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Diagnosis of inflammatory disease in the acute abdomen

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DIAGNOSIS OF INFLAMMATORY DISEASE IN THE ACUTE ABDOMEN

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INTRODUCTION

In following acute abdominal cases from bedside to autopsy, I have been impressed with their frequent erroneous diagnosis.

After making a correct diagnosis, the well trained surgeon has little difficulty in adequately treating the patient with acute abdominal manifestations. The desirability of a correct preoperative diagnosis is obvious, but in spite of refinements in diagnostic methods there are still many cases undiagnosed. An exact preoperative diagnosis is not only of academic interest, but also of practical importance as when it is possible the subsequent morbidity and mortality will be considerably decreased.

Because of the numerous conditions encountered in the acute abdomen, and the voluminous material available, this thesis has been confined to only one phase, namely, inflammatory disease and its diagnosis.

MECHANISM OF PAIN

In the diagnosis of acute abdominal disorders the first essential is a careful study of the nature, distribution and mechanism of the pain which is the patient's chief complaint. Without a clear conception of the neurological mechanism by which the pain is produced, no amount of care in the clinical study of pain will lead to a correct diagnosis. Before the various lesions which manifest themselves by abdominal pain are considered, therefore, it is necessary to describe the sensory innervation of the abdominal cavity and the remarkable mechanism by which, on deep-seated stimulation, pain is radiated or "referred" to the more superficial sensory nerve terminals. (1)

The intraperitoneal viscera must first receive attention. They consist of the gastro-intestinal tract from the cardiac orifice of the stomach to the upper end of the rectum, the liver, pancreas, gall-bladder and bile-ducts, the spleen, the body of the uterus, and the Fallopian tubes. The kidneys, ureters, and bladder by development and situation are extra-peritoneal and must be considered separately. All the strictly intra-peritoneal viscera are entirely insensitive to pain when subjected to those stimuli which provoke pain in the sensory nerves of the skin. The stomach or gall-bladder,

for instance, when exposed under local anesthesia of the abdominal wall alone, may be cut, crushed with clamps, burned with the cautery or strong chemical corrosives, and yet the patient feels no pain. These organs are not supplied, that is to say, with somatic sensory nerves. This does not hold good in the deeper or more posterior parts of the mesentery of the small intestine or of the transverse or pelvic mesocolon, which contain somatic nerves that are sensitive to mechanical, thermal or chemical stimulation. (2) (3)

The solid intraperitoneal viscera, namely the liver and the spleen, are in all probability quite incapable of giving rise to true visceral pain, though there is no general agreement on this point. The hollow intraperitoneal viscera, however, despite their apparent insensitivity, give rise to visceral pain when subjected to an adequate stimulus, and the one stimulus adequate to cause the pain is tension on the viscero-sensory nerves in their walls, associated with exaggerated peristalsis or spasm. Broadly speaking, visceral pain is an expression of the violent peristaltic efforts of the muscular walls of the hollow viscera that occurs in response to obstruction, partial or complete, of their lumen. One may cite as examples of this visceral pain, biliary colic, the pain of acute intestinal

obstruction from strangulation in a hernial sac, the colicy spasms in an obstructing carcinoma of the colon, or the early spasmodic pains of a tubal abortion.

Visceral pain has certain definite features that must be borne in mind. It is appreciated as deeply situated in the abdomen, and is not referred to the more superficial sensory nerves of the abdomenal wall, despite the opinions of many authorities to the contrary. It is vaguely and imperfectly localized. Visceral pain arising in the stomach, for instance, is vaguely localized in the epigastrium. In the small intestine it is felt in the umbilical zone. Pain in the colon is hypogastric in situation. Further, it is commonly intermittent or spasmodic in character. (4)

Although the visceral peritoneum enveloping the intraperitoneal viscera is completely insensitive, whether inflamed or not, the parietal peritoneum, and particularly that part of it lining the anterior abdominal wall and the under surface of the diaphragm, is richly endowed with somatic sensory nerves. These nerves can be likened only, as regards their sensitivity to pain, to the sensory nerves of the cornea or conjunctiva. They are far more sensitive than the nerves of the skin, since light contact with gauze swab, or the gentle pressure of a gloved finger, is capable of

producing acute pain in the parietal peritoneum. The membrane is also exquisitely sensitive to chemical stimuli, such as acid gastric juice, blood clots in the peritoneal cavity, or the bacterial toxins of a peritoneal inflammatory exudate. (1)

It must now be explained that pain caused by the stimulation of the sensory nerves of the parietal peritoneum is not felt in the peritoneum itself, but is projected or "referred" to the more superficial nerves that are connected with the same spinal segments as those receiving the painful stimulus. This remarkable mechanism, the physiology of which is still obscure, can best be appreciated if we consider the effect of stimulating the under surface of the diaphragm. (2)

According to Ortner, "in a patient operated under spinal anesthesia, which renders the anterior abdominal wall completely insensitive, a swab may be passed up in contact with the under surface of the diaphragm. The phrenic nerves, derived from the third, fourth, and fifth cervical segments of the cord, are not anaesthetized in this procedure, and the moment the swab comes in contact with the phrenic nerve-endings in the diaphragm the patient complains of a sharp pain. This pain is felt, not in the region of the diaphragm at all, but entirely in the supra-acromial nerves on the

corresponding shoulder. This area received its sensory nerves from the same spinal segments, the third, fourth, and fifth cervical, as give origin to the phrenic nerves. (5) Although so widely separated from the diaphragm, the skin over the shoulder-tip area is developmentally the dermatome of the diaphragm, for the diaphragm is originally formed in the cervical region of the embryo, and only descends to its ultimate position on the growth of the lungs and pleural cavities."(6) Thus "what may be termed an embryological accident" gives an area of parietal peritoneum lining the diaphragm which is widely separated from its skin segment or dermatome, and yet retains its primitive neural connections with the skin. Here, then, can be studied with the greatest ease the projection of pain termed peritoneo-cutaneous radiation. (1)

ACUTE APPENDICITIS

Appendicitis is by far the most frequently encountered acute inflammatory condition in the abdominal cavity, constituting, according to Eliason (7), from seventy-five to ninety per cent of such lesions.(8) Despite its frequent appearance, inflammation of the appendix may present symptoms to puzzle the most experienced, and on the other hand, the constant thought of this common condition may result in its erroneous diagnosis. Although appendices are frequently unnecessarily removed, the fact that there are from 18,000 to 20,000 fatalities annually from acute appendicitis indicates that too little importance is placed upon appendicular colic. (8)

The majority of attacks of acute appendicitis begin with a central pain in the region of the umbilicus or a little above it. This pain is a dull heavy pain, described by the patients as "like a belly ache". It is vaguely localized to the interior of the abdomen, and is not felt on the surface, nor is it associated with any tenderness on palpation or muscular rigidity. This early pain is purely visceral in origin, and is due to obstruction of the base of the inflamed appendix, with retention of inflammatory exudate in its lumen, and a resulting contraction of the muscular coat in an

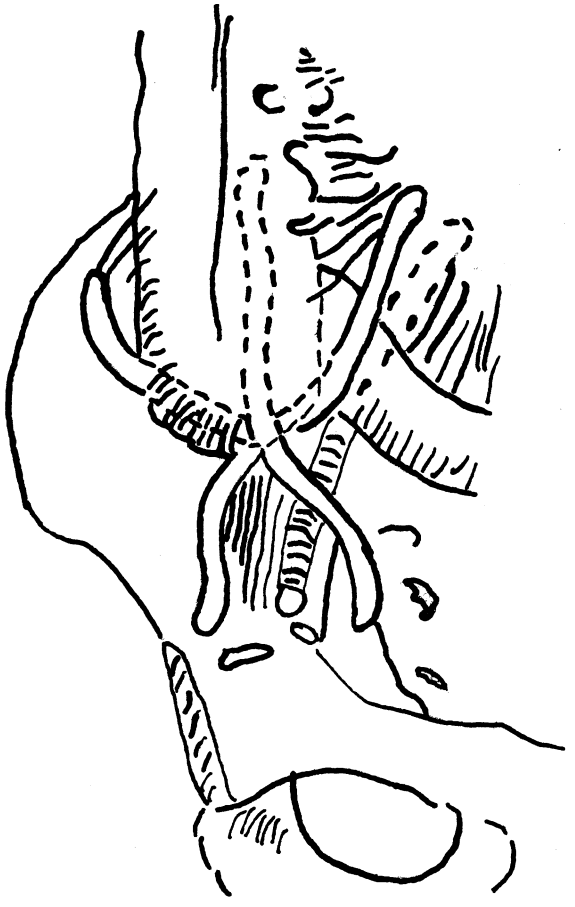
attempt to overcome the obstruction. In the worst cases the pain has a distinctly spasmodic character, though it does not disappear between the more severe spasms. The initial phase may only last two or three hours, or may more rarely continue for twelve or even twenty-four, but while it lasts there will be no tenderness on palpation, no increased pain on movement of the body and no rigidity. Failure to appreciate the complete absence of objective physical signs in the early hours of acute appendicitis leads to many errors in diagnosis. (9)

According to Snorf, pain arising in the appendix itself is referred to the epigastric and umbilical regions. When referred to the right lower quadrant it is an indication of the involvement of its peritoneal coat or the caecum. (10) (11)

Acute continuous navel pain may be due to appendicitis or peri-appendicitis. Chronic, dormant, or recurrent chronic appendicitis may cause recurrent pain or soreness about the region of the navel. When a patient complains of apparently simple colic in the region of the navel, coming on three to four hours after meals and accompanied by a marked constipation, loss of weight and dyspepsia, we must think of appendicitis. (5)

After a variable number of hours an entirely

different pain makes its appearance. It is not central but is sharply localized to the right iliac fossa, or wherever the inflamed appendix happens to be lying. It is sharp and stabbing in character, is accentuated by any movement, such as coughing or vomiting, and is appreciated as a superficial pain. When the pain is felt, localized muscular rigidity and tenderness on deep palpation over the rigid muscles are found on examination. (9). With the appendix in its usual position, the greatest point of tenderness is about McBurney's point, half way between the anterior superior spine of the ilium and the navel. (12)(See diagram page 15.)



The pain is peritoneal in origin, and is caused by stimulation of the parietal peritoneum nearest to the inflamed appendix, by contact, not necessarily with the appendix itself, but with the bacterial toxins poured out into a peritoneal exudate in its immediate vicinity. Should perforation of the appendix take place, spreading peritonitis causes a rapid increase in the area of tenderness and rigidity, but there is no essential difference from the mechanism of the pain in the early non-perforated appendicitis. We should be on the alert for a sudden subsidence of tenderness following an abrupt onset as this may signify either a gangrenous process or an evacuation of the pus into some hollow viscus.(15)

The doctrine of Sir James Mackenzie (13) that this pain, with its associated tenderness and rigidity, is due to a viscero-cutaneous and viscero-muscular reflex, mediated through the visceral afferent nerves of the appendix, cannot be true because of its strict localization to the area immediately over the appendix. Were Mackenzie's theory true, the pain, tenderness and rigidity would be constant in position and would not be dependent on the position of the appendix in relation to the overlying parietal peritoneum. (9)

Although most cases of acute appendicitis show both the initial visceral pain and the second peritoneal pain, cases are sometimes observed in which only

one pain appears. Morely reviewed records of three cases in which repeated attacks of central abdominal pain occurred at intervals of some months, lasting a few hours, without going on to any localized pain in the right iliac fossa, or showing any tenderness or rigidity on examination. The diagnosis was in some doubt in each case until a laparatomy revealed an obstructed appendix with a stricture at the base, and an inflamed appendix containing pus distal to the stricture. The acute attacks giving rise to the visceral pain were of short duration, and the appendix was shielded, either by a covering of omentum or by its pelvic or retro-caecal position, from any near contact with the parietal peritoneum that might have declared the diagnosis by causing localized pain and tenderness. Quite often cases of appendicitis are seen in which the pain is localized from the first to the right iliac fossa. In these there is none of the usual obstruction of lumen such as is commonly found from impaction of a fecalith, a stricture, or mucosal swelling near the base. (9)

Hertzler has very wittily asked why it is that, while the appendix may vary in its anatomical position anywhere from the under surface of the liver to the lower abdomen or the dulde-sac, the pain is always at

McBurney's point? His answer is, "It is not." Too frequently a diagnosis of appendicitis is excluded because of the absence of many of the so-called typical symptoms and signs,--and too frequently a catastrophe follows. (14)

The patient should be asked where the pain began. He usually places a finger near the umbilicus. In asking him where the pain is at the present time, the pointing finger passes to the right iliac fossa. The "pointing test", when positive, is of the greatest possible diagnostic significance. (14)

Not infrequently the physical signs of pain and muscle spasm are present without any other change. The previous history is often illuminating, particularly if there have been spells of so-called "indigestion", stomach trouble, and general discomfort and slight pain in the lower abdomen. (12) (15)

It is well known that different individuals react differently from the same stimulus. There is undoubtedly, as Hughson has demonstrated, a pylorospasm that may be induced in some persons by irritation anywhere in the peritoneal cavity. (16) Horsley sites many cases of appendicitis in which there was definite pylorospasm and hunger pain relieved by food, and a few in which roentgenologic examination, while it did not

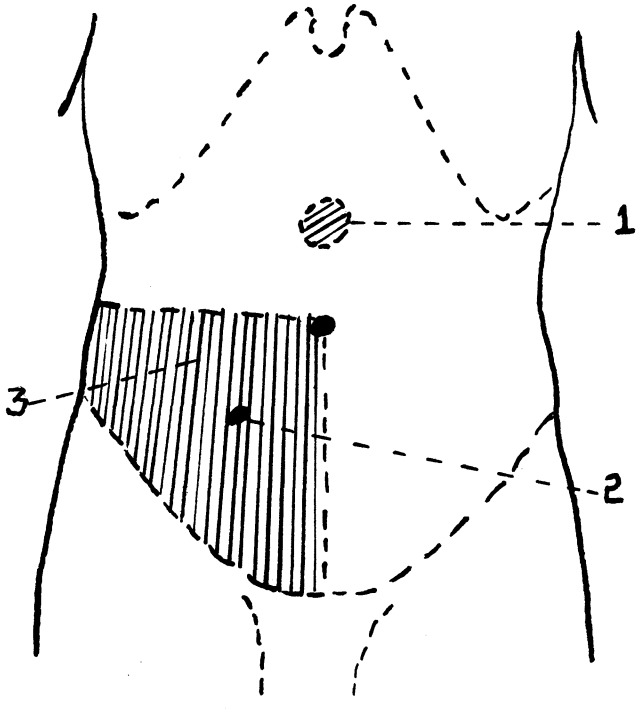
disclose a filling defect was suggestive of a duodenal lesion because of the spasm, and in which the removal of a diseased appendix produced a cure. (12) Pain arising soon or immediately after food intake need not be associated with disease of the stomach, as it may also occur in disease of the appendix. (5) This phenomena may be explained by reflex activity. (12)

According to Cope (17), Ellars (18), and Abell (19), the order of occurrence of symptoms is of utmost importance in diagnosis. The march of events is: Pain, usually epigastric or umbilical; nausea or vomiting; local iliac tenderness; fever; leucocytosis. He states that "the symptoms occur almost without exception in the above order, and when that order varies I always question the diagnosis. Everyone who has carefully investigated the point must be able to confirm this dictum, though it must be allowed that occasional exceptions occur. If fever precedes the onset of pain, if vomiting accompanies or precedes the first bout of pain, it is generally not appendicitis with which we are dealing." 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. The vomiting, if present, is an educated form of emesis, in contra-distinction to the type of vomiting found in intestinal obstruction.

In other words, the patient will vomit once to three or four times and that is all. (18) Loss of appetite or repulsion of food may be regarded to a lesser degree of the same sensation and often of equal value in diagnosis. The degree of nausea and the frequency of vomiting in the early stages appear to depend on two factors--first, the amount of distension of the inflamed appendix; and secondly, the reflex nervous susceptibility of the patient. Vomiting is the more prone to occur in children (20) or in patients whose digestive tract is easily deranged. It may be taken as an important general rule that the severity and frequency of the vomiting at the onset of an attack of appendicitis indicates the degree of distention of the appendix and consequently the immediate risk of the patient that perforation may occur. (5) With perforation there is usually an accession of pain and renewal of vomiting.

Local hyperaesthesia of the skin of the abdominal wall is a frequent, but not a constant, accompaniment of an inflamed unperforated appendix. It can be demonstrated in over half of the cases of appendicitis. Though occasionally bilateral, 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 spinal segments. Though

occasionally a zone of hyperaesthesia may be found extending from the middle line in front back to the spine, yet, as a rule, only the anterior part of the abdominal wall is affected. Sometimes the right iliac "appendix triangle of Sherren" is demonstrable. At other times, only a part of such triangle is hyperaesthetic, as is shown by diagram below. (17)



As Sherren has pointed out, hyperaesthesia depends largely on the degree of distension of the appendix. A common place in which it can be elicited is a circumscribed area just to the right of and on a level with the umbilicus. Sometimes the sensitive area is slightly lower than this, but generally it lies in the

area of distribution of the tenth and eleventh thoracic spinal segments. (17) (14) In a few cases ittitation of the external cutaneous nerve as it crosses the iliacus is evidenced by pain and hyperaesthesia along the distribution of that nerve. (12) (17)

Local muscular rigidity over the inflamed area is frequently present, but is by no means a constant symptom in the initial stages. There are several grades of muscullar 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 muscle 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 towards the appendix. In most cases the extreme degree of muscular rigidity coincides with commencing peritonitis, though undoubtedly it may exist when no peritonitis is present.

It is common experience not to find 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 which many patients develop as a result of nervousness and apprehension, or which may be induced by a rough or

cold examining hand. (17)

With an unperforated appendix situated in the pelvis, rigidity of the abdominal wall is nearly always absent. (12) 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 a free manipulation without any rigidity appearing. This fact must be known to every surgeon of experience, but in general it is certainly not fully appreciated, nor do the textbooks make the point clear. (12) (17)

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 is absent even though pelvic peritonitis exists. (17) Quoting Richardson, "Rigidity with distinctly localized pain strongly suggests appendicitis; with fever it almost proves it; with tumor it fully establishes the diagnosis." However, while of great value and quite often found during the first stages of an attack, it sometimes disappears early, and in the most serious conditions may be entirely wanting or so slight as to be

scarcely recognizable. This is particularly true in the presence of gangrene, where local tenderness and rigidity may both fail, and also in many cases of perforative appendicitis, where rigidity is so slight and transient as to escape observation. On the other hand, there may be pronounced localized rigidity in the presence of very mild inflammatory processes. The muscular tension is sometimes so pronounced as completely to mask a tumor mass beneath. As a rule, the tension diminishes as the active inflammatory process subsides and the abdomen becomes soft.

Increasing severity of the local infection, or the beginning of a diffuse peritonitis is marked by the return and increase of the muscular tension, and in extensive peritonitis the abdomen usually becomes uniformly distended, rigid, and motionless. (21) The rigidity may be situated only over Poupart's ligament and extending a slight distance upwards. (15)

While deep tenderness may be fairly well marked in retrocaecal appendicitis, rigidity is inclined to be ill defined in front. In palpation of the right flank the maximal point of tenderness is usually located. (14)

Fever may not be present at the beginning of the attack, but nearly always develops before twenty-four hours have passed. (12) (17) Before rupture has

occurred the temperature does not usually go much above normal, two or three degrees Farhenheit being the average elevation. (17) (22) Mistakes are liable to be made owing to the fact that the temperature is not elevated at the time of the onset of the pain, and thus the more serious disease may be mistaken for an attack of simple intestinal colic. In any suspected case the temperature should be taken every two or four hours, and 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.), the presumption is against appendicitis. (17)

Lennander (Beit. a. klin. Med. u. Chir., 1895) calls attention to the importance of observing the variations in the relation between the axillary and rectal temperatures. With early abscess formation and in spreading abdominal infection, the difference is sometimes once or twice greater than normal. In very ill patients this difference is sometimes marked, and may be due to the influence of a neighboring inflammatory mass, but very often it is a sign of collapse in which there is a fall of temperature on the surface of the body and a rise in its interior. (21) Very occasionally the illness may start with a rigor. (17) (5) (21)

The pulse is only slightly, if at all, accelerated in the early stage; it may be normal in every way, even though the temperature be raised. (17) As the disease progresses, a more rapid pulse, with a rising temperature, usually occurs. (12) Any continued or decided acceleration of the pulse generally corresponds with the occurrence of local peritonitis; to wait for such alteration is therefore to sacrifice the best time for operation. (17) (12)

The pulse is of greater importance than the temperature as an indication of the condition of the patient, and as a guide to prognosis; and more especially the relation of the pulse-rate to the temperature. A very rapid pulse is always a grave symptom and a rapid pulse out of proportion to the amount of fever usually presages a very stormy course if not a fatal termination.

In the majority of cases of acute appendicitis the pulse-rate is affected early, and while an active process is going on, continues slightly accelerated, even with a normal temperature, but this is by no means a constant symptom; on the other hand, in nervous individuals and children the pulse is quickened even with simple functional disturbances. As the affection becomes localized and the active process declines, the pulse becomes normal. (21) (15)

When the appendix is acutely inflamed gaseous distension of the caecum is frequently present; this local distension is due partly to the excessive formation of gases by the active bacterial decomposition of the contents of the caecum and appendix, and probably in some cases partly to an accompanying inflammation of the interior of the caecum (typhilitis) with atony of the gut. It is more likely to be present when the appendix is retrocaecal in position and closely embedded in the wall of the caecum. It gives rise to a local swelling with a typanitic note on percussion, to borborygmi, and occasionally to painful peristaltic waves. This may cause the observer to think that he is merely dealing with a case of caecal dyspepsia, and the swelling of the caecum may mask the inflamed appendix placed behind it; or the painful contractions of the distended gut, attempting to empty itself, may even suggest intestinal obstruction. (17)

There is a sign described by Owen which may prove of use in some cases. He states: "If in a case of appendicitis, when the colon contains much gas, firm pressure is made with the hand over the ascending colon, the gas is forcibly drawn towards the caecum, and the inflamed tissues being disturbed, the patient may complain of pain in the right iliac fossa. This may prove useful as a diagnostic measure in an obscure case of

appendicitis; again, it may be that a person with appendicitis tolerates a considerable amount of pressure with the hand over the right fossa, and if the steady pressure is maintained long enough to drive some of the gas out of the blind end of the large intestine and the hand is then suddenly taken off, the quick return of gas into the caecum so disturbs the inflamed appendix that the patient calls out with pain." (17)

Constipation is present in the majority of cases of appendicitis. As before noted, it is one of the most constant events preceding the onset of the attack, and it usually persists until the acute symptoms are over. When the bowels have previously been normal, or even when there has been a tendency to diarrhea, constipation usually occurs with the appearance of acute symptoms. In a considerable number of cases the initial violent intestinal contractions cause a sudden evacuation of the bowels, and in a small number, more or less severe diarrhea may continue for a day or two, being then followed by constipation; in other instances, diarrhea persists throughout the entire attack. It is exceptional to find the bowels normal during the course of the whole illness. Constipation is often very obstinate, and there may even be complete obstruction. As a rule, the bowels are moved after the first few

days, but continue more or less constipated until the end of the attack. This symptom, unfortunately, is often aggravated by the large doses of opium so frequently required for the relief of the first acute symptoms. Symptoms of complete obstruction may be due to intestinal paralysis caused by the direct invasion of the intestinal walls by the infective microbes or their toxic products, or there may be true obstruction due to kinks or strangulation produced by the inflammatory exudate. The characteristic picture of ileus then develops; constant vomiting, becoming stercoraceous, and absolute constipation without the passage of either feces or gas. The abdomen usually becomes distended and acutely tender. (21) (17) (23)

The occurrence of genito-urinary symptoms in appendicitis is rather common, and, moreover, important to the surgeon for the reason that it may cloud the issue at point. Extreme latitude in position of the appendix within the abdominal cavity also tends to confuse the diagnosis and make difficult an accurate estimation of the true extent of pathology involved. Mistakes met with in the diagnosis of appendicitis are in cases where one or two of the signs is missing. The pain may be situated in the umbilical region, epigastrium or right iliac fossa, and if the appendix be long

and overhangs the brim of the pelvis, a referred pain to the left side of the abdomen or ovarian region in the female, or along the course of the spermatic cord towards the testicle in the male would be noted. When the appendix is post cecal with the distal and diseased, the pain is referred to the loin or back or to the region of the liver or kidney. (15)

In 1402, consecutive, unselected, emergency appendectomies for proved acute appendicitis, hematuria due to appendicitis was encountered in 124 patients, an incidence of 8.84%. Hematuria caused an average pre-operative delay of four hours before primary genito-urinary disease could be excluded. About 84 per cent of these cases of hematuria were associated with a flexed retrocecal situated appendix. Hematuria usually disappeared, on an average, by the fourth post-operative day; but the extremes varied from the first to the twenty-second day post operatively. It must be stressed that the utmost care must be exercised in making a diagnosis of hematuria due to acute appendicitis. This is a diagnosis of exclusion only and required a very accurate and skilled pre-operative study of the genito-urinary tract. (24) (25)

In the male, testicular symptoms are sometimes produced by an inflamed appendix even when unperforated.

There may be pain in either right or left testicle, or in both, or the patient may say that the right testicle was retracted at a certain stage of the disease. The pain may possibly be due to irritation of the sympathetic filaments accompanying the spermatic artery, but it is more likely that it is a true referred pain since the tenth dorsal segment apparently supplies both viscera. The direct stimulation of the genito-crural nerve by inflammatory exudate might account for testicular retraction. (17)

In cases of gangrenous appendicitis, if even pressure is exerted over McBurney's point the right testis is drawn upwards. As long as the pressure is maintained the retraction commonly persists. When the pressure is released the testis drops back into its usual position. (26) (14) LaRoque has found the sign positive in five hundred cases of gangrenous appendicitis. (14)

The ureter crosses the pelvic brim in close relationship to the medially directed appendix, and occasionally pain on micturition may be produced presumably by irritation of the ureter. (25) An inflamed appendix overlying the ureter will produce ureteritis with pain radiating to the penus and scrotum. (27)

Leucocytosis is present in the majority of cases,

though at times in the presence of a severe infection the leucocyte count is not increased. A moderate count of 12,000 to 16,000 is noted in ordinary catarrhal cases of appendicitis and higher counts in more active infections. (12) (15) A leucocytosis may be observed either as an increase in the actual number, or an increase in the polymorphonuclears. (12) (15) A Schilling blood count may be helpful in showing a shift to the left when the white count seems otherwise normal. (12)

Jaundice appears in a comparatively small number of cases of appendicitis, but it may possess considerable significance as an index to the patient's condition. On the other hand, it is sometimes a very misleading sign, because when associated with hypochondriac pain, the appendical origin of the affection may not be recognized. (21) The icterus may be due to sepsis, toxic affection, or purulent infection of the liver. The icterus in simple appendicitis may be due to toxic sepsis and may be a sign of necrosis of the appendix. (5)

A silent abdomen, both on observation and auscultation is the case in acute appendicitis. (22)

The vermiform appendix, though usually described as being situated behind the eleo-caecal junction with the tip directed towards the spleen, is not by any

means always found in that situation when it is diseased and sought for by the surgeon. The realization of the common positions is of great importance in diagnosis, for the signs and symptoms vary considerably in the various positions.

SEE DIAGRAM PAGE 9.

For descriptive purposes it is well to recognize the ascending appendix, the iliac appendix, and the pelvic appendix. It is clear that 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 be situated behind the caecum, or behind the end of the ileum, the common mesentery, 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 supra-pubic region of the abdomen, and a dangerous condition results to which we shall call attention below. Very many, if not most, of the mistakes made in the diagnosis of appendicitis are due to a failure to realize the very great difference in signs and symptoms which follow from the varying position and relations of the appendix.

When the appendix lying above the pelvic brim ruptures there will be found on examination either a definite tender lump, a very definite rigidity of the abdominal wall over the site of the diseased viscus, or both rigidity and a lump. In addition, there will be fever, higher as a rule than before perforation, hyperaesthesia of the skin of the abdominal wall in the right iliac or right lumbar region, and certain localizing signs varying according to the position of the appendix.

When the appendix perforates retrocaecally there will be a lump which may be resonant on percussion, owing to the intervening caecum. 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.

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

The conditions resulting from perforation of an appendix lying in the iliac fossa on the iliacus or psoas are sufficiently 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. (17) Very rarely, chiefly in patients suffering from severe toxic absorption, rigidity, which had at first been present, disappears on perforation of the appendix. (21)

After a time, if suitable resistance is offered to the infection, the peritoneal reaction becomes limited,

and the rigidity usually diminishes somewhat, allowing the palpating hand to feel a tender lump--either due to a small local abscess or a mass of omentum wrapped round the inflamed perforated appendix. There are two special symptoms which may help exact localization in this region. The irritation and reflex rigidity of the ilio-psoas frequently cause the patient to hold the right thigh flexed, or with a lesser degree of irritation pain may be felt only if the right thigh be fully extended as the patient lies on the left side. This sign is often of great value.

When the appendix lies so that the tip is directed medialwards the result of its perforation varies greatly according to whether it is behind or in front of the ileum. If 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, whilst the test for psoas-irritation may help in diagnosis.

If the appendix perforates whilst 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 up against the abdominal wall leads to local boardlike

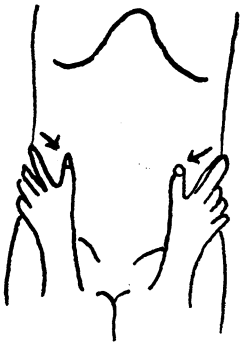
rigidity and exquisite tenderness (hyperalgesia) over the affected area. Psoas-irritation will be absent. (17)

The early symptoms of an attack of appendicitis, when the appendix is situated in the pelvis, are similar to those which ensue when it is situated above the pelvic brim, with the exception that rigidity of the right iliac region of the abdominal wall is seldom present in the early stages, and that the pain is more frequently felt in both left and right iliac fossae. Pain is not so readily localized in the right iliac fossae, but is always felt on deep pressure at the brim of the true pelvis, and the epigastric pain may dominate the scene for a longer time. (17)

Brunn has commented upon the most frequent variation of the normal appendix, the pelvic appendix. "Difficulty in the diagnosis is caused by the pelvic appendix both in children and adults. In the majority of unrecognized and fatal cases of appendicitis the appendix is of this type." Pelvic appendix almost constitutes a clinical entity as Brunn has insisted. Pain may be sudden and sharp, as in ordinary appendicitis, then it may become less marked. When the patient is first examined, however, usually there is no point of tenderness, and no muscle spasm. If the appendix is well down in the pelvis, a rectal examination will disclose tenderness, especially with the finger high up in

the rectum. Not infrequently these patients may have a constant desire to deficate, and there may be a diarrhea. Because of the adherence of the appendix to the bladder there may be a desire to urinate with frequency, and the urine may actually contain some blood cells and leukocytes. The temperature is about normal. When the pain can be localized it occurs as frequently on the left side as on the right. As the disease progresses the white blood cell count will usually increase. If the pain eases off after the first attack, the temperature is normal and the belly soft, with an absence of tenderness and rigidity at first, and often on the left side, when it does occur, the clinical picture is very confusing. In pelvic appendicitis in women salpingitis or a ruptured graafian follicle must be ruled out. A stone in the ureter must be differentiated, because often pelvic appendicitis will produce urinary symptoms and even pain in the penis. (28)

A sign is described that is of considerable value in the diagnosis of retrocecal appendicitis, when the classical signs are absent. Circumscribed tenderness and muscle spasm are found on palpating the right pelvic margin as shown by diagram.



The sign is especially useful in cases of acute retrocecal appendicitis before tenderness has appeared in the usual position; small chronic almost symptomless abscess after retrocecal appendicitis without operation; long standing chronic retrocecal appendicitis generally diagnosed as colitis. In the chronic cases careful radiography is an additional aid to diagnosis.

The third, fourth, and little fingers of the left hand are laid on the outer border of the ilium and the left index finger on the inner border. If the index-

finger is very gradually moved over the soft parts from the anterior spine downwards, every case of retrocecal appendicitis shows a definite, often very painful sensitivity, usually restricted to a small area. In severe cases there is also very definite localized muscle spasm in the same place, sometimes higher, sometimes lower. The abdomen is usually not sensitive to pressure and the usual points of tenderness are absent.

The contrast is particularly striking when the left side is examined in the same manner and not the slightest tenderness is elicited.

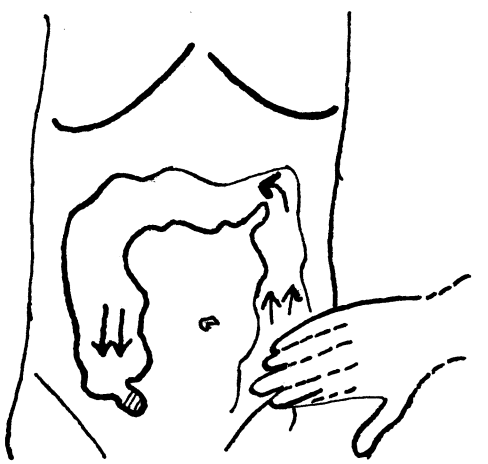
The cases with a severe and acute onset that are not diagnosed and not operated on generally lead to retrocecal and retroperitoneal pus formation. The peculiar thing is that the abscesses often develop without much pain or high temperature, the symptoms being limited simply to generalized abdominal discomfort. The diagnosis of these abscesses is often very difficult, especially when they are not very large. In these cases, also, the sign described above is an important diagnostic aid. (29)

In the retroperitoneal position, higher than its normal position, the appendix may produce abdominal findings which are indistinguishable from those of gall-bladder disease, although, if tenderness is present,

it may be limited to the groin. (27)

As has been demonstrated by Robertson of the University of Nebraska, very often in absence of right rectus rigidity, a diminution in the abdominal reflexes on the right as compared to those of the left will be found. (26)

Exerting even pressure over the pelvic colon forces gas into the caecum. If, when pressing the left iliac fossa, pain is appreciated in the right iliac fossa the case is probably one of acute appendicitis. This maneuver is commonly known as Rovsin's sign. (14)



Rectal examination should always be done. Particular care to introduce the finger slowly with a rotatory movement is necessary. If the finger can be placed within the rectum without causing pain, not only can a much more thorough examination be made, but the

discovery of a tender area becomes of real diagnostic significance. The best method of procedure is as follows: Palpate the left side of the rectovesical pouch; then palpate the right side as shown in the diagram below. The patient should be questioned as to the difference in pain in the two sides. In early cases of pelvic appendicitis tenderness in this area is often the crucial point of an all-important diagnosis. In later cases, the finding of a tender lump or cystic swelling (pelvic abscess) when perhaps there are few, if any, signs on abdominal examination, brings home the cardinal importance of rectal examination in suspected pelvic appendicitis. (14)

We should be on the alert for a sudden subsidence of tenderness following an abrupt onset as this may signify either a gangrenous process or an evacuation of the pus into some hollow viscus. (15)

The "stage of illusion" is really worthy of its name. It occurs a few minutes after an obstructed appendix has perforated. The patient may say that he feels better. The hyperaesthesia goes and the rigidity to a large extent passes off. Fortunately the pulse begins to rise, or we should probably be mistaken more often than we are. (14)

A confirmatory test for retrocaecal appendicitis, known as the Baldwin test, is sited by Bailey. The finger locates the most tender spot in the flank. Pressing lightly, but just enough to produce a little pain, ask the patient to lift his right leg a few inches off the bed, keeping the knee stiff. If the patient promptly complains of an increase in pain, or drops the leg with a distinct outcry, the test is positive. (14)

Flexing the right thigh, and rotating the hip-joint internally is known as the "obturator test". This puts the obturator on the stretch. An inflamed appendix, in contact with and adherent to this muscle, will be irritated by this movement, and the pain will be experienced in the hypogastrium. (17)

Another test of value is known as the "psoas test". This is accomplished by placing the patient on his left side. Fully extend the hip-joint and adduct the thigh.

If the psoas muscle is in a state of irritation from its proximity to an inflamed appendix, this maneuver will bring on pain. (14)

Male places much reliance in the presence of a persistent "squelchy" cecum, despite definite bowel clearance. He states that this is often accompanied by a spastic condition of the colon which is detectable if carefully sought. (30)

In inflammatory disease in children there are only two or three things to think of, practically--the appendix and peritonitis. The appendix is a little thing, and therefore one must not expect very marked constitutional symptoms. The patients do not have much fever, feel very sick, or have much more pain then they have with a boil, but they have the tenderness of a boil, and that is the important point to remember--"the tenderness in the appendix is much greater than the pain." It is quite rare to ever see a child crying with appendicitis, but he has marked pain every time the tender point is touched. The important point in the early diagnosis of appendicitis is first the pain around the navel, passing over to the right side, and second, the one tender point. The tenderness indicates the site of pathology in the appendix. The combination of shifting pain from one place to the other and but one point

of tenderness, is the important thing in the early diagnosis of appendicitis. (31) (20)

Appendicitis, while very rare before the second birthday, is not unknown in infancy. The incidence of the disease steadily increases with advancing age. (20) In a typical case of appendicitis in children the clinical picture differs little from that of appendicitis in adults; there is the classical history of epigastric or umbilical pain, or sometimes pain all over the "stomach", followed by vomiting and later localization of the pain in the right iliac fossa. At this stage the temperature is generally in the region of 101 F. and only very occasionally exceeds 102 F. (32) Cases are seldom seen before the pain is thus localized, but every effort should be made to get an accurate account of events from the very onset of the illness.

Careful abdominal investigation reveals tenderness on pressure in the right iliac fossa; guarding on pressure is frequently very pronounced in children, but true muscular rigidity is absent unless the parietal peritoneum is already involved. (20)

Skin hyperesthesia is a valuable sign, and a pin run lightly over the skin will often reveal a sensitive area of varying extent on the right side, between the umbilicus and the inguinal ligament. Low hyperesthesia

in this area is suggestive of very early pathologic changes, while high hyperesthesia is suggestive of the fact that the inflammatory process has already spread to the peritoneal coat of the appendix. (30)

Bimanual rectal examination should never be omitted. A white cell count and Arneth count are useful adjuncts in cases which have to be distinguished from alimentary colic without any inflammatory reaction.

Most difficulty in diagnosis is experienced when the appendix lies in an abnormal position, and the possibility of this should always be remembered in doubtful cases. (33)

Pelvic appendicitis often gives rise to great difficulty in diagnosis; low initial pain, painful and frequent micturition in the absence of pyuria, a positive obturator sign or suspicious abdominal distention may give the clue.

Do not forget that a pelvic abscess may form, remain latent for several days and then suddenly rupture and cause rapid general peritonitis. (17)

Bimanual rectal examination is really of great value in this type of case; it is often the sheet anchor, and if any doubt exists, it may be done daily under light anesthesia. (33)

The free hand presses gently down the abdominal

wall until a nearly complete exploration has been made of the entire pelvis, abdomen and even of the flanks. Do not omit looking for blood on the glove finger. (32)

In retrocecal appendicitis vomiting is generally absent owing to noninvolvement of the peritoneum, and the close proximity of the appendix to the retroperitoneal muscles may produce a positive result to the psoas test; pain and tenderness in these cases may be referred to the loin. (24)

When the appendix lies in close relationship to the mesentery of the terminal part of the ileum, vomiting is early and persistent, and obstructive symptoms develop rapidly; this type is fortunately rare.

In some cases of imperfect descent of the cecum, the appendix may actually be located in the neighborhood of the pylorus and an upper abdominal lesion is simulated. (34)

The blood count should be considered an aid and check in diagnosis, practically never as diagnostic in itself. Extremes of high, low, and differential counts, which should be made in the case of every sick child, should give pause for thought, but should almost never be considered conclusive. (32)

It cannot be emphasized too strongly that one should never touch the suspected spot--the right lower

quadrant, of course--until the end of the abdominal examination. Usually the writer lays all four fingers casually on a thigh or the left flank, gets the feel of the skin, fat, and muscles. Then, gradually and very gently, he approaches the abdominal wall, working from the left lower quadrant, upward, across and downward and testing the quality and response of the muscles so that a groundwork for comparison is laid.

Finally, his fingers rest gently upon the skin over the appendix. Superficial tenderness is tested, then muscle spasm, deep tenderness, and finally rebound pain. During all of this abdominal palpation, he faces the child and tries to instil confidence that he will not be hurt. In this way, the very earliest evidence of tenderness is observable in the child's expression, his eyes, or in the movement of his hands.

In children over three years of age, he tries, always--even before he palpates--to get them to point out "the place that hurts".

It is surprising how thorough and deep an examination can be made if one proceeds slowly and gently in the fashion described. Unusual findings, such as mesenteric nodes, cysts, small tumors and ectopic kidneys may be discovered.

Vomiting may be the initial symptom of almost any

disease. Obviously, therefore, vomiting alone is not helpful in diagnosis. Taken in consideration with age, feeding habits, and other data, however, and considering the character of the act, its repetition, and the nature of the vomitus, it is an aid. (32)

Absent findings occur when the appendix is wrapped in omentum and nowhere touches the parietal peritoneum. There may be tenderness on deep pressure, but no tenderness on light palpation and no rigidity. (31)

DIFFERENTIAL DIAGNOSIS OF APPENDICITIS

The diagnosis of appendicitis is usually easy. Considerably over fifty per cent of the acute abdominal emergencies admitted to a hospital are cases of appendicular inflammation. So frequent is the condition that it would almost appear that some do not trouble to attempt a differential diagnosis, since many mistakes are made which might easily be avoided by a careful examination. (35)

The typical case with epigastric pain, followed by vomiting, succeeded by localizing of the pain in the right iliac focca, where tenderness can always, and rigidity of the overlying rectus can usually be made out, is sufficiently characteristic, even without the presence of slight fever, to make the diagnosis certain. But there are certain difficulties which need to be discussed. (17)

As stated by Ochsner, "Acute appendicitis is most commonly mistaken for the following diseases in the order named: Gastritis, or gastric ulcer; enteritis; gall-stone colic; peritonitis, due to infection through the Fallopian tubes in women; extra-uterine pregnancy; renal colic; perforative intestinal ulcer, due to tuberculosis, actinomycosis, carcinoma, or typhoid fever; intussusception; strangulated hernia; intestinal obstruc-

tion due to bands of adhesion." (35)

It cannot be denied that careful observers, who are at the same time skilful diagnosticians with an enormous clinical experience, have at times not been able positively to make a differential diagnosis, in some special case, between some of these conditions. But with possible exceptions of renal colic and enteritis both the medical and surgical treatment which is indicated in these severe cases of appendicitis, in which a positive differential diagnosis is sometimes impossible, is equally applicable for the condition for which it may have been mistaken, so that the patient will not suffer from our inability to make a differential diagnosis in any particular case in which the diagnosis may be especially difficult. (36)

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, and a local examination will usually determine whether the site of pain be appendicular. Yet pain and tenderness in the right iliac fossa are

sometimes present in influenza, though the abdominal pain is more likely to be general, and borborygmi may sometimes be heard all over the abdomen. Backache 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. (17) (35)

As stated by Deaver the onset of pneumonia and pleuritis is sometimes very acute, and the pain in the side is so severe as to cause rigidity of the abdominal muscles. If the right side be affected, the diagnosis is sometimes quite difficult, especially in children, who are unable exactly to describe their pain. Careful physical examination will, however, clear up the diagnosis.

Morely has written that the pain in an ordinary attack of acute pleurisy is most commonly felt in the side, and occasionally referred to the tip of the shoulder. Occasionally, however, when the inflammation is low in situation, so as to involve the diaphragmatic pleura, the pain is referred along the course of the intercostal nerves to the abdominal wall, and in these circumstances the clinical picture is atypical and may simulate that of acute abdominal disease. Diaphragmatic pleurisy may occur without any accompanying pneumonia, and may or

may not be followed by effusion. In either event the attack is commonly ushered in by acute abdominal pain, and for the first few hours the difficulty of diagnosis may be very great, since the symptoms appear to point to intra-abdominal inflammation and the physical signs in the chest are often indefinite. Tenderness on pressure over the tenth rib anteriorly is suggestive, and if it can be established that the pain is associated with the respiratory movements, especially with deep inspiration, the absence of muscle rigidity low in the abdomen would, in combination with the above-mentioned association, favour the diagnosis of diaphragmatic pleurisy and suggest a reasonable ground for postponement of exploratory coeliotomy. The simulation by lobar pneumonia of acute appendicitis, and other suppurative conditions within the abdomen, is well known. The pain in the early stages of pneumonia, which is due to associated pleurisy, is referred along the intercostal nerves, and may not infrequently be localized in the right lower quadrant of the abdomen, with a suggestion of the characteristic tenderness over McBurney's point. The difficulty of differential diagnosis is especially marked in the primary pneumonias of children, in whom the disease is frequently ushered in by severe abdominal pain, and not a few such pneumonia

patients have been operated upon for acute appendicitis. (2)

It is a truism of practical surgery that careful examination of the chest should precede a final decision to operate on what appears ostensibly to be an "acute abdomen", and in most cases the observance of this precaution will obviate a mistake. It must be admitted, however, that in the earliest stages of pleuro-pneumonia the physical signs in the chest are often very scanty, and the absence of such grows evidence as an obvious pleural rub is by no means conclusive. (35)

Strumpell, A., and Seyfarth, E. state that in severe pleural inflammation there may be some apparent abdominal rigidity. This is not so marked or so definite as in peritonitis, and can usually be overcome by gradual and gentle examination of the abdomen after the patient's fear of being hurt has yielded to the confidence inspired by a careful clinician. Urgent dyspnoea or marked acceleration of the respiration rate are more generally associated with pleuro-pneumonia than with abdominal disease, while the reverse must be said of vomiting. These statements, however, are but truths, since vomiting and anxious breathing is not an infrequent concomitant of an acute abdominal catastrophe. (36)

Appendicitis can usually be differentiated from

gastritis because the greatest point of tenderness on pressure is in the vicinity of the appendix, even though the primary pain seems to be located in the region of the stomach. The tenderness of the abdominal muscles is more marked directly over the seat of the appendix, and the tenderness in the region of the appendix upon deep pressure persists after the general abdominal pain has begun to subside. (35) (17)

In a perforative gastric ulcer the shock is much greater and the abdomen becomes suddenly distended. There is no peristalsis perceptible through the abdominal wall, and the liver dulness disappears almost at once.(35)

A twisted ovarian cyst gives the same group of symptoms as appendicitis, but, of course, this always occurs in the female and as a rule the mass can be palpated on bimanual examination. (22) Also, with the twisted viscus, the pain and vomiting come on simultaneously (or almost so), so that the proper appendix 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 onset of the symptoms. This swelling may be situated in the mid-

hypogastrium or to one or other side, or may be limited to the pelvis. Superficial hyperaesthesia to pin-stroke in the right iliac region is commonly found with appendicitis, but is less frequently detected with an ovarian cyst.

With a twisted fibroid the symptoms are not usually so acute, and the presence of the fibroid will most likely have been known previously. It may be impossible to differentiate between twisted fibroid and an ovarian cyst with twisted pedicle. (17)

Although ureteral and vesical lesions are probably more frequently overlooked when an erroneous diagnosis of appendicitis is made, appendiceal lesions may present symptoms and signs referable to the urinary tract. An inflamed appendix overlying the ureter will produce ureteritis with pain radiating to the penus and scrotum. Similarly, an acutely inflamed pelvic appendix is likely to produce a cystitis with urinary symptoms. (27)

In those unusual cases in which appencitis is accompanied by pain in the right testis it may closely simulate renal colic. An X-ray photograph should show the stone and differentiate. Cases do occur, however, in which small ureteric calculi do not show on an X-ray negative, and then the character of the pain must be the deciding factor in diagnosis. Cope sites a case in

which acute pain in the right loin radiating to the right testis, accompanied by fever and some muscular rigidity, caused a diagnosis of renal colic to be made. A radiogram 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 gland in the meso-appendix. Fortunately such cases are rare. (17)

In renal colic the pain usually commences in the region of the kidneys and extends downward along the ureter into the scrotum of the male, and the labia majora of the region of the ovaries in the female. There is usually an accompanying irritation of the bladder, and the urine usually contains more or less red blood corpuscles. As stated before, in case the appendix is adherent to the ureter or the bladder, very similar symptoms may occur, but the urine remains free from blood. (35)

Acute right-sided pyelitis is frequently mistaken for appendicitis, and not infrequently operations are unwisely undertaken because insufficient attention is paid to the symptoms. The points in differential diagnosis can be as follows: In acute pyelitis the initial rigor is common, although unusual in appendicitis; the temperature is 103 F. or more in acute pyelitis; pain

on micturition is uncommon in appendicitis; increased frequency of urination is the case in pyelitis although inconstant in appendicitis; abdominal muscles are lax in pyelitis; no pus in the urine in appendicitis. The symptoms of acute pyelitis may be produced by the presence of bacilli in the urine without any or much formation of pus. In such cases there is always a turbidity of opalescence of the urine which is suggestive of the bacilluria. One must not forget also that an inflamed appendix lying in front of the renal pelvis may actually cause an acute pyelitis. If the urine be carefully examined as a routine there will seldom be any difficulty in diagnosis. (17)

Acute right-sided hydronephrosis is sometimes misdiagnosed appendicitis with abscess formation. A hydronephrosis forms a rounded, tense, tender swelling which occupies the lateral aspect of the abdomen and can be felt well back in the loin. The swelling is sometimes freely movable and usually rounded 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 corresponding to Dietl's crises.

Rigidity of the abdominal wall over the swelling is usually absent. (17) A kinking of the reno-ureteric junction may occur and cause severe pain in the loin and diminution of amount of urinary secretion, without much swelling of the kidney. The urinary symptoms, lack of fever, and relief of the pain when urine passes more freely, serve to distinguish. (17) (14)

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 gall-bladder frequently comes down into the right lumbar region, but more usually enlarges in the direction of the umbilicus. In thin subjects without rigidity of the abdominal wall diagnosis is usually easy, for the tender rounded gall-bladder may be felt continuous with the liver and perhaps moving with respiration. The pain in 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 be impacted in the cystic duct. There may be resonance of the ascending colon over an inflamed retrocecal appendix. There is never resonance in front of an inflamed gall-bladder, which is usually on an anterior plane to the caecum, colon, and appendix. In very stout subjects and in patients with very rigid abdominal

muscles it may on occasion be almost impossible to diagnose whether the appendix or gall-bladder be at fault without giving an anesthetic, unless the previous history be clearly indicative of one or other condition. (37) (17)

When with the cholecystitis a stone is simultaneously impacted in the cystic duct the constant spasms of pain accompanied by retching, with deep tenderness in the right hypochondrium and right subscapular region, are sufficiently diagnostic and clearly differentiated from appendicitis. (17)

A hypodermic injection of morphine will usually make a gallstone colic subside within one-half hour, leaving but little tenderness in any portion of the abdomen and not any over the appendix. In an acute appendicitis, though the pain may subside after the injection of morphine, the tenderness does not subside for fully twelve hours. (35)

The radiation of the pain to the back in cholecystitis sometimes proves helpful. Boas's test, which is an area of epicritic hyperaesthesia posteriorly extending from about one inch external to the spines of the vertebrae to the posterior axillary line, and vertically from the eleventh dorsal to the first lumbar spine. There may also be itching in this area which is not re-

lieved by scratching. (14)

Periduodenitis around an inflamed duodenal ulcer should be distinguished by the characteristic history elicited by careful questioning. The pain of duodenal ulcer comes two or three hours after food, and is relieved by the taking of food. (17) (35)

Torsion and strangulation of a portion of 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. If the affected fat becomes adherent to the abdominal wall there may be superficial hyperaesthesia. Vomiting is less common than in appendicitis, but differential diagnosis may be impossible. (17)

Perforated duodenal ulcer is frequently misdiagnosed appendicitis. The escaping contents travel down first to the 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 shock 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 in favor of a perforated duodenal ulcer. If there be any obliteration of liver-dullness in the absence of general abdominal distention a duo-

denal (or gastric) perforation is certain. (17) (22)

CHOLECYSTITIS

This is one of the most common of the inflammatory diseases of the acute abdomen. It may occur in the course of an acute infection such as typhoid fever and is associated frequently with gall-stones. It occurs in about ten per cent of males of adult years and about twenty-five per cent of women who have borne children. Women who have not had children are not more apt to have gall-stone disease than males. It may occur at any age but is seen most frequently in the fourth and fifth decades. (38) (39)

The nerves supplying the gall-bladder, both motor and inhibitory, are from the splanchnic and vagi. These splanchnic fibers emerge from the spinal cord in the roots of the sixth thoracic to the first lumbar spinal nerve and pass to the coeliac plexus by was of the splanchnic nerves. Sensory fibers are found in both the splanchnic and vagus nerves. The afferent path is formed by the vagus fibers and the efferent path by the splanchnic fibers. (38)

If there has been a history of typhoid fever or repeated attacks of colic of the type associated with gall-stones, it is reasonable to assume that the gall-bladder is the likely seat of trouble. (40) Most infections of the gall-bladder with or without stones, espec-

ially the former, are so straight-forward that detection is easy. The X-ray and Grahm test have heightened the percentage of accurate diagnosis. (41) (38)

Cholecystitis may occur with or without the presence of gall-stones. Infection may gain access either from the blood stream (more commonly) or from the intestine via the biliary ducts. The intensity of the inflammation varies greatly. Sometimes there is a mere catarrh of the mucous membrane lining the gall-bladder, which may be full of clear or bile stained mucous, while frequently the inflammation involves the whole thickness of the bladder wall, which becomes edematous and friable. In extreme cases gangrene of part or whole of the gall-bladder may occur. The inflamed viscus may have omentum adherent to it, but this does not occur quite so frequently as with an inflamed appendix. (17)

The contents of an inflamed gall-bladder consists either of clear or bile-stained mucus, or of mucopurulent bilious material sometimes containing much cholesterin in suspension, or accompanied by gall-stones. When gall-stones are present they may belong to any of the different varieties--the large barrel-shaped stone, the multiple small facetted stones, or the innumerable black pigment-calculi like small jet beads, which are sometimes embedded in the tar-like matrix. (17) (40)

In females the gall-stones are due to the high cholesterolemis incident to pregnancy and high fat diets. (41)

Acute cholecystitis usually occurs in patients over forty, frequently women and persons of an obese habit, and with a previous history of flatulence, dyspepsia and occasional biliary colic, but seldom of jaundice. (42)

We must remember the old saying, "Fair, fat, forty and belch", as a previous history, together with attacks of "indigestion". (18)

The symptoms of acute cholecystitis vary greatly with the severity of the infection. It is very probable that some of the milder cases are overlooked, the condition being diagnosed as "dyspepsis" or "indigestion". In other cases, in which the disease accompanies some acute infection, the symptoms of the later, as for instance the stupor and the abdominal distention that so frequently accompany typhoid fever, may obscure entirely the symptoms of inflammation of the gall-bladder. (39)

It is quite usual for vague digestive disturbances such as fullness or oppression in the upper abdomen, nausea, acid eructations, flatulence, and chilliness after eating to develop as early manifestations. (43)

In well-marked cases of cholecystitis, as in cases of other infections, the onset of the symptoms is quite

sudden and is sometimes accompanied by a chill. Chills occasionally occur at the onset, but as a rule they are not severe. The temperature varies from 100 to 102 F., though in severe cases of suppuration of the gall-bladder it may rise as high as 104 or even 106 F. The rise in temperature is accompanied by symptoms of intestinal irritation, anorexis, nausea and vomiting. (39) (40)

The degree of temperature varies according to the extent of the inflammatory process and the virulence of the infection. If the bile-ducts are simultaneously infected it is common to get higher and more irregular fever, occasional rigors, and in general more serious symptoms. (17)

If the cholecystitis is associated with stones in the gall-bladder, the pain may be cramp-like and colicky, and so severe that a hypodermic injection of morphine is required for relief. In some cases the pain may be referred to the back, especially to the region of the angle of the scapula and to the right of the lower dorsal vertebrae, and in the rare cases may be referred to the precordium or to the left upper quadrant of the abdomen. If there is a localized peritonitis around the gall-bladder, the pain may be referred to the tip of the right shoulder as a consequence of the irritation of the terminal branches of the phrenic nerve, the origin of

the later being in the third, fourth and fifth cervical segments and the pain being felt in the sensory distribution areas of these segments. The pain is most acute during the first two or three days, after which it begins to subside so that as a rule it disappears within a week or ten days. (39) (42) (40) (17)

Instead of passing off within a short time, the colic changes to acute stabbing epigastric agony and is exaggerated by the slightest movement of the diaphragm. (40) Phillips of London, states that pain of a severe, continuous, and aching nature was present in ninety per cent of his series without stones. (39)

The pain varies according to whether or not there is a stone attempting to pass along the cystic duct. When there is no stone the pain is generally localized to the region of the gall-bladder, or if there be contiguous peritonitis (as is not infrequently the case) the pain may be diffused over the right hypochondriac region and even felt on the top of the right shoulder. (39) (17) If the liver and gall-bladder are much enlarged downwards the pain may extend down almost to the iliac fossa. (17) (44)

Usually the patient becomes very much excited, and may pace the floor, press the fists into the abdomen, lean over the back of a chair, or roll from side to side

in agony. It is characteristic for sweat to drench the clothing. (43)

The method of production of gall-stone colic and other types of pain in the biliary tract is poorly understood. Experiemtns have shown that the gall-bladder is insensitive to crushing or cutting. Sudden distention of the organ will produce some of the feelings of bloating and indigestion that are so annoying to patients with cholecystitis, but usually not the pain. The common duct is more sensitive, and distention here will produce pain, nausea, vomiting and that difficulty in breathing which is so characteristic of biliary colic. The puzzling feature is that the pain produced in experiments on human volunteers was usually epigastric and did not radiate typically to the back. (11)

When there is a stone in the neck of the gall-bladder or in the cystic duct the pain radiates also to the area beneath the inferior angle of the right scapula. This corresponds to the level of distribution of the eighth dorsal segment from which the gall-bladder derives its main nerve supply. In uncomplicated cases pain is not felt in the right acromial or clavicular regions. (17) (45)

Alvarez has shown several reasons for believing that the pain in the back must be due to some irritation,

perhaps inflammatory in origin, of nerves that go out by way of the posterior parietal peritoneum, and not due to distention of the gall-bladder. It is possible that during simple distention of the uninflamed biliary tract the experimenter did not stimulate those particular fibers in the splanchnic bundle which, on arriving in the dorsal region of the spinal cord, send out impulses to sensitize the region under the right scapula. (11)

Ellars states that "The pain is always first and is not of the colicky type but more constant. It is usually a through and through pain to the right shoulder." (18) The pain is usually described as "knife-like" in the majority of cases of gall-stones. (38) (17) (39)

Gall-stone colic so often occurs when the mother is nursing, that Haggard always aska the patient, "How old was the baby at your breast when you had your first attack of colic?" (41)

Chronic cholecystitis is usually manifested by sharp attacks of gall-stone colics for a long period, followed by chronic dyspepsia, or by chronic dyspepsis followed by biliary colic. (41) (46)

There is often generalized abdominal pain caused by the association of the branches of the coeliac axis

and the vagus. (43) (17)

These attacks leave the patient with tenderness over the right upper quadrant, and very frequently there is pain referred to the left costal cage, with attacks over the precordium which simulate anginal attacks. (38) (48)

Vomiting is also a variable feature. It is slight in severity when there are no gall-stones and no peritonitis, but when either or both of these are present there may be constant vomiting or continual retching and bringing up of bilious material. (17) (40) The vomiting is more persistent than in appendicitis. (18) (39) (17)

Accompanying the vomiting one usually finds constipation of a varying degree. (40) (49) Cope states that constipation is usual, and is more obstinate if there be local peritonitis affecting the neighboring coils of intestine. (17)

When the yellow flag of icterus is displayed it usually puts the guilt on the gall passages. (41)

The presence of jaundice carries the investigation at once to the right hypochrondrium. (41) Jaundice is not usual in cases of simple cholecystitis, nor is it the rule even when gall-stones are present, but there is frequently a history of jaundice occurring after previous

attacks of acute abdominal pain. This would suggest the previous passing of a gall-stone.(50) (17) When jaundice does occur, its presence indicates that there is some obstruction of the hepatic or common bile duct by stones or by the extension of the inflammatory process from the gall-bladder to the ducts. (51) In cases of severe inflammation of the gall-bladder jaundice may result from the associated hepatitis which, as Grahm has shown, occurs in practically all cases of cholecystitis and is characterized by inflammation around the intrahepatic bile ducts (pericholangitis). (52) (39) Jaundice, however slight, makes the diagnosis more certain. (43)

The conjunctive is the best place to look for minor degrees of jaundice, but let it be emphasized that it is by no means necessary for the patient to have jaundice in order to make the diagnosis of gall-stone colic. The presence of jaundice associated with this condition means that a gall-stone is, or has been, obstructing the common duct. (14)

Intense itching is often produced by the intense jaundice, and this sometimes leads to vigorous scratching and the production of scratch-marks, blood-crusts, and sore places. (53)

Descent of the stone in the common duct with obstruction and jaundice means ten times the operative

mortality that is obtained where the stone is in the gall-bladder. (41)

On examination of the patient it is usually found that his general health is not much impaired, though he may have lost considerable weight as the result of the gastro-intestinal disturbances which generally are associated with cholecystitis. (39) (54)

Tenderness over the gall-bladder and rigidity of the right rectus muscle are present, in fact, the rigidity may be so marked that it is impossible to determine whether or not the gall-bladder is enlarged. (55) (39)

Cope has found local tenderness over the gall-bladder to be a constant feature. Frequently when there is no muscular rigidity one can feel the rounded fundus of the viscus projecting below the inferior margin of the liver. (17) Usually the swelling is small, but occasionally it may be of considerable size and bulge down well into the right iliac fossa or into the umbilical region. (17) (39)

Marked rigidity of the right rectus muscle and a slowly increasing area of tenderness over the gall-bladder indicates the spread of pericholecystitis and involvement of the peritoneum in the inflammatory process. (40) (43)

In cases in which the cystic duct is obstructed the

gall-bladder may be enormously distended, so that it can be felt as a large, cystic, pear-shaped tumor extending into the right flank or even downward toward the pelvis. In such a case the gall-bladder may be displaced laterally like a pendulum. (56) The rounded mass which is quite tender and moving on respiration may be felt beneath the right costal margin, where a respiratory "catch" may also be detected. (42) The liver sometimes is enlarged, though as a rule to no great degree, and tenderness can be elicited by pressure at the right of the eleventh and twelfth dorsal vertebrae. (39) (57)

Bailey sites Courvoisier's law in referrence to enlargement of the gall-bladder. This law states that if in a jaundiced patient the gall-bladder is enlarged, it is not a case of stone impacted in the common bile-duct, for previous cholecystitis which existed when the stone was in the gall-bladder must have rendered the gall-bladder fibrotic and incapable of dilatation. Courvoisier's law has much to be said for it, but, as with all laws in medicine, there are many exceptions, and on this account the law has fallen into disrepute. The most notable of these exceptions are double impaction, when there is one stone in the cystic and another in the common bile-duct and a pancreatic calculus causing obturation at the ampulla of Vater. (14)

When a gall-bladder is inflamed the overlying liver substance sometimes enlarges and projects downwards from the liver margin, forming one variety of Riedl's lobe. (17) The right lobe being involved. (39)

The respirations are jerky and because of the pain are restricted on the right. The respiratory sounds at the base of the right lung may be diminished in intensity. (39) (58) McLaughlin of Nebraska also states that quite frequently small moist rales may be heard in the right base directly over the liver due to an associated hepatitis. (59)

Bailey demonstrates a sign which is often of value. The left hand is placed on the costal margin in such a manner that the thumb lies over the fundus of the gall-bladder. The thumb exerts moderate pressure. The patient is asked to take a deep breath. The sign is positive if the patient "catches her breath" when the descending diaphragm causes the inflamed gall-bladder to impinge against the pressure of the thumb. Technically speaking, Murphy's sign may be described as a temporary inhibition of respiration when inspiration is nearing its zenith. (14)

Tenderness to finger percussion will be present in ninety-six per cent of cases and is a differential diagnostic sign. Place the palm of the left hand over the

ribs at the junction of the midclavicular line and abdomen. Have the patient exhale all the breath, then flex the middle finger down into the gall-bladder region. Then have the patient take a deep breath and as he does so strike the back of the hand and the patient will almost come out of the bed if it is an acute gall-bladder. (14) (17)

A tender rib cartilage may be a sign in cholecystitis. The sign is sought for with the hand flat upon the abdomen. Beginning on the left side, the pulp of a finger is brought into firm contact with the costal margin. Inch by inch the costal margin is examined in this way, saying nothing but watching the patient's face. On the right, in cases of cholecystitis, a single tender spot, indicated by the patient's expression, is often found. Generally this is upon the eighth rib edge, but sometimes it is a little higher or lower. Carmalt-Jones speaks highly of this sign in diagnosis. (14)

In cholecystitis there may be an area of epicritic hyperaesthia posteriorly. The tenderness extends from about one inch external to the spines of the vertebrae to the posterior axillary line, and vertically from the eleventh dorsal to the first lumbar spine. Bailey sites a case of recurrent cholecystitis with gall-stones in which there was itching in this area. The itching was

not relieved by scratching. This sign is often referred to as Boas's sign in the literature. (14) (42)

Quite frequently associated with icterus one finds clay colored stools and dark urine. However, this is only present with an occlusion of the common duct. (43) (41)

The pulse is not diagnostic and the rate is usually proportional to the amount of fever present. (40) (39) (43) It may remain steady and slow in spite of acute inflammation of the gall-bladder, the presence of biliary calculi, or even local peritonitis. A rapid pulse in Cholecystitis may be indicative of severe toxemia, either from extending peritonitis or merely from toxic substances absorbed from the bile ducts and gall-bladder. (17)

Leukocytosis of moderate degree may accompany the condition although in more than fifty per cent of cases the leukocyte count will not be greater than ten thousand. (40) (22) (60)

Graham has developed a plan of visualizing the gall-bladder in the X-ray, which has added very much to our ability to make correct diagnosis. However, there is no laboratory test that supersedes good clinical evidence. The fact that a gall-bladder does not fill is not conclusive evidence that the patient has gall-

stones or cholecystitis. Stout sites three outstanding conditions which produce non-filling of the gall-bladder: During pregnancy frequently the gall-bladder will not fill but after delivery it will; in the presence of acute ulcer, particularly duodenal, the gall-bladder will not fill and visualize with the dye during the active stage of the ulcer symptoms. After the active symptoms and pylorospasm have subsided, the gall-bladder will fill and empty normally; in the presence of well-marked colitis the gall-bladder will not visualize. (38)

DIFFERENTIAL DIAGNOSIS

In the presence of colic the diagnosis of cholecithiasis usually is simple. (60) In establishing the differential diagnosis, however, the following conditions must be considered: Renal colic, Dietl's crisis and pyelitis; acute pancreatitis; diaphragmatic pleurisy; angina pectoris; abdominal angina associated with abdominal arteriosclerosis; pericarditis; epigastric hernia; lead colic; herpes zoster; gastric crisis of tabes; acute appendicitis (appendix high in the abdomen). (61) (62)

In renal colic the pain is felt first in the lumbar region and is referred downward along the line of the ureter to the testicle on the right side, sometimes to the end of the penis, or to the upper portion of the thigh, following the distribution of the ilio-inguinal nerve. It is extremely severe, and if the urine is examined shortly after an attack, red blood cells nearly always are found in it. (17) In cases of Dietl's crisis the location and distribution of the pain, which is caused by the kinking of the ureter with resultant hydronephrosis, is the same as in renal colic. This is also true of the pain in pyelitis. In the majority of cases, however, pyelitis is associated with a high temperature and with irritability of the bladder. (63) An

X-ray examination of the kidneys, ureters and bladder including a pyelogram will make it possible to differentiate between these conditions and gall-stone colic. (64) (65) (66)

Acute pancreatitis gives rise to very severe pain in the upper portion of the abdomen, but the pain is not referred to the same areas as in either renal or biliary colic. (67) Pancreatitis is associated with very severe nausea and vomiting, and with a temperature which rapidly rises to 103 or 104 F. The patient is extremely ill, and very soon shows evidences of collapse, such as pallor and a rapid, thready pulse. (17) Jaundice is present because the swelling of the pancreas causes compression of the bile ducts. This disease usually runs a rapidly fatal course, the patient dying within two or three days. In a large proportion of the cases of acute pancreatitis an operation is performed, the surgeon thinking that he is dealing with some acute condition of the gall-bladder. (68) The principal points of differentiation are the severity of the symptoms and the high temperature, which usually are much more marked than in acute cholecystitis. (69) (70) (17)

In diaphragmatic pleurisy the pain often is referred to the upper abdomen. It is increased upon deep inspiration, and examination of the chest often will

reveal a friction rub along the line of the attachment of the diaphragm. (53) As in gall-stone colic, the pain often is referred to the right shoulder or to the neck. (17) In diaphragmatic pleurisy, however, pressure over the lower portion of the chest or the upper portion of the abdomen usually gives relief, in contrast to acute cholecystitis , in which pressure intensifies the pain. (71) Diaphragmatic pleurisy often is associated with pneumonia, so that areas of consolidation may be found at the base of the lung on the affected side. Moreover, in diaphragmatic pleurisy the temperature usually rises rapidly, and there is marked leucocytosis. (74) (72) (73)

As mentioned above, it is often very difficult to distinguish angina pectoris from gall-stone colic. (75) This is particularly true in cases of so-called "angina abdominalis" associated with arteriosclerosis of the abdominal vessels. It is true that in many cases angina may be differentiated from biliary colic by the fact that the pain was brought on by exertion, and that the patient presents a history of symptoms which suggest cardiac disease, such as shortness of breath on exertion, in particular. (17) There may be evidence also of arterial thickening and myocardial degeneration. In most cases of angina the pain is referred down the arms, and

the sensitive areas of the skin, which are found afterward, are in the region of the precordium rather than in the epigastric region. (75) Even with these points of differentiation, however, it is not always easy to decide which condition is present, and a great many patients have been doomed to invalidism or have been given a serious prognosis, under the assumption that pectoris was present, when an operation for the removal of gall-stones would have cleared up all the symptoms. In every doubtful case of angina, therefore, it is important to examine the urine carefully after an attack to see whether or not bile pigment is present. (77) In the majority of cases it is important also to make a careful X-ray study of the gastro-intestinal tract including the gall-bladder, in order to exclude the possibility of gall-stones. (78) (72) (64)

In a case of coronary thrombosis in which the pain is referred to the epigastrium the condition can simulate gall-stone colic, and there may be tenderness in the epigastrium from the enlargement of the liver that so quickly follows coronary thrombosis. In the latter condition, however, the heart is dilated, the heart sounds are faint, occasionally a pericardial friction rub can be heard, and the pulse is small, often imperceptible, rapid and irregular, while the blood pressure

falls rapidly so that it may be difficult to estimate. Signs of passive congestion at the base of the lungs appears early. (79) (75)

Phillips reviews several cases of acute pericarditis in which the pain was referred downward to the epigastrium, and definite tenderness was felt over the gallbladder. In examining the hearts of these patients, however, a definite pericardial friction rub nearly always was elicited in the second and third interspaces to the left of the sternum. Furthermore, in every case of pericarditis there is more or less difficulty in breathing accompanied by a hacking cough. (39) The patient is more comfortable propped up with pillows and he nearly always shows a temperature ranging between 101 and 103 F. In many instances there are signs of dilatation of the heart. Moreover, in the majority of cases of pericarditis there is a history of previous attacks of rheumatism, or there is evidence of a coexistent rheumatic arthritis. (39) (17)

In acute or chronic pain in the upper abdomen, it is always important to consider the possibility that it may be caused by epigastric hernia. Epigastric hernia usually occurs slightly to one side of the median line, at the point when the blood-vessels emerge through the rectus muscle. The hernia often is very tender and can

be reduced quite readily, the reduction in the case of the larger herniae often producing a sound like that of splashing water. Sometimes injury causes the herniated intestine to become very much inflamed so that operation becomes necessary, or it may become incarcerated and cause very severe pain. The symptoms due to epigastric hernia are very similar to ordinary symptoms of gastric hyperacidity. The pain nearly always is aggravated when the patient bends backward. (79) (39)

Lead colic often causes very severe pain, particularly in the upper abdomen, so that the condition sometimes is mistaken for gall-stone colic. The history of an occupation involving exposure to lead, the observation of the so-called "lead line" on the gums, the presence of anemia associated with basophilic stippling of the red cells and occasionally with nucleated red corpuscles will all help to establish the diagnosis of lead colic. (73) (39)

Phillips sites a case in which the patient had been advised to have an operation for gall-stones because of severe pain in the right upperquadrant of the abdomen from which he had been suffering for two days, pain so severe that he had to be given morphine, but on the third day a very definite eruption of herpes zoster manifested itself. (39) The pain in herpes zoster is not

severe, of course, as in cases of gall-stone colic, and yet it may be so troublesome that the patient demands sedatives for relief. It would seem to be important, therefore, in cases in which there is localized pain in the upper portion of the abdomen, particularly if the pain occurs in the back as well as in the front, to consider the possibility of herpes zoster. (39) (79) (17)

Many cases are in the literature in which tabes has been associated with very severe pain in the upper part of the abdomen and with nausea and severe vomiting, these symptoms almost compelling the physician to believe that he is dealing with a case of gall-stone colic. (80) It is for this reason that a complete neurologic examination is of importance in all doubtful cases. The finding of pupils which are fixed and inactive to light, which have irregular margins and very often an eccentric position, the absence of knee-jerks, the presence of the Romberg sign, the characteristic findings indicative of tabes in the spinal fluid and a positive Wasserman, all these features will serve to differentiate the gastric crises of tabes from an acute attack of gall-bladder disease. (81) (39)

If the appendix is situated high in the abdomen and the tip is turned upward beneath the liver, an attack of acute appendicitis can simulate gall-stone

colic very closely. The tenderness of the abdomen and the occurrence of fever and of leucocytosis should make one think seriously that acute appendicitis may be present, especially if the patient is comparatively young. (17) (79) (21)

In the case of a duodenal ulcer which is threatening to perforate and has caused periduodenitis the local findings may be similar to those of cholecystitis with local peritonitis, but a careful inquiry into the history will distinguish. The pain which comes on about two and a half hours after meals and is relieved by taking food, the bringing up of "water-brash" and acid eructations, the attacks of flatulence, and possibly the occurrence of melena may give a clear picture of ulcer. If there be time, and the conveniences, the diagnosis of ulcer may be confirmed by noting deformity of the duodenal cap and a rapid emptying of the stomach as observed by X-rays after administration of a barium meal. (39) (17)

Retroperitoneal perforation of a duodenal ulcer may be attended by severe collapse at the onset, but the condition quickly localizes and leads to tenderness and swelling in the right loin. The perinephric tissues become edematous, and there may be frequency of micturition and even hematuria from the irritation of the renal

pelvis. There is great pain on pressure at the errector-costal angle. The diagnosis is difficult, since a primary renal condition is likely to be suspected. (39) (17)

In hepatitis the tenderness is all over the liver, including the lateral aspect as ascertained by pressure in the lower intercostal spaces laterally, as well as in the right hypochondrium. This sign serves for diagnosis except in those cases where hepatitis coexists with the cholecystitis. (82) (17)

ACUTE PERITONITIS

Apart from hemorrhage, the cause of death in nearly all fatal acute abdominal cases is either peritonitis, or acute paralytic ileus or mechanical obstruction of the intestines. Spreading or general peritonitis, with consequent toxemia and secondary shock, is the commonest single cause of death. Nearly all such cases, unless the patient is actually moribund, demand an opening of the abdomen for drainage purposes, and it is sometimes impossible to determine the actual cause of the peritonitis, either before the operation or even during its performance, if the state of the patient forbids any prolonged manipulation. (17)

Infective organisms may reach the peritoneum through a wound of the abdominal wall; via the blood stream; from the viscera contained within the abdomen; rarely through the diaphragm or by lymphatic extension from the thigh. (17)

The only commonly clood-borne organism of importance is the pneumococcus, which may cause severe so-called primary peritonitis. It is a dangerous disease, practically confined to girls of school age, which is often confused with appendicitis. (83)

Organisms may reach the peritoneum from the contained viscera either by rupture of a viscus; or, by escape

through the diseased wall of any viscus. In the female is the additional path of infection via the Fallopian tube. Frequently a local abscess may form either extra- or intra-peritoneally near the diseased viscus, and later such abscess may burst into the general peritoneal cavity. (17)

The common causes of general peritonitis, which is usually secondary, comprises disease or rupture of a hollow viscera, and ruptured abscess of the solid viscera. General peritonitis may follow such conditions as: Perforation of the appendix vermiformis; perforation of gastric or duodenal ulcer; perforation of typhoid or tuberculous ulcer of the small intestine; perforation of dysenteric or stercoral ulcer or of a diverticulum of the colon; perforation of the gall-bladder, or biliary ducts; gangrene of any strangled coil of gut, or intussusception, or volvulus; infection spreading from a pyosalpinx; infection spreading from an infected uterus; infection spreading from a pyonephrosis; rupture of a liver-abscess or splenic-abscess. (17) (84)

The above comprises all of the common causes of general peritonitis. The symptoms of peritonitis vary greatly according to the part and extent of the peritoneum involved, the nature of the infective agent, and the acuteness of onset. Help in diagnosis will be

obtained by regarding the symptoms as being roughly grouped in two classes--reflex and toxic. (84)

The reflex group being pain; vomiting; anxious facial expression; rigidity of abdominal muscles; superficial hyperesthesis; collapse; and alteration of temperature. In the toxic group, collapse; alteration of temperature; distension; intestinal paresis; and general toxemia are the symptoms of note. (84) (71) (17)

The importance of recognizing these two groups of symptoms lies in the facts that reflex symptoms are earlier in onset when a demonstrative part of the peritoneum is affected, but may be delayed considerably when a non-demonstrative part is affected. The division of the peritoneum into these two parts is based upon a relatively free or scanty cerebro-spinal nerve supply. (84) The anterior and lateral parts of the abdomen are lined by peritoneum well supplied by somatic nerves which bring about brisk reflexes. (85) The pelvis and medium portion of the posterior abdominal wall have a scanty cerebro-spinal supply, and in consequence irritation of these parts causes minimal reflex symptoms. (85) (71)

Toxic symptoms are nearly always late in onset. There is indeed an inverse relationship between the two groups, since severe toxemia diminishes the sensibility

of the reflex arc. It thus follows that when a non-demonstrative part of the peritoneum (e.g. the pelvic) has been primarily affected reflex symptoms may be minimal throughout, for oncoming toxemia diminishes the reflexes from the demonstrative part as it becomes progressively involved. Unless this fact is appreciated it is easy to overlook a pelvic or central peritonitis until the infection has advanced to a serious extent. (17)

As grouped above one finds the two symptoms collapse and alteration of temperature are included in both groups. Collapse, by which we mean obvious and rapid depreciation of the circulation and metabolism, may be seen either early or late in the course of peritonitis. In the early stage it is a reflex symptom, while later in the course of the disease it is the result of absorbed toxins. The early reflex collapse is usually quickly recovered from, though occasionally toxic collapse follows close on the heels of reflex collapse. Early collapse is absent in those cases which have an insidious onset and is less likely to occur when the silent area of peritoneum is primarily involved. (84)

Alteration of temperature is common in peritonitis, but is not sufficiently constant or regular to be of much aid in diagnosis. Early collapse is accompanied by subnormal temperature, while the ingravescent stage

of the disease is usually indicated by fever of an irregular type. In the later stages of peritonitis, the temperature may be normal, subnormal, or slightly elevated. (84)

Variations in the temperature are usually an index of the patient's resistance to the infection. (71) As a rule there is an elevation which may seem slight when compared with the intensity of the symptoms. Such moderate fever must not be misinterpreted in diagnosis and prognosis. Feber is a fairly accurate measure of resistance against the toxins absorbed. Low or subnormal temperature is the rule at the onset of severe cases as stated above. High fever is common when there is marked invasion of the lymphatics as well as of the endothelial surface. (86)

The temperature should always be taken with the thermometer in the rectum. The cold skin and the open mouth of peritonitis may register low or subnormal temperatures at the same time that the rectum shows a rise as high as 104 F. (40)

Occasionally, especially in cases due to rupture of a gangrenous organ, a chill may take place at the onset of the attack. The chill is seldom repeated, except in cases of puerperal peritonitis. Recurrent chills indicate a pyemic process with the development

of new areas of infection, especially a thrombophlebitis. (43)

The early and reflex symptoms of peritonitis may, in the absence of initial collapse, be extremely equivocal. They are more likely to be definite in young persons whose reflex arcs are normally more sensitive, and conversely they may be insignificant in old and debilitated patients. (87)

One would expect to find peritonitis always very painful, but this is not always the case. There is a type of fulminating generalized peritonitis in which the symptoms are those of shock, combined with almost unbearable pain. In other cases an appendiceal abscess, walled off by loops of bowel, will suddenly leak and throw the patient into spasms of pain. Strange to say, simple drainage of such an abdomen will often put a stop to the pain although the inflammatory exudate is still spread widely over stomach, bowel and liver. In other cases generalized peritonitis will be painless, or peritonitis that began with pain will later become painless. It seems probable that nerve endings are so exhausted or so severly injured that they can no longer respond. In some cases cessation of pain may come with the cessation of all movement in the intestine. It may be like the cessation of pain that comes when an inflamed joint is

immobilized. (11)

Pain is the most constant of the symptoms of peritonitis according to McGlannan and Cope. It is also the most constant symptom of those lesions which cause peritonitis. Persistent abdominal pain therefore, should never be dismissed as an unimportant condition. It may be confined to the local area of inflammation or referred more generally over the abdomen. (84) (17) As the peritonitis extends the pain-area also extends, though the maximum pain is nearly always felt at the initial focus. (11)

The pain of onset may be relatively slight and gradually increase to great intensity as the process of inflammation advances, after which it may remain stationary, or decrease. In certain rare cases the pain may never be severe enough to give the patient serious concern, and this in spite of the fact that the peritonitis is spreading and the constitutional effects of the septicemia are of the gravest type. (88) In the perforative types intense pain is the characteristic symptom of onset. (84)

The pain is continuous, with or without exacerbations. It is not often paroxysmal, although occasionally the etiological factor in the development of the peritonitis may also be responsible for a simultaneous

mechanical obstruction of the bowel, in which event the pain would become paroxysmal. Such a condition may be noted in cases of appendiceal peritonitis in which the edematous ileum has been acutely angulated by the developing protective adhesions. Similarly, paroxysmal pain may result from spastic constracture of the bowel, occurring as a reflex from the irritation of the peritoneum by the infecting material. (84) Exacerbations probably represent the alternate contraction and relaxation of an inflamed organ and the intermittent flow of irritating material into the peritoneum. (11)

The severity of pain bears no relation to virulence of infection. A patient with an overwhelming streptococcus peritonitis may have little or no pain. Spontaneous relief of pain may accompany the development of gangrene, or it may take place after a tense localized abscess has ruptured. (89) As a rule relief or subsidence of the initial pain followed by its sudden return after an interval indicates rupture of the primary focus into the general peritoneal cavity. (86)

Tenderness is a constant feature over any focus of peritoneal inflammation. Even when rigidity is absent there is usually pain felt on pressure over the affected site. Cope sites three cases in which the tenderness was absent. Two cases in which extreme toxemia had

dulled the sensorium and one in which extreme muscular rigidity apparently prevented transmission of the applied pressure to the underlying inflamed area. (17)

Pain on pressure is a general sign of inflammatory reaction. Unless the connection with the central nervous system has been broken, pressure on an inflamed area produces pain and with it some kind of defensive muscular reaction. (87)

In peritonitis the tenderness varies from an exquisite degree which makes contact with the bed clothes painful to a mild discomfort when pressure is made over the involved area. (86) As a rule, however, there is prompt response to pressure over the inflamed area evidenced not only by voluntary complaints of the patient but also by the reflex contraction of the abdominal muscles protecting the diseased area. A certain degree of tenderness is found all over the abdomen, but in the early stages the tenderness is always most marked in the region where the peritonitis begins. (90)

Apparently tenderness is largely the result of friction on an inflamed surface and therefore it becomes less acute as an exudate form and protects such an area. With localization of peritonitis, tenderness becomes limited to the region involved. (84)

Localized pain on distant pressure sometimes indicates

the seat of a circumscribed peritonitis. This sign is credited to Rovsing who explains its occurrence as the result of pressure on the inflamed surface transmitted from the hand of the examiner by way of the column of gas contained in the bowel. (14) (84) (71)

In some cases there is no tenderness when firm gentle pressure is made over the diseased area, but pain is felt when the pressure is suddenly removed. (17) (14)

Both of the last-mentioned methods of observation are more valuable in determining the presence of a local, relatively quiet focus than in making the diagnosis of an active acute process. (84) (14)

Vomiting is common at the onset of peritonitis, but is usually infrequent until late in the case. The later vomiting is usually obstructive in character. (17)

The initial vomiting is a reflex phenomenon. It is the result of the stimulation of afferent nerve endings located in the peritoneum. (87) The emetic impulse passes to the medullary center by way of sensory nerve fibers which are included in both vagel and sympathetic trunks. (85)

The combination of nausea or vomiting with abdominal pain, sometimes spoken of as peritonism, is observed in practically all cases of peritoneal irritation irrespective of the cause. In the presence of these symptoms,

the greatest alertness is demanded until the attending physician has determined the cause for their development. (71) (84)

The vomiting takes place without regard to the ingestion of food, although it is generally increased by any material taken into the stomach. (84)

At first it consists of ingested food or gastric juice, later it may become bile-stained. (86) As the peritonitis develops the character of the vomitus is likely to change with the severity and extent of the infection. The material becomes green, brown and black from regurgitation of decomposed material from the intestine. (84) In certain severe infections hemorrhage from the gastric mucosa stains the contents with partially digested blood. (89)

When the peritonitis becomes localized, vomiting usually stops. Recurrence of vomiting, like recurrent pain, means a new extension of infection. (53)

The initial vomiting is forceful, but late in the disease there is regurgitation from the dilated stomach rather than true vomiting. The dark material expelled has a disagreeable taste and odor and is extremely irritating to the mouth and skin of the face. (84) (42)

The change in facial appearance, though a guide to the experienced, is something which cannot be indicated satisfactorily in words. The white drawn face of ini-

tial collapse will tell anyone that something serious has happened, but collapse is by no means constant. In any case, the reaction from initial collapse is so rapid and complete that the facial aspect commonly becomes and remains almost normal for a time. But there is usually an indefinite yet perfectly definite aspect of countenance in many persons who may present an otherwise doubtful picture of peritonitis. (17) The Hippocratic facies present in late peritonitis is merely that of extreme collapse. (53)

The verbal picture of the disease is commonly emphasized by the patient's physical appearance. Pale features, terror-stricken eyes and cold, beaded sweat covering the brow announce to the observer that the language expresses the truth. (40)

The mental state in the beginning is usually agitated as the patient attempts to acquaint the medical adviser with the intensity of his suffering. The mind remains alert, the eyes are wide and shining even at a stage when they literally sink into their sockets. Even as death approaches and the limbs are cooled by the indescribable chill of death, beginning at the extremities and gradually approaching the trunk, the mind remains clear, unmindful or fearless of the approaching end. (43) (40)

Muscular rigidity is a common accompaniment of the early stages of peritonitis, but only when the part of peritoneum affected lies in the demonstrative area. It is best seen in perforation of a duodenal or gastric ulcer, whereby a large part of the demonstrative section of the peritoneum is irritated. (14) It is generally absent or but slightly demonstrable when the peritonitis is limited to the pelvis. (91) In those cases in which rigidity is present in the early stages the muscles relax as the peritonitis progresses, until in the final picture it is almost absent. Rigidity is also either absent or difficult to detect in fat people with flabby muscles and in old and weak patients. Rigidity may be of slight degree in some cases of pneumococcal peritonitis and in some of the slowly advancing infections due to the bacillus coli and streptococcus. (17)

These conditions of the abdominal wall represent a protective mechanism to restrict the movements of the inflamed peritoneum. Limitation of respiratory movements of the abdomen, or confining respiratory action to costal type, is a further evidence of this protective muscular rigidity. Contracture of the ileo-psoas muscle leads to flexion of the thigh. (14)

Muscle spasm and rigidity, being phenomena of reaction, depend in a degree upon the character and extent

of the infection and the resistence of the patient. At the onset the spastic contracture is usually general and equal all over the abdomen. As the inflammatory change develops the rigidity becomes most marked in the segment of the abdominal wall covering the primary focus. With localization of the peritonitis there is also localization of resistance with relaxation of the muscles over the uninvolved peritoneum. (86)

When the patient is strong and vigorous rigidity is prominent and persistent, the muscles may contract so firmly that the abdomen is board-like and retracted. This sign is especially common in the early stages of peritonitis following rupture of a peptic ulcer. When the abdominal walls are thin and flaccid, as in the cases of multiparous women, spasm of the stretched out muscles may produce so slight a degree of rigidity that it is hardly appreciable. In certain types of peritonitis, especially nonperforative varieties in which there is a slowly developing fibropurulent exudate, muscle spasm and rigidity may never be pronounced. Fulminating infections, and those associated with gangrene of the viscera, are likely to be associated with such severe toxemia that the muscular reaction is feeble or even may be abolished. (84)

Muscle spasm, is a valuable sign when it is present,

absence of rigidity must not be considered an indication that peritonitis also is absent. (14) When present the spastic contracture of muscle almost invariably persists even when the patient is anesthetized. (71)

Cutaneous hyperaesthesia is frequently seen in the subumbilical area of the abdomen in the region supplied by the tenth, eleventh and twelfth thoracic nerves. It is more frequently seen on the right side. Commonly it is limited to a narrow strip above each Poupart ligament. (53) (17)

The toxic symptoms of peritonitis are later in appearance and indicate a more serious stage of the disease. An occasional intermittence of the pulse is often one of the indications of advancing peritonitis. As the infection involves the various coils of intestine they become paralyzed and distended, while the intestinal contents stagnate and increasing obstruction results. Poisonous substances are absorbed from the stagnating contents and secondary collapse results. At this stage true obstructive vomiting is commonly a feature, and at this time will be noted the small running pulse commonly described as indicative of peritonitis. Such a pulse is felt in the ätest stages of peritonitis, and not in the earlier stages when diagnosis is so important. (17)

Change in pulse rate is a reliable sign in periton-

itis. From the onset, in most cases, the pulse rate is increased and its volume diminished. Occasionally at the onset the pulse becomes fuller, but this condition never lasts long and the pulse soon becomes the characteristic peritonitis type, that is, small, wiry, and rapid. (84)

The increase in pulse rate may develop so speedily that a progressive rise will be noted in observations repeated at ten minute intervals. At the onset, the change in rate is reflex through irritation of the vagus nerves; later, myocardial changes are produced by the action of the toxins on the heart muscle. (13)

Shock incident to the rupture of a viscus or a walled-off abscess will cause a fall in blood pressure. If the infection is a fulminating one, the low pressure will continue; but, if the patient rallies the blood pressure rises and reaches a point above the normal, where it remains during the height of the peritonitis. In twenty-three cases Crile found an average pressure of 162 at the height of the disease. The rise in blood pressure was distinct in the cases of peritonitis due to typhoid perforation. (89) The blood pressure is raised at the time of the attack in tabetic crises and in lead colic. In other forms of sudden severe abdominal pain it is lowered. (81) (84) (89)

Cyanosis may result from direct embarrassment of the heart, but usually indicates a severe toxemia. The bluish tint shows first in the finger nails. (71) Jaundice may be extensive or limited to a slight yellowing of the sclerotics. It is a sign of severe infection. (53)

Intestinal obstruction due to nervous imbalance, better known as paralytic ileus, is most often seen in peritonitis. (92) The term is badly chosen, for the intestinal wall is not paralyzed; on the contrary, its activity appears to be inhibited by an overactive sympathetic nervous system. Extreme meteorism dominates the picture and may be great enough to embarrass the respiration. On auscultation, the abdomen is relatively silent, only feeble noises being heard; usually no gurgling or splashing sounds are audible. (40)

Distention of the abdomen is due to the accumulation of gases in the bowel (meteorism), or to the presence of gases free in the peritoneal cavity (pneumoperitonuem). The flatulent distention of the bowels is a relatively late symptom resulting from changes in the intestinal wall which inhibits peristalsis. Pneumoperitoneum, on the other hand, may be among the earliest symptoms because of the escape of gas through perforation of the bowel. This is particularly likely to occur in cases of traumatic rupture of the intestine. (86)

As a rule the presence of gas free in the cavity is recognized by the general tympany with obliteration of the normal area of liver dulness. When meteorism is extensive the pressure of the distended bowels may push up and rotate the liver so that the area of dulness in front may be lost. The dulness in the mid-axillary line is very slightly diminished, as long as the gas remains in the bowel. When the liver dulness in the mid-axillary line disappears, the diagnosis of gas free in the peritoneal cavity should be made. A small collection of gas may be shown by the X-ray as bubbles in the right hypochondrium, close to the diaphragm. (84)

Hiccough may occur in place of the initial vomiting and has the same significance. Later in the disease hiccough may be caused by pressure of the distended bowels or by infection or irritation of the diaphragm. This late hiccough is a bad omen. (14) (71) (53)

Increase in the number of white blood corpuscles is common in peritonitis. The average leucocyte count is from 15,000 to 18,000, varying from 10,000 to 30,000. (73) The higher counts are more commin in hematogenous infections than in perforative peritonitis. The greatest leucocytosis seems to occur in the pneumo-peritonitis. Well marked suppurative peritonitis may exist without any accompanying leucocytosis. (84) In tuberculosis

peritonitis there may be a leukopenia, and the number may be below normal in peritonitis from perforation of a typhoid ulcer. (93) (84) In the typhoid cases however, if the patient is able to make any reaction to the infection of the peritoneum, the hourly count will show a rising leucocytosis, and of the relative proportion of polynuclear neutriphil corpuscles. The increased proportion of polynuclear cells, as shown by the differential leucocyte count has greater significance than the total increase of white cells. Interpreted with consideration of other symptoms, fluctuations in the leucocyte count, may be of some prognostic value. Like the temperature curve, that of the leucocytes generally runs parallel with the extent of infection and the reaction of the patient. As the absorption of toxins is diminished by limitation of the peritonitis, there is usually a drop in the leucocytosis with distinct improvement in the other symptoms, notably in the pulse rate. On the other hand it must be kept in mind that exhaustion of the patient's resistance may be indicated by a falling leucocytosis, and that a diminution in the number of white cells in the blood can never be considered proof that infectiousness of the exudate is at an end. (84)

Denzer describes a method for the diagnosis of peritonitis by means of abdominal puncture. A specially

constructed trocar and cannula fitted with capillary glass tubing is used for this purpose. The diagnostic puncture is made over the area of exudate, care being taken to avoid a distended bladder or one of the solid viscera. The trocar is withdrawn and the capillary tube inserted as far as it will go. Fluid rises in the glass tube at once or after a few minutes. The gross appearance of the fluid, as well as its examination by the microscope and by cultural methods gives information of diagnostic value. The method has been used only in the peritonitis of infants. (94)

The patient takes an almost characteristic attitude in bed. The knees are drawn up to fix the psoas muscles, while the respiratory movements become entirely or principally thoracic, because of the rigidity of the abdominal wall and limitation of the movements of the diaphragm. As the disease progresses the abdomen becomes distended from meteorism and other causes. The increased abdominal tension further embarrasses the action of the heart, already made weak by the action of the toxemia. As a result oxygenation of the blood becomes imperfect and more or less cyanosis develops. A cold sweat makes the skin moist and clammy to touch. (71)

The urine becomes scanty and highly colored and there may be difficulty in emptying the bladder as a

result of the action of the infectious material on the bladder wall. (53)

DIFFERENTIAL DIAGNOSIS OF PERITONITIS

It is not difficult to diagnose a flagrant case of peritonitis, for the pain, vomiting, local tenderness and muscular rigidity with fever sufficiently indicate the condition. The mistakes are likely to be made either because the symptoms are thought to be too slight, or because they are atypical. The early symptoms are slight and deceptive when the part primarily affected lies in the pelvis or in some other relatively silent area of the abdomen. They are often atypical in patients who are old, debilitated, or very fat. In the late stages of peritonitis it is frequently impossible to differentiate from intestinal obstruction, which is always a late consequence of peritonitis. Again it must be emphasized that the condition of the pulse is no true guide in diagnosing early peritonitis. (17)

The conditions simulating peritonitis are: Pleuro-pneumonia; the colics; intestinal obstruction; internal hemorrhage, and; nervous conditions such as tabes and hysteria. (53)

Abdominal symptoms may come on at any time in the course of pleuro-pneumonia, but confusion is most likely to take place when they occur at the onset of the thoracic disease. The greater relative frequency of respiration as compared with pulse rate indicates the thoracic

disease rather than peritonitis. (84) If the pain be unilateral and of abdominal origin pressure from the opposite side of the abdomen towards the affected side will cause pain, while if the pain is referred from the thorax no pain is caused by such pressure. (17) Bailey describes a test which is of value in determining whether the abdominal pain is referred or not. The patient is instructed to place his arms by his side and then to raise himself in bed by means of the abdominal muscles alone. The sign is positive when the patient fails to rise or complains of great pain in attempting to do so. (14) Normally, during inspiration, when the chest comes out the abdomen comes out. If, however, when the chest comes out the abdomen goes in, it is highly probable that a diffuse leak is present and general peritonitis is imminent. It should be remembered that the first three or four respirations must be disregarded in order to allow the patient to overcome his self-consciousness. (53) (14)

Superficial tenderness is more marked than the deep tenderness in the thoracic lesions and if this area of pain and tenderness be mapped out carefully and the patient then be directed to hold his breath, the pain and tenderness, as well as the muscle spasm, will be absent as long as the diaphragm remains quiet. (84)

In the absence of other signs of acute thoracic disease, abdominal pain associated with movements of the alae nasi during respiration indicates a thoracic and not an abdominal lesion. (17)

Colic from the passage of calculi, either renal or biliary, is usually quite distinct. Biliary colic is associated with jaundice of some degree and the pain is referred to the epigastrium and toward the right shoulder. In renal colic blood is found in the urine and the pain is referred from the loin along the course of the ureter to the external genitals. (37) (17)

The differentiation between peritonitis and intestinal obstruction, except at their onset, is usually difficult and often impossible. Laboratory examinations give little help and clinical signs are likely to be confusing. A local peritonitis by infiltration and angulation of the bowel wall can set up an obstruction. The fulminating type of peritonitis causes a paralytic distention of the intestine with stoppage of its contents. A tightly strangulated bowel will allow the passage of infectious material through its damaged wall and thus set up a peritonitis. At the onset the continuous pain of peritonitis contrasts with the paroxysms of obstruction. Muscle spasm and rigidity of the abdominal wall are prominent symptoms in peritonitis and are absent

in obstruction. Fever is more likely to be present in peritonitis and peristalsis is lessened. The development of distention in a quiet abdomen indicates peritonitis and makes a contrast to the noisy abdomen of obstruction with its visible peristalsis and palpable distended coils. The progressive rise in pulse rate is characteristic of peritonitis. The plain X-ray film will show the ladder pattern of obstructed coils of small intestine, as distinguished from the general distention of peritonitis. (84)

In intra-peritoneal hemorrhage, most frequently due to ectopic gestation in women, the history of the case, the sudden onset and the persistence of the extreme pallor and subnormal temperature without rigidity of the abdominal wall in a patient previously well, except for some slight irregularity of menstruation, seldom or never leaves room for confusion with peritonitis. (17)

The crises of Tabes are often associated with distention, muscle spasm and other symptoms of peritonitis. The characteristic changes in the pupil and in the other reflexes make the recognition of tabes definite. Similar crises resulting from other diseases of the cord are recognized by the signs of the neurological lesion. When perforative peritonitis occurs in a tabetic patient,

the disturbance of sensation produced by the spinal cord lesion influences the tenderness and abdominal pain so that these symptoms and the accompanying muscle spasm are not marked or may be absent. Distention is usually present; the fever with change in the pulse rate, and leucocytosis follow the general rule. (81) (84)

ACUTE PANCREATITIS

Acute pancreatitis accounts for less than one per cent of the cases of acute abdominal disease and must therefore be regarded as a comparatively rare disease. It must be exceptional for any one surgeon to see more than two or three dozen cases in the course of his career. (17) (56)

Of all the acute abdominal diseases this is one of the most fulminating and serious. Dieulafoy has aptly termed it "the acute pancreatic drama". It requires early recognition and prompt operative interference in order to prevent a fatal termination. It is only since the development and increased frequency of operations in the gall-bladder region that our attention has been focused upon this disease. Previous to its recognition the deaths resulting from this disease were reported as "acute indigestion" or "acute cardiac failure". (95)

It has been stated that the common failure to diagnose acute pancreatitis correctly is due to neglect to consider its possibility in the individual case, but even when the condition is thoroughly considered and discussed a mistaken diagnosis frequently results. (96) Probably less than half the cases are correctly diagnosed before operation. (97) For this reason a special

consideration of the symptoms is therefore all the more necessary.

To understand and remember the symptoms one should recollect the anatomy of the pancreas and the pathology of the disease. The gland lies in the retro-peritoneal tissues in close relationship with the coeliac plexus and the semilunar ganglia. The head of the gland is surrounded by and slightly overlaps the curve of the duodenum. The body lies in front of the first lumbar vertebra, while the tail reaches the left loin and lies against the spleen. (98) (56)

All observers agree that the parenchyma of the pancreas is markedly insensitive. As a result, abscesses and infarcts are usually painless unless the organ is rapidly distended or unless inflammation or irritation reaches nerves in the parietal peritoneum or along the arteries. Although it is usually an uncomplaining organ it responds painfully to acute injuries and particularly to that acute form of inflammation which is accompanied by fat necrosis in the adjacent tissues. (11)

There are still many points in the pathology of pancreatitis which are not settled, but there is a preponderance of evidence to show that the acute forms of inflammation are almost always due to infection which leads to severe and widespread hemorrhage into the gland,

with subsequent disorganization of its substance and liberation and activation of its ferments which attack and destroy the gland, eventually leading to gangrene. (99) (56)

Acute pancreatitis seldom occurs before the age of forty, and is more common in stout, rather obese people. Men are most frequently affected. (56) It may or may not be associated with gall-stones. (100) The blockage of the ampulla of Vater by a stone which may divert the bile along the pancreatic duct is an uncommon accompaniment of the disease. (17) (42) (100)

The symptoms of acute pancreatitis are rather variable--a fact which explains the conflicting accounts of the disease published by individual observers. The one or two pathognomonic symptoms are rarely present, and the more constant features must be carefully considered together before a diagnosis can be determined. (101)

The symptoms are due to various causes, such as inflammatory pressure, swelling of the gland, extravasation of blood and disturbed function. (56)

Usually one is able to elicit a previous history of gastro-intestinal or gall-bladder disease. Some patients volunteer the information that they are suffering from another attack of "acute indigestion", which

seems to be a little different and much more severe than the previous attacks. In some cases there is no history of any previous disease. The possibility of a previous acute attack of mumps with severe abdominal pains and vomiting might indicate that the pancreas was implicated. (102) (95)

Though there may have been slight attacks of pain prior to the main attack, the acute onset is usually dramatically sudden, and fainting may occur. The pain is excruciating and the patient will cry out in agony. It is felt in the epigastrium and in one or both loins. The position of the gland accounts for the loin-pain, and the neighborhood of the coeliac plexus explains the severity. (42) Sometimes the pain is felt in the left scapular region and occasionally in the left supra-spinous fossa (phrenic pain). (69) (85) Later on the intensity of the pain diminishes, but it may be felt over the whole abdomen or perhaps more in the right iliac fossa. (17)

Ortner sites cases in which the intense epigastric pain extended into the splenic area. Most frequent however was the radiation downwards, even reaching the genitalia or lower extremities. (5) Friedenwald and Morrison report the same findings. (69)

The pain is usually even more severe than that

found in a ruptured viscus, and causes profound shock. (22)

According to Abell the pain typically radiates from the right costal margin across the upper abdomen. (103) (19)

The pupils are usually dilated, the expression drawn and anxious. (95)

Profound shock usually accompanies the pain and is quite marked, accompanied by a weak, rapid pulse, subnormal temperature, cold and sweating skin. (56) The collapse is out of all proportion to the patient's condition. (42) The thermometer may register as low as 95 F.

With the development of peritonitis, pancreatic suppuration or thrombosis of the portal, splenic or mesenteric veins, the temperature may be of a septic type. (95)

The pulse is usually rapid and weak, but Cope sites cases in which it was slow and full even in the early stage of an attack, when other symptoms of shock were very evident. (17) The blood pressure is low. (95)

Cyanosis of the face and the extremities is frequently noted and is accompanied by dyspnea, due to the limitation of diaphragmatic movement, caused by the nearby inflammation. (56) (42) The respirations are superficial

and shallow, according to Joachin, because of the high position of the diaphragm (abdominal distention) and to the possible acidosis. (95)

Reflex vomiting or retching nearly always occurs. Sometimes the retching is incessant, but usually it is unproductive. (104) Occasionally no nausea is felt, and only rarely is the vomitus feculent. In true reflex vomiting the vomitus is never feculent. (56)

The vomiting is quite often accompanied by bleeding from the stomach due to the rupture of vessels from the retching, or from a general hemolytic condition which may develop in pancreatic disease. Occasionally a pancreatic hemorrhage empties itself into the duodenum and is expelled by a hematemesis. (105) (106)

Archibald states that constipation is the rule, due to the development of paralytic ileus.(107)

Salivation is rare, although singultus may be a prominent symptom. (95)

Local epigastric tenderness is a constant finding, and follows the course of the pancreas. (79) (42) The greatest tenderness and pain on palpation is to the left of the upper midline. (103) Mitchiner has repeatedly found tenderness in the loin posterior. (42)

Epigastric rigidity is by no means constant. It is true that soon after the onset there may be board-like

rigidity of the epigastric muscles, but when the patient is examined there is often a lax abdominal wall. (17) Of sixteen cases recorded by Waring and Griffith, thirteen had a soft abdominal wall. This point should be emphasized, since extreme muscular rigidity was at one time thought to be characteristic. (106) Ellars has found that in the few cases in which rigidity is found, it is not as great as one would expect, considering the intensity of the pain, and is more transverse across the upper abdomen. (22)

Archibald, states that the abdomen is markedly distended, with upper abdominal rigidity or a doughy sensation on palpation. (107)

No peristalsis is visible and little gurgling is discernible on auscultation with the stethoscope due to the development of a paralytic ileus. (95)

Symptoms which are usually found as a result of swelling of the pancreas whether due to inflammation or neoplastic changes are: epigastric tumor; jaundice; and obstructive vomiting.

Tumor in the epigastrium may be found, due to the swelling. In this case the tumor is transversely placed. The mass usually being quite tender. (56)

Slight jaundice is found in about one half of the cases. Since frequently, if not usually, there are no

obstructing gall-stones, the most reasonable explanation for the jaundice is that the common duct is compressed by the swollen head of the pancreas. The common duct is normally surrounded by the head of the gland in two out of three cases. (56) (17) In cases of jaundice, pruritis is usually concomitatn. (53)

Rarely will the swollen head become large enough to cause obstructive vomiting by pressure on the duodenum. (56) However, Cope sites one case in which at operation the swollen pancreatic head was definitely obstructing the duodenum. This type of vomitus must be distinguished from the more common reflex vomiting as mentioned before. (17)

Joachin, states that some observers report their ability to palpate a swollen, tender pulsating pancreas in acute hemorrhagic pancreatitis. However, this seems hardly conceivable when one reflects upon the abdominal distention, tenderness and rigidity which are usually present. It may be possible to hear an aortic bruit. The desperate condition of the patient, however, seldom permits extensive palpatory or postural manipulation. (95)

A rather rare but pathognomonic finding is discoloration in one or both loins, and is due to eccymosis or extravasation of blood from the disintegrating gland into the retroperitoneal areolar layers. (56) It be-

comes evident as a greenish-yellow or purplish stain in the loin external to the erector spinae muscle-mass. (17) It occurs, when present, only after two or three days. (56)

Robson states that hiccough is frequently present due to the irritation of the diaphragm. (108)

Glycosuria is an occasional finding but is not constant. However, when present in any case of acute abdominal pain, pancreatic disease should be thought of. (56) None of the cases sited by Abell showed sugar, although albuminuria was always present. (103)

The liberation of the pancreatic ferments leads to an increase in the amount of diastase in the blood and urine. The urine normally contains from ten to twenty units of diastase. In acute pancreatitis this may be increased to one-hundred or two-hundred units, constituting a reliable corrborative finding when laboratory facilities for its determination are available. (103) (56) (19)

Loewe's test or adrenalin mydriases is sometimes positive. The pupils should be examined before starting the test. Into one conjunctival sac instil four drops of 1:1000 solution of adrenalin hydrochloride. Wait for five minutes and then instil another four drops of the same solution. The test is read in one half hour.

Adrenaline, of course, has no effect upon the pupil of a healthy subject, but in acute pancreatitis one often gets a positive reaction, namely, dilatation of the pupil. The dilatation is not infrequently slightly eccentric, and often conspicuously oval in form. (14) The test indicates disturbance of the suprarenals by contiguous disease, and is found occasionally in acute pancreatitis. This test is often of confirmatory value. (42) (17)

The white blood cell count in Abell's series varied from 5,300 to 42,000. (103) Robson found in a series of thirty-one cases, a variation of from 5,300 to 26,000. (108) An increase in the bleeding and coagulation time is usually found. (95)

It should be remembered that in the later stages of acute pancreatitis a more general abdominal condition results. Blood-stained fluid collects in the peritoneal cavity, distension supervenes, and there may be irregular fever. (17) At coeliotomy considerable fat necrosis is found. (79) (108) It is very difficult to diagnose such cases without a very accurate previous history of the case. (17) For this reason it is very important to check the condition at onset, and then its subsequent development. (56)

The Cammidge pancreatic reaction, upon which so

much hope was placed at one time, has been permanently abandoned as unreliable. It depended upon the demonstration of a pentosazon. (95)

Fallis has made mention of the presence of a positive Cullen's sign in acute pancreatitis. Discoloration of the region of the navel indicates a positive. (109)

DIFFERENTIAL DIAGNOSIS OF PANCREATITIS

Acute pancreatitis is most commonly mistaken for perforated gastric or duodenal ulcer. The less acute cases may be misdiagnosed appendicitis, while those cases with distension may easily be regarded as examples of intestinal obstruction. Acute cholecystitis and biliary colic may also simulate the symptoms of pancreatitis. (108) (17) (56)

In perforation of a duodenal or gastric ulcer, there will generally have been premonitory symptoms pointing to the disease before the perforation actually occurs, and almost immediately an absence of liver dullness will usually be found. (110) In perforated ulcer general abdominal rigidity is constant in the early stages after perforation, while in pancreatitis the abdomen may be softer, and any rigidity is usually limited to the epigastric zone. In his original paper, Fitz very accurately wrote that the symptoms of acute pancreatitis were those of an epigastric peritonitis. In a case of perforated ulcer the symptoms are usually more widespread. Pain on top of the shoulder is frequently felt when an ulcer perforates. With pancreatitis such pain is rare, and is felt on top of the left shoulder. Bilateral lumbar pain, cyanosis, and slight jaundice would be in favor of pancreatitis, while liver

dullness in the axillary line would definitely indicate perforated ulcer. Glycosuria, a positive Loewe test, and a great increase in the diastase content of the urine would point to pancreatitis. (17) (56) (111)

Appendicitis is generally distinguishable if careful attention be paid to the history of onset and the order of symptoms. The vomiting and pain are both less severe in appendicitis, and there may be definite local symptoms as pain and rigidity in the right iliac fossa. (17) (56) (108)

With acute cholecystitis and biliary colic tenderness is felt more in the right hypochondrium. There may be a definite history of previous attacks, while hyperaesthesia to pin-stroke in the superficial distribution of the 8th or 9th thoracic nerves may point to gall-bladder trouble. The tests of glandular derangement may help to determine, but it must be remembered that cholecystitis and pancreatitis may co-exist. (17) (108) (113)

When distension has supervened it is difficult to distinguish from the late stages of peritonitis and intestinal obstruction unless positive tests of deranged gland function and a very clear history point to the correct diagnosis. (17) (113)

With every care in investigation acute pancreatitis

is frequently only diagnosed with certainty when the abdomen is opened and blood-stained fluid and areas of fat necrosis seen. (17) (108)

Attacks of angina pectoris, particularly those accompanied by acute gastric dilatation and collapse , are extremely difficult to differentiate. The short duration of the attack and the response to nitrites are important in differential diagnosis. On several occasions thrombosis of a coronary artery has simulated a hemorrhagic pancreatitis. Irregularity of the pulse, fine rales at the pulmonary bases or a pericardial friction rub are in favor of a diagnosis of coronary thrombosis. Electrocardiographic studies may be confirmatory. (95)

The condition known as dyspraxia arteriosclerotica abdominalis of Ortner, or spasm of the mesenteric arteries, may give all the signs of a pancreatitis. Here the demonstration of an arteriosclerosis and of a hyperpiesis, and the relief of the attack by nitrites and morphine should clear up the difficulty. (95)

Pancreatic calculus is not clinically distinguishable from pancreatitis, but even if it were, this would be of no practical value from the surgical standpoint, as both conditions demand prompt surgical interference. (107)

The presence of splenic enlargement and the history of an infection (typhoid) or leukemia should be looked

for in thrombosis of the splenic vein and infarcts of the spleen. This condition should also arouse the suspicion of a disturbance of the pancreas as the etiologic factor. (95) (110)

Aneurysm of the abdominal aorta, which has ruptured produces symptoms of dullness in the flanks, expansile pulsation, and rapid exitus with the accompanying picture of internal hemorrhage. (112)

In intestinal obstruction, the diagnosis may become exceedingly difficult, particularly when the obstruction is high, as in the case of a hernia in Treitz's fossa, in the foramen of Winslow or in the diaphragm. This type of obstruction is usually mechanical and differs from the paralytic type, which is more characteristic of pancreatic inflammation. An unnular inflamed pancreas may, however, obstruct the duodenum by its pressure. (107)

Hemorrhage into the left adrenal is extremely difficult to differentiate. Coeliotomy may be the only means of differentiation. Laboratory tests for diastase, lipase, and glycosuria may be of value. (95)

REGIONAL ENTERITIS

Crohn, Ginzburg, and Oppenheimer were the first to describe the symptoms in any detail, and since then, very little has been added to their findings. As the original disease was described as one involving the terminal ileum alone, it is natural that a few symptoms have since been added to the list: namely those seen when the process involves some portion of the intestinal tract other than the terminal ileum. (115)

The general symptoms which persist throughout the course of the disease are weakness, progresive loss of weight, poor appetite and fever. The temperature is usually intermittent with long periods of apyrexia being interspersed with shorter and irregular cycles of moderate temperature. Occasionally, though rarely, the temperature rises above 103 F. It is during these febrile bouts that the appetite is poorest. Some cases run the complete course without fever. Pemberton and Brown point out that there is usually a history of early exacerbations and remissions. (116)

The original authors divided the disease into four clinical phases, each of which presents its own symptoms. (114) (115) (116)

The acute stage presents signs of acute intra-abdominal inflammation and is impossible to distinguish

clinically from acute appendicitis. The most constant symptoms here are generalized colic, pain and tenderness in the right lower quadrant, and fever to 101 or 102 F. In addition there may be nausea or vomiting or both and diarrhea or constipation. These symptoms develop somewhat slower than in acute appendicitis, an observation which has been substantiated by many investigators in more recent years. (115)

The second phase, that with symptoms of ulcerative enteritis, is characterized by colicky periumbilical or lower abdominal pain, tendency toward loosness of the bowels, constant fever, and loss of weight. This stage may be the first to manifest. (115) (114)

Pain, one of the most constant features of the disease may be located in any part of the abdomen but is usually periumbilical or right sided and is colicky in nature. Brown, Bargen, and Weber found that most patients described it as "cramp-like", while others described it as "colicky","Knife-like", "gripping", "obstructive", "sickening", or "to-and-fro colic". (117) Sproull found that while the severity of the pain usually varies with the degree of involvement of the intestine, some patients present few or mild symptoms even though there is severe intestinal involvement. (118) Jellen in reviewing fifty cases seen at

the Mount Sinai Hospital of New York City, found that 66% complained of pain as the first symptom while the remaining 34% complained of diarrhea. (119)

Diarrhea is usually an outstanding feature of the disease. The number of movements and intensity of the actions never approach those of a true colitis. The average patient has two to four loose or semi-solid defecations daily. The stools are rarely mushy or liquid and generally contain free pus, coagulated lumps of mucus, and occult blood or streaks of free blood. There is no gross melena and tenesmus is always lacking. (53) Forbes and Duncan describe a case with painful defecation as a symptom, but as this patient had recently had an abcess anterior to the rectum drained, this symptom can be eliminated as being a symptom of regional ileitis. Although diarrhea is usually constant throughout this stage, Brown, Bargen, and Weber found that it is occasionally intermittent and may even alternate with short periods of constipation. (120) (117) Regional enteritis does not show the common complications of true colitis: perianal fistulas, condylomas, a perianal abcesses.

The fever in this stage rarely rises above 100 F. but has been known to go as high as 104 F. (117)

In most instances the fever is constant but may be intermittent. (53)

Loss of weight and strength is a fairly constant symptom and shows a wide variation in degree. Even with marked loss of weight, disturbances in general nutrition may be slight. This may continue over a year or more until exhaustion sets in as the case reported by Abercrombie, but this stage more commonly passes on into the stenotic phase before this can happen. (121)

Anemia is another feature often encountered in this stage as well as the following one. This is secondary to the loss of blood in the stool and varies greatly in intensity: many cases being so mild as to pass unobserved while other cases are very severe. (115)

The third or stenotic phase is the one most commonly encountered and occasionaly occurs as a primary manifestation. The symptoms of this stage are those of subacute or small intestinal obstruction of varying severity. It is characterized by violent cramps which are most severe when there is visible peristalsis, borborygmus, and occasional attacks of vomiting and constipation. The vomiting is never marked or persistent and is usually accompanied by abdominal pain and visible peristalsis. The pain often

accompanies or is followed and relieved by defecation. It is most commonly seen in the right lower quadrant, but may be referred across the entire lower abdomen. Visible peristalsis and intestinal erection are common. An abdominal mass may also be noticed by the patient as is brought out by Ravdin and Rhodes. (122) Brown, Bargen, and Weber found the pain to be localized about the umbilicus in cases of jejunal involvement. The pain is often increased by the ingestion of food and is frequently relieved by vomiting or bowel movement, either normal or by means of enema. They also found that the vomiting is not that of complete obstruction, but only part of the food and drink taken is lost. (117)

The fourth stage, that of fistula formation, is closely connected with the preceding phase and the two are usually present at the same time. Fistulas usually lead to the colon or sigmoid and such cases frequently give rise to symptoms of colitis, thus masking the true nature of the disease. With fistula formation between the ileum and sigmoid, the pain is mainly localized in the left lower quadrant. (117) Pollock, observed that with internal fistula, the pain frequently radiates to the point of the fistula. (123) Forbes and Duncan report two cases with entero-

vesicle fistula in which symptoms of cystitis developed and gas and fecal material was passed by urethra.(120)

External fistula are frequently encountered and are the result of previous drainage operations or appendectomies. They may persist from the time of the original operation or may not develop for several months, the wound meanwhile having healed and having remained healed for a few months. (120) Harris, Bell, and Brunn state that the appearance of a persistent fistula in the abdominal wall following the removal of a supposedly acute appendix which turns out to be innocent is practically diagnostic of regional enteritis. These authors also state that these fistulae not only resist simple surgical closure, but never close spontaneously and therefore are different from simple appendiceal fistulae. (124) Pollock, found that debility is most marked in the presence of a chronic fecal fistulae. (123)

Halligan and Halligan report a case in which acute free perforation was the first symptom to appear. (125)

DIFFERENTIAL DIAGNOSIS

Although preoperative diagnosis of regional enteritis is very difficult to make, it is being made more and more frequently, particularly by those who encounter the condition relatively often.

The disease must be differentiated from conditions which produce a mass in the right iliac region with fever and diarrhea. The acute stage closely simulates acute appendicitis, and although Crohn, Genzburg, and Oppenheimer observed that the symptoms usually come on more gradually than in appendicitis, differentiation is practically impossible except at the operating table. (115) Brown, Bargen, and Weber found this stage to resemble intussusception or diseased Meckel's diverticulum in some cases; heretoo diagnosis can be made only by exploration. (117)

Non-specific ulcerative colitis is another condition frequently confused with regional enteritis. Here differentiation can usually be made by sigmoidoscopy and the barium enema. (53) Jellen found differentiation to be difficult only when there is an ulcerative colitis involving the proximal colon and terminal ileum, a condition in which accurate preoperative diagnosis is sometimes impossible. If the terminal ileum shows evidence of ulceration without

stenosis, differentiation can be made with some degree of assurance, because whenever regional ileitis is associated with colitis, the process in the terminal ileum is usually far advanced and shows evidence of considerable stenosis. The converse of this, however, does not hold always, and roentgen evidence of what appears to be a stenotic ileum does not exclude proximal colitis with involvement of the terminal ileum. (119) Crohn, Ginzburg, and Oppenheimer stated that colitis is never associated with fistula formation except about the rectum and anus and that there is seldom a palpable mass with this condition. (115) Bissell pointed out that regional enteritis is never associated with the common complication of colitis: namely perirectal abcesses, condylomas, or perianal fistulae. (126)

Intestinal tuberculosis is another condition frequently confused with regional enteritis. Jellen made a review of the literature on intestinal tuberculosis and was able to find several points of value in making differential diagnosis. Ulcerative intestinal tuberculosis is usually secondary to pulmonary tuberculosis and is relatively common. The hyperplastic type may be found in the absence of pulmonary lesions and is very rare. (119)

Rockey states that there were only nine cases of hyperplastic tuberculosis of the terminal ileum reported in the literature up to 1933. (127)

Moschcowitz and Wilensky pointed out the similarity in pathology between non-specific granulomas and of the intestine and primary hyperplastic intestinal tuberculosis and stated that "many if not the majority of the cases of so-called hyperplastic tuberculosis of the colon are really simple granulomata." The demonstration of tubercle bacilli in the lesion is the only way to make positive diagnosis of tuberculous enteritis. (128)

Stierlin first pointed out the absence of normal barium shadow in the proximal colon in ileocecal tuberculosis. This sign is of value in making diagnosis, but it must be kept in mind that this sign may appear with any ulcerating lesion of the ileocecal region. (129)

One of the most valuable diagnostic points between intestinal tuberculosis and regional enteritis is the roentgenologic demonstration of evidence of spasm as commonly seen in tuberculosis. (72)

Lymphosarcoma and Hodgkin's disease may give rise to a characteristic monocytic blood picture or enlargement of the regional lymph nodes may reveal

the true nature of the disease. (53)

Mesenteric tuberculosis is differentiated only at operation. (115)

Actinomycosis should be considered in every case with persistent abdominal fistula. Diagnosis of this condition is made on demonstration of sulphur granules in the discharge. (71)

Amebiasis rarely involves the small intestine but may simulate regional enteritis of the large bowel. The diagnosis of amebiasis rests on the demonstration of amebae or cysts in the feces. (73)

Carcinoma can not be preoperatively diagnosed from regional enteritis, and in some instances can be differentiated only by microscopic examination. Sproull describes a case in which an operative diagnosis of inoperable carcinoma was made, thus illustrating the difficulty sometimes encountered in making diagnosis. (118)

BIBLIOGRAPHY

1. MORLEY, JOHN: Abdominal pain, New York, William Wood and Company, 1931.

2. MAYLARD, A.E.: Abdominal pain, its causes and clinical significance, Philadelphia, P.Blakiston's Son & Company, 1905.

3. POTTENGER, FRANCIS M.: Symptoms of visceral disease, a study of the vegetative nervous system in its relationship to clinical medicine, Ed. 3rd, St. Louis, C.V.Mosby and Company, 1925.

4. BEHAN, RICHARD J.: Pain, its origin, conduction, perception and diagnostic significance, New York, D. Appleton and Company, 1914.

5. ORTNER, NORBERT.: Abdominal pain, New York, Rebman Company, 1922.

6. AREY, LESLIE.: A laboratory manual and textbook of embryology, Ed. 3rd, Philadelphia, W.B.Saunders Company, 1920.

7. ELIASON, E.L.: Early diagnosis in abdominal surgery, Am. J. Surg., 31:275, 1936.

8. GRIFFITH, F.P.: The significance of abdominal pain and tenderness, Penn. M. J., 41:376-382, February 1938.

9. FRANK, R.T.: Early diagnosis of acute abdominal conditions, Surg. Clin. North America, 15:361, 1935.

10. FRIEDENWALD, J., and MORRISON, S.: Clinical significance of abdominal pain, Int. Clin., 2:76, 1937.

11. ALVAREZ, W.C.: Abdominal pain, J.A.M.A., 102:1351, 1934.

12. HORSLEY, J.S., HORSLEY, J.S.Jr., and HORSLEY, G.W.: Appendicitis; its diagnosis and improved methods of treatment, Virginia M. Monthly, 65:207-213, April 1938.

13. BATTLE, W.H.: Clinical lectures on the acute abdomen, New York, William Wood and Company, 1911.

14. BAILEY, HAMILTON: Demonstrations of physical signs in clinical surgery, Ed. 6, Baltimore, William Wood and Company, 1937.

15. BLACHLEY, T.W.: Appendicitis causing genito-urinary symptoms, Urol. & Cutan. Rev. 42:36-37, January 1938.

16. HUGHSON, WALTER: Sited by article by Horsley (12)

17. COPE, ZACHARY: The early diagnosis of the acute abdomen, Ed. 7, London and Edinburgh, Humphrey Milford Oxford University Press, 1935.

18. ELLARS, L.Ray: The practical diagnosis and treatment of the acute abdomen, Kentucky Med. Jour., 36:303, August 1938.

19. ABELL, IRVIN: Acute abdominal emergencies, Southern Medical Journal, 31:39, January 1938.

20. BRENNEMANN, JOSEPH: Acute abdominal conditions in children, Colorado Med., 32:14, January 1935.

21. KELLEY, HOWARD A., and HURDON, E.: The vermiform appendix and its diseases, Philadelphia, W.B. Saunders and Company, 1905.

22. ELLARS, L. RAY.: The practical diagnosis and Treatment of the acute abdomen, Kentucky Medical Jour., 36:303, August 1938.

23. DODD, H.: Clinical picture of acute appendicitis, Practitioner, 140:77-92, January 1938.

24. COLLINS, D.C.: Acute retrocecal appendicitis, Arch. Surg., 36:729-734, May 1938.

25. HICKEN, N. FREDRICH: Personal communication.

26. ROBERTSON, GEORGE,: Personal communication.

27. OCHSNER, ALTON, and MURRAY, SAMUEL D.: Pitfalls in the diagnosis of acute abdominal conditions, Am. Jour. Surg., 41:343, August 1938.

28. BRUNN, HAROLD: Acute pelvic appendicitis, Surg., Gynec. & Obst., 63:583, November 1936.

29. ALTSCHULER, E.: Sign for retrocecal appendicitis, Lancet, 1:892-893, April 1938.

30. MALE, LINDSAY: Recurrent abdominal pain in childhood, Medical Jour. of Australia, 1:782, May 22, 1937.

31. BARRINGTON-WARD, LANCELOT E.: Diagnosis and treatment of acute abdominal conditions in children, Edinburgh Med. Jour., 43:25, March 1936.

32. FARR, CHARLES E.: The acute abdomen in infancy and childhood, Surg. Clinics. of North America., 15:329, April 1935.

33. JOHNSTON, LOYD B.: The diagnosis and surgical treatment of abdominal surgical conditions in young infants, Ohio State Med. Jour., 33:737, July 1937.

34. FRASER, K.B.: Abdominal pain, Medical Jour. of Australia, 1:280, February 20, 1937.

35. OCHSNER, A.J.: A handbook of appendicitis, Chicago, G.P. Engelhard and Company, 1902.

36. STRUMPELL, A., and SEYFARTH, A.: Practice of medicine, Vol. 1, London, W.B.Saunders and Company, 1931.

37. SMITH, J.H.: Diagnosis of cholecystitis, Virg. M. Monthly, 55:40-43, April 1928.

38. STOUT, B.M.: Gallbladder disease, West Virginia M. J., 33:23-25, January 1937.

39. PHILLIPS, JOHN: Diseases of the liver and biliary tract, New York, Oxford University Press, 1936.

40. CHRISTOPHER, FREDRICH: A textbook of surgery by american authors, Philadelphia, W.B.Saunders and Company, 1937.

41. HAGGARD, WILLIAM D.: Lesions of the right upper quadrant, the area of romance, Virginia Med. Monthly, 63:589, January 1937.

42. MITCHINER, PHILIP H.: The problem of the acute abdomen, Practitioner, 140:363-372, April 1938.

43. CECIL, RUSSEL L.: A textbook of medicine by american authors, Philadelphia, W.B.Saunders and Company, 1937.

44. MILLER, T.G.: Diagnosis and management of cholecystitis, Delaware State M. J., 9:35-42, March 1937.

45. REHFUSS, M.E.: Gallbladder and the general practitioner, J. M. Soc. N. J., 34:95-100, February 1937.

46. MACCARTY, W.C.: Gallbladder and its diseases, Proc. Staff Meet., Mayo Clinic, 11:805, Dec. 16, 1936.

47. WARREN, R.: Diagnosis and treatment of cholecystitis, Clin. J., 66:191-194, May 1937.

48. BEHREND, M: Symptoms and treatment of acute inflammation, M. Rec., 147:500-504, June 1, 1938.

49. BARKSDALE, G.H.: Diagnosis of cholecystitis, West Virginia M. J., 24:223-227, May 1928.

50. HANCOCK, J.D.: Diagnosis and management of acute disease, South. Surg, 7:121-124, April 1938.

51. HEINECK, A.P.: Surgical indications, Am. Med., 23:122, Febr 1928.

52. GRAHAM, EVARTS A.: Diseases of the gallbladder, Philadelphia, Lea and Febiger, 1928.

53. FRENCH; Index of differential diagnosis, Ed. 4, New York, William Wood and Company, 1936.

54. IMMERMAN, S.L.: Early symptoms of cholecystitis, M. J. & Rec., 127:266-268, March 7, 1928.

55. BOWER, JOHN O.: When is an acute abdomen not an acute surgical abdomen? Penn. Med. Jour., 41:792, June 1938.

56. SOHMER, A.E.: Acute conditions in the abdomen, Minn. Med., 20:597, September 1937.

57. LICK, MAXWELL: Differential diagnosis in acute abdominal tragedies, Minn. Med., 20:351, June 1937.

58. BOLAND, FRANK K.: The interpretation of abdominal pain, South. Med. Jour., 28:133, February 1935.

59. MCLAUGHLIN, C.W.: Personal communication.

60. DOUGLAS, RICHARD: Surgical diseases of the abdomen with reference to diagnosis, Philadelphia, P.Blakiston's Son and Company, 1903.

61. MACKENZIE, JAMES: Symptoms and their interpretation, Ed. 4th, London, Shaw and Sons, 1920.

62. MORISON, RUTHERFORD: Abdominal and pelvic surgery for practitioners, London, Oxford University press, 1925.

63. PEMBERTON, CHRISTOPHER R.: Practical treatise on various diseases of abdominal viscera, Ed. 1, Worcester, G.A.Trumbull, 1815.

64. RIGNEY, L.J., MORTENSEN, W.L., and MILLER, T.G.: Diagnostic value of duodenal drainage and cholecystography, Am. J. Digest. Dis., 5:1-4, March 1938.

65. DORAN, W.T., FORSTER, J.W., and SPIER, L.C.B.: Value of diagnostic non-surgical biliary drainage as compared with cholecystography, Am. J. Digest. Dis. & Nutrition, 4:821-823, February 1938.

66. HODGES, F.J., and LAMPE, I.: Comparison of Cholecystographic findings and proved evidences, Am. J. Roentgenol., 37:145-153, February 1937.

67. ANDRAL, T.:Diseases of the abdomen, Philadelphia, P.Blakiston's, 1893.

68. ELMAN, R.: Acute non-hemorrhagic pancreatitis, Am. J. Digest. Dis. & Nutrition, 4:723-736, January 1938.

69. FRIEDENWALD, J., and MORRISON, S.: Gastro-intestinal disturbances associated with endocrinopathies, Endocrinology, 17:393-413, July-August 1933.

70. OCHSNER, A.J.: Editorial, Surg., 1:633, 1937.

71. CABOT, R.C.: Differential diagnosis, Ed. 2, Philadelphia, W.B.Saunders and Company, 2:449, 1918.

72. FEASTER, O.O.: The roentgenologist as a consultant in acute abdominal conditions, Jour. of Florida Med. Ass., 21:143, October 1934.

73. OSGOOD, EDWIN E., and HASKINS, HOWARD D.: A textbook of laboratory diagnosis, Philadelphia, P.Blakeston's Sons and Company, 1931.

74. DAVIDSON, MAURICE.: The diagnosis and treatment of pain referred to the abdomen from the thoracic organs, Practitioner, 140:126-134, February 1938.

75. BERTUCCI, J.P.: Gastro-intestinal syndrome in coronary disease, Mich. State Med. Soc. Jour., 35:506, August 1936.

76. LEWIS, T.: Diseases of the heart, Ed.2, London, Shaw and Sons Ltd., 1937.

77. SNELL, A.M.: The diagnosis of common causes of jaundice, Canadian M. J., 37:319-327, 1937.

78. FOOTE, F.S.; and CARR, J.L.: Obstructive jaundice, the differential diagnosis by Roentgen-ray, Surg., Gynec. & Obst., 63:570-575, 1936.

79. BLALOCK, W.: Clinical study of biliary tract disease, J.A.M.A., 83:2057, 1924.

80. LYON, B.B.V.: Diagnosis and treatment of disease of the gallbladder and biliary ducts, J.A.M.A., 73:980, 1919.

81. WECHSLER, ISRAEL S.: A textbook of clinical neurology, Ed. 3, Philadelphia, W.B.Saunders and Company, 1937.

82. GRAHAM, E.A.: Hepatitis a constant accompaniment of cholecystitis, Surg., Gynec. & Obst., 26:521, 1918.

83. MACCARTNEY, J.E., and FRASER, J.: Pneumococcal peritonitis, Brit. J. Surg., 9:479-489, April 1922.

84. MCGLANNAN, ALEXIUS: Acute and chronic peritonitis and tumors of the peritoneum, Tice Practice of Medicine, Vol. VII, Chap. XXXIV, 1938.

85. ALVAREZ, W.C.: Abdominal pain, paths in which it travels in which these may be blocked, Am. Jour. Surg., 14:385, 1931.

86. MELENEY, HARVEY, and JERN: Peritonitis, Arch. Surg., 22:1, January 1931.

87. HERTZLER, A.E.: The peritoneum, St. Louis, C.V.Mosby and Company, 1919.

88. FULMER, S.C., and KILBURY, M.J.: Peritonitis, J.A.M.A., 89:1661-1662, November 12, 1927.

89. CRILE, G.W.: Treatment of Peritonitis, J.A.M.A., 73:1655, 1919.

90. SYMS, P.: Pneumoccus peritonitis, Ann. Surg., 67:263, 1918.

91. WALSCHEID, ARTHUR J.: Abdomino-pelvic diagnosis in women, St. Louis, C.V.Mosby, 1931.

92. PORTER, M.F.: Chronic peritonitis with complete obstruction, J.A.M.A., 51:719, 1908.

93. STEIN, A.: Oxygen inflations of peritoneal cavity in tuberculous exudate peritonitis, J.A.M.A., 78:718, 1922.

94. DENZER, G.S.: Diagnosis of peritonitis and peritoneal transudates in infants by means of abdominal puncture with capillary tube, Am. J. M. Sc., 163:237, 1922.

95. JOACHIN, HENRY: Diseases of the pancreas, Tice Practice of Medicine, Vol. VII, Pages 29-58, 1937.

96. TRASOFF, ABRAHAM, and SCARF,Maxwell: Acute pancreatitis, Am. J. M. Sc., 194:470-474, 1937.

97. WHIPPLE, G.H., and GOODPASTURE, E.W.: Acute hemorrhagic pancreatitis, Surg., Gynec. & Obst., 17:541-547, 1913.

98. PIERSOL, GEORGE A.: Human anatomy, Ed. 8, Montreal, J.B.Lippincott and Company, 1923.

99. BOYD, WILLIAM, A textbook of pathology, Philadelphia, Lea and Febiger, 1935.

100. MANN, F.C.; and GIORDANO, A.S.: The bile factor in pancreatitis, Arch. Surg., 6:1-30, 1923.

101. HENDERSON, F.F.; and KING, E.S.A.: Acute pancreatitis, Arch. Surg., 30:1049-1057, 1935.

102. FARNAM, LOUISE W.: Pancreatitis following mumps, Am. J. M. Sc., 163:859-870, 1922.

103. ABELL, IRVIN: Acute abdominal catastrophes, J.A.M.A., 109:1241, October 16, 1937.

104. ABELL, IRVIN: Acute pancreatitis, Surg., Gynec. & Obst., 66:438-453, 1938.

105. KOSTER, H., and KASMAN, L.P.: Acute pancreatitis, Arch. Surg., 29:1014-1023, 1934.

106. MCCARTNEY, J.E., and FRASER, JOHN: Peritonitis, Brit. Jour. Surg., 9:479, 1922.

107. ARCHIBALD, E.: Diseases of the pancreas, Nelson's loose leaf Medicine,

108. ROBSON, A.W., and MOYNIHAN, B.G.A.: Diseases of the pancreas and their surgical treatment, Philadelphia, W.B.Saunders and Company, 1902.

109. FALLIS, L.S.: Cullen's sign in acute pancreatitis, Ann. Surg., 106:54-57, 1937.

110. OPIE, E.L.: Disease of the pancreas and its cause and nature, Philadelphia, J.B.Lippincott and Company, 1903.

112. EINHORN, MAX: A clinical contribution to pancreatitis, J.A.M.A., 65:149, 1915.

113. COLE, W.H.: Acute pancreatitis with special reference to diagnostic value of amylase test, Am. J. Surg., 40:245-259, April 1938.

114. CROHN, BURRIL B.: The broadening conception of regional ileitis, Am. J. Digest. Dis. & Nutrition, 1:97-99, 1934.

115. CROHN, B., GINZBURG, LEAN, and OPPENHEIMER, G.D.: Regional Ileitis, J.A.M.A., 99:1323-1328, 1932.

116. PEMBERTON, J.de J., and BROWN, P.W.: Regional ileitis, Ann. Surg., 105:855-882, 1937.

117. BROWN, PHILIP W., BARGEN, J.ARNOLD., and WEBER, HARRY M.: Chronic inflammatory lesions of the small intestines, Am. J. Digest. Dis. & Nutrition, 1:426-431, 1934.

118. SPOULL, JOHN: A review of some features of regional ileitis, Am. J. Roentgenol., 36:910-920, 1936.

119. JELLEN, JOSEPH: Regional ileitis with report of two cases, Indust. Med., 6:67-70, 1937.

120. FORBES, R.D., and DUNCAN, J.: Regional ileitis and allied conditions, with case reports, West. J. Surg., 1455:362-367, 1937.

121. ABERCROMBIE, JOHN: Pathological and practical researches on diseases of the stomach, the intestinal canal, the liver, and other viscera of the abdomen, Philadelphia, Carey and Lea, 1830.

122. RAVDIN, ISIDOR S., and RHOADS, JONATHAN: Regional ileitis and fibroplastic appendicitis, Ann. Surg., 106:394-406, 1937.

123. POLLOCK, LEO H.: Regional enteritis, J. Missouri State Med. Ass., 34:109-114, 1937.

124. HARRIS, FRANKLIN; BELL, GLENN; and BRUNN, HAROLD: Regional ileitis. A new surgical entity, Surg., Gynec. & Obst., 57:637-645, 1933.

125. HALLIGAN, EARL; and HALLIGAN, HAROLD: Acute free perforation as first sign of regional enteritis, Am. J. Surg., 37:493-497, 1937.

126. BISSELL, ARTHUR D.: Localized chronic ulceration ileitis, Ann. Surg., 99:957-966, 1934.

127. ROCKEY, E.W.: Thickening of the terminal ileum with mesenteric adenitis in children, Northwest Med., 32:145-147, 1933.

128. MOSCHCOWITZ, ELI; and WILENSKY, ABRAHAM O.: Non-specific granulomata of the intestine, Am. J. M. Sc., 166:48-66, 1923.

129. STIERLIN, EDWARD: Die Radographie in der Diagnostik der Ileozoehaltuberkulose und anderer Krankheiten des Dickarms, Munchen med. Wchnschr., 58:1231-1235, (quoted from Crohn, Ginzburg, and Oppenheimer).