the result of a perforation of the diverticulum, with the development of a well-localized peridiverticular abscess. This explains the greater likelihood of fever, leukocytosis, diarrhea, and the presence of a mass. On occasion the peridiverticular abscess may rupture and produce peritonitis without a clear opening in the colon, probably because the diverticulum is usually obstructed by a fecolith. Even more rarely, there is a free rupture of the diverticulum itself into the peritoneal cavity. Differentiation of these types of rupture is prognostically important, since mortality due to the less common free perforation is so much greater.

The differential diagnosis between diverticulitis and appendicitis may be so difficult and the treatment so different that there are cases in which a CT scan done with a water-soluble radiopaque material will solve the problem by demonstrating a tiny extraluminal tract arising from the pelvic colon (Plates 4A and 4B) or a phlegmonous inflammation, either in the sigmoid mesocolon or on the right side of the colon. A CT scan with contrast may be very useful in helping to make the distinction (Plate 4B).

Perforation of a typhoid ulcer. When, in a patient suffering from a mild attack of typhoid fever, a subacute perforation occurs in the lower ileum, a pelvic abscess may result that may at the time of examination be indistinguishable clinically from that due to a perforated appendix. But the diagnosis will be helped by the previous history.

Stone in the lower part of the ureter. When a stone is near the bladder, there are often additional symptoms, frequency, strangury, pain in the penis, or emissions, which may point to the genitourinary system.

Gastroenteritis. When the inflamed appendix is in the pelvis and lies against the rectum, “diarrhea” in the form of frequent loose, mucoid movements is common, and for that reason the diagnosis of gastroenteritis is frequently made. True pelvic tenderness and/or a lump in the cul-de-sac are never present in gastroenteritis and should serve to distinguish between the two conditions.

Pelvic abscess. Instances occur in which the acute symptoms due to appendicitis are transient, the inflammation becomes limited by adhesions to contiguous viscera, and perforation may occur without the supervention of extending peritonitis. In such circumstances the patient may not seek medical advice until an abscess has developed. When the abscess is retrocecal, the observer will usually detect a lump in the right iliac fossa. When the abscess has resulted from the perforation of an appendix situated in the pelvis, the resulting abscess may reach large dimensions without being palpable above the pubis; as the abscess increases in size, it may cause pressure upon the rectum and the lower coils of the ileum, leading to a true intestinal obstruction. The course of the whole illness may be so insidious that the patient may first present symptoms of obstruction of the ileum—colicky pain, a ladder pattern of distention, etc. The importance of a rectal examination is obvious, and sometimes an X-ray examination will be of assistance.

Such a pelvic abscess may attain a large size without giving rise to obvious symptoms until its pressure on the end of the ileum causes definite obstruction. The cause of the alarming symptoms may not be obvious until a careful rectal examination has been made. A boy was once admitted to my wards with symptoms of acute intestinal obstruction. No apparent cause was discovered until a rectal examination revealed a large pelvic abscess. Some days previously, the patient had symptoms that were in keeping with an acute attack of appendicitis that had subsided before the obstruction had developed. The abscess was opened per rectum, the distention and vomiting subsided, and the obstruction was relieved without any need for an abdominal incision.
DIFFERENTIAL DIAGNOSIS IN THE FEMALE

The female reproductive organs add considerably to the difficulty of diagnosis of pelvic appendicitis. Acute pain referable especially to the hypogastrium and pelvis may be due to any of the following:

1. Uterine colic (dysmenorrhea or threatening abortion)
2. Ectopic gestation
3. Twisted pedicle, inflammation, rupture of an ovarian cyst, or torsion of a normal or slightly enlarged ovary
4. Twisted or inflamed fibroid
5. Twisted hydrosalpinx
6. Salpingitis or pyosalpinx
7. Rupture of an endometrioma

Dysmenorrhea. Dysmenorrhea, with its periodicity, lack of signs on local examination, and pain referred to the lower lumbar and sacral regions as well as the hypogastrium should not cause serious difficulty in diagnosis.

Threatened abortion. In threatened abortion, the previous amenorrhea, bleeding, character of the pain, and absence of local signs serve to distinguish the condition. A positive pregnancy test will be helpful.

Ectopic gestation. Ectopic gestation is frequently misdiagnosed as appendicitis, but there is almost invariably some menstrual irregularity, often a history of a fainting attack, and generally some anemia, and the symptom sequence of appendicitis is not usually ascertainable. The uterus may be displaced by the extravasated blood. In unruptured cases the enlarged tube may be felt as an abnormal mobile and tender swelling to one side of the uterus (see Chap. 18), and the pregnancy test is positive. A pelvic ultrasound examination is of considerable value here.

Ovarian cyst and hydrosalpinx. In the case of an ovarian cyst or hydrosalpinx with a twisted pedicle, diagnosis is made chiefly by the fact that with the twisted viscera the pain and vomiting come on simultaneously (or almost so), so that the proper appendicitis symptom sequence is wanting; moreover, the vomiting or retching is usually more frequent and more persistent than in appendicitis. In the case of an ovarian cyst, it may have been previously known that there was a tumor, and a definite tender swelling may be made out from the time of onset of the symptoms. This swelling may be situated in the midhypogastrum or to one or the other side, or it may be limited to the pelvis. Torsion of a normal ovary may occur but is rare. If this happens in early pregnancy, there may be difficulty in distinguishing it from an early ectopic pregnancy or a pelvic appendicitis.

The symptoms of a ruptured follicular cyst (Mittelschmerz) or a ruptured corpus luteum cyst may be difficult to distinguish from acute appendicitis if on the right side. The timing as related to the menstrual cycle is of the utmost importance. In Mittelschmerz the pain occurs almost precisely at midcycle, whereas in rupture of a corpus luteum cyst the pain develops around the time of the menses. Nausea and vomiting are less frequent than in appendicitis, but the patient may show evidence of some blood loss. The usual appendicitis symptom sequence is absent.

With a twisted fibroid the symptoms are not actually so acute, and the presence of the fibroid will perhaps have been known previously. It may be impossible to differentiate between a twisted fibroid and an ovarian cyst with twisted pedicle.

Acute salpingitis. Acute salpingitis is one of the most difficult conditions to distinguish from appendicitis. Occasionally it is difficult to say in which of the contiguous organs the inflammation started. Distinction may usually be made by considering the following points. Acute salpingitis does not so frequently cause epigastric pain at the onset, and vomiting is less frequent. The salpingitic pain is frequently felt on both sides from the onset, and there may be greater tenderness in the left iliac region than the right. The history is often unreliable, but the presence of a vaginal discharge is a valuable guide, and examination should be di-
rected to this point. It has been stated that with salpingitis, pain is more often felt down the thigh, even as far as the knee, but this is certainly not a constant symptom. If in doubt, it is in this circumstance that laparoscopy is being used with increasing frequency and considerable success. If there is no reasonable doubt that the condition is acute salpingitis, most surgeons consider nonoperative treatment preferable. It has been said that an elevation of the erythrocyte sedimentation rate (ESR) is much more common in salpingitis than in appendicitis. In early cases, a very high ESR may be a useful indicator, but its true diagnostic value has not been systematically investigated. Extreme pelvic tenderness and pain produced by motion of the cervix may occur in acute appendicitis, especially with rupture. Therefore, the finding should not exclude the diagnosis of appendicitis, as is so often thought.

Pyosalpinx. A pyosalpinx may rupture and cause a condition simulating pelvic appendicitis. The typical appendicular symptom sequence is usually wanting. If examination is made soon after the onset of symptoms, a pelvic swelling will be felt. This is usually bilateral. A history of chronic pelvic pain and leukorrhea may be ascertained. In patients coming under observation after some days, diagnosis may be made by CT scan or laparoscopy.

Ovarian endometrioma. Rupture of an ovarian endometrioma may closely simulate a pelvic appendicitis. Sudden hypogastric pain, vomiting, slight fever, and tenderness on pelvic examination may be present in both cases, but with an endometrioma a unilateral or bilateral swelling ought to be detected on bimanual examination. A previous history suggestive of endometriosis is very helpful.

ULTRASOUND IN THE FEMALE

While a clear, positive diagnosis of a thick-walled appendix, and hence acute appendicitis, may not consistently be possible by ultrasound, this procedure is extremely useful in demonstrating an ovarian or tubal mass and the presence of fluid in the cul-de-sac. Remember, however, that

LATE CASES OF APPENDICITIS

after rupture and extrusion of the contents into the peritoneal cavity, a follicular or luteal cyst itself may no longer be detectable by ultrasound.

Late cases of appendicitis

In late cases of appendicitis that have led to a very diffuse or general peritonitis, or in those cases of a very fulminating type that are associated with a rapid form of spreading peritonitis, it is often impossible to make a certain diagnosis. Distinction has to be made from the following:

Primary pneumococcal peritonitis
Secondary general peritonitis due to other causes (rupture of gastric, duodenal, typhoid, stercoral, or carcinomatous ulcer or of a pyosalpinx)
Thrombosis of mesenteric vessels
Acute intestinal obstruction
Acute pancreatitis
Pylephlebitis

In finding out the exact cause, the greatest importance attaches to the history. The subject is considered more fully in the next chapter and in that on peritonitis (Chap. 20).