

value in determining any of the features of visceral lesions.

Tenderness, on the other hand, is of great value, and as a rule is felt only in the region injured, and is thus often an accurate guide to the location of the intra-abdominal trouble.

With injuries of the *liver* there is a history of wound or contusion in the region of the liver, followed by the local and general symptoms of hemorrhage.

With injuries of the *spleen* there is a history of wound or contusion in the region of the spleen, followed by the local and general symptoms of hemorrhage.

With injuries of the *stomach* there is a history of wound or contusion in the region of the stomach, or of the ingestion of a foreign body, followed by loss of liver dullness, by hæmatemesis, by peritonitis.

With injuries of the *intestine* there is a history of a wound or contusion of the abdomen followed by loss of liver dullness, by bloody stools, in some cases, and by peritonitis.

With injuries of the *kidney* there is a history of a wound or contusion in the region of the kidney, followed by evacuation of bloody urine, probably by tumefaction in the loin, and very often by the symptoms of suppurative nephritis and perirenal cellulitis.

With injuries of the *bladder* there is a history of a wound or contusion in the region of this organ. The symptoms and the conditions observed are the following: The bladder is very often, although not always, empty, and this condition is associated with apparent suppression of urine, with tenesmus, with evacuation of small amounts of blood through the catheter, with nondistensibility of the bladder by means of injections or with the return of smaller volumes than those injected, and, finally, with perivesical cellulitis or with peritonitis.

With injuries of the *mesentery* there is a history of a wound or contusion of the central region of the abdomen, followed by the local and general symptoms of hemorrhage or of intestinal obstruction and peritonitis.

With injury of any of the good-sized vessels of the abdomen there are the symptoms of hemorrhage.

DIAGNOSIS.

In most instances it is practically impossible to make a correct diagnosis of the viscera injured, and of the extent of the lesions present in consequence of injuries of the abdomen. It comparatively rarely happens that such injuries are confined to single viscera, and in the combination of symptoms that regularly ensue, some are overshadowed by others. This fact, together with the unreliability of many of the symptoms which should be pathognomonic of special injuries, renders the diagnosis always one of probability. Nevertheless, in a considerable number of cases the lesions probably present may be estimated with a fair degree of accuracy, and in a small number the diagnosis may be made with certainty; but it should be emphasized that this number is small, and that in these particular cases the injuries present are relatively slight. All the factors possible must be duly considered: the character of the violence; its degree and the particular region which it affects; the viscera present in this region and their condition at the time of injury; and both the immediate and the later symptoms produced. To all of these features proper value must be assigned before the final conclusion can safely be formulated.

PROGNOSIS AND COMPLICATIONS.

For the same reasons any statement in regard to the prognosis of abdominal injuries must be made with great caution. It may be said, however, that of those cases that recover after abdominal injuries, there are some in which the recovery is complete, and others in which it is incomplete (through the persistence of fistulæ or of peritoneal adhesions, or through the development of herniæ).

Of the complications of abdominal injuries, hemorrhage

is perhaps the most important. It may accompany almost any of the visceral injuries.

Peritonitis is an almost equally grave complication. It is particularly apt to accompany injuries of the gastrointestinal tract, the bladder, and the biliary ducts.

Later complications, as mentioned under prognosis, are: fistulæ communicating with the alimentary canal, the biliary passages, and the kidney; adhesions which possibly give rise to functional disturbances of the viscera and especially to intestinal obstruction; herniæ due to yielding of cicatrices of the abdominal wall; and, finally, the protrusion of one or other or several of the abdominal organs.

TREATMENT.

The treatment of patients suffering from the results of abdominal injuries is of a twofold character: it comprises the treatment of the general symptoms—those of shock, hemorrhage, or peritonitis—and the treatment of the local lesions present.

So far as the treatment of shock is concerned, the patient should be placed in bed and the foot of the bed should be elevated. He should be warmly covered, and artificial heat should be applied externally by hot bottles, etc. Heart action is to be stimulated by the application of heat or mustard paste over the precordium, by subcutaneous injections of strychnine, of morphine, of atropine, or of whiskey, and by enemata of hot water, fluid extract of coffee, and whiskey. In many cases, and in those particularly in which the symptoms are due to hemorrhage, the infusion of the patient with from forty to sixty ounces of normal salt solution is of the greatest possible service; but it should be borne in mind that the effect of the infusion will subside in about four hours, and that then the injection may have to be repeated.

All that it is necessary to say in this place in regard to the treatment of peritonitis has reference to its prevention, and this end is best served by the rigid observance of the rules which have been formulated for the aseptic or antiseptic treatment of wounds.

In the case of a wound of the abdominal wall, whether penetrating or not, the object of the local treatment is to secure union in the shortest time possible and in such a way that hernial protrusions are least likely to occur. For this purpose surgeons are fairly agreed that suturing must be done in layers, that is, that identical structures in each margin of the wound are to be united again; further, that such union is best accomplished by buried absorbable suture material, namely, catgut. But since catgut is absorbed within a few days, some other more enduring suture material must be used to preserve the apposition and beginning union, started between structures brought together by catgut. For this purpose, then, it is conventional to use deep sutures, embracing all the layers except the peritoneum, composed of silk, of silk-worm gut, or of silver wire. Finally, accurate union along the skin incision is obtained by a continuous suture of fine silk.

For *subcutaneous injuries* of the abdominal wall in which no rupture of muscle occurs, no special treatment is required beyond promoting the disappearance of extravasated blood by massage or aspiration.

When rupture of muscle occurs the overlying skin is to be incised and the injury treated as a wound by successive tiers of sutures.

When injury of one or of several of the abdominal viscera is certain or seems probable, no delay in instituting active treatment is permissible. It is far and away the better scheme to make explorative incisions through the abdominal wall, to render the diagnosis certain, than to subject the patient to the dangers of peritonitis or fatal exsanguination by waiting for a confirmation of the diagnosis of some doubtful or probable lesion by the development of positive symptoms. Many patients have without doubt been saved in consequence of this practice, and it is equally evident that many have been lost through hesitation in carrying out this scheme. There is little or no risk involved in the simple incision itself.

But no operative procedure may be undertaken in states of profound shock or in cases in which the injuries are so extensive or so complicated as to make their treatment practically impossible; nor should interference be resorted to in the presence of well-marked peritonitis. On the other hand, in the presence of a beginning peritonitis there still remains some possibility of success.

If decided shock is present, energetic measures for its relief are called for, and only when the patient has begun to rally, that is, when the pulse becomes slower and stronger and the temperature begins to approach normal, may an operation be contemplated. The exception to this rule is met with in those cases in which the symptoms of apparent shock are due to hemorrhage. In such cases no substantial improvement is likely to result from stimulation, and the patient's best if not only hope lies in immediate intervention, during which active stimulation should be carried on.

For the treatment of any visceral lesion that is a consequence of a non-penetrating injury of the abdomen it is necessary to incise the abdominal wall, the position, direction, and extent of the incision being determined by the viscus to be reached.

To expose the liver and biliary ducts, an oblique incision parallel with the free border of the ribs, with its centre about opposite the tenth cartilage, is conventional, while a similar incision on the left side exposes the stomach. But for either purpose a vertical incision through the outer part of the rectus downward, for variable distances from the free border of the ribs, serves equally well, and has the advantage that on the right side the kidney may be explored and attacked through it, while on the left side the spleen may also, if necessary, be reached.

To expose the kidney by the transperitoneal route, the incision just described is the best; but for general purposes the König incision of the loin is much to be preferred in every way, since in itself it is extraperitoneal, but at the same time it allows the peritoneal cavity to be entered very readily by extending the incision forward but a short distance.

For the purpose of reaching the bladder an incision carried upward from the symphysis between the rectus muscles for the necessary distance, with the patient in the Trendelenburg position, exposes this organ perfectly; and, in order still further to enlarge the working space, the insertions of the recti into the symphysis may be divided for a short distance. Then, by the aid of retractors placed so as to draw the margins of the wound apart, one may obtain a perfect view of the bladder, and ample room may be gained for any suturing operation.

To gain access to the intestine and mesentery a median incision through the linea alba, of variable length and carried around the left side of the umbilicus, will answer the purpose best. In this way the small intestine and mesentery, the rectum, and the sigmoid flexure may readily be reached, and by use of vigorous retraction the rest of the colon may be exposed, as well as the first and second parts of the duodenum.

In making incisions through the abdominal wall, no time should be lost in using a director. The incision should be rapidly carried through the skin, the superficial and deep layers of fascia, and the muscles—clamps being applied to all bleeding points—until the transversalis fascia is reached. This is to be nicked with the knife and then divided along the length of the wound by scissors, thus exposing the peritoneum. The latter in turn is then to be pinched up by two pairs of forceps, a nick is to be made between them, and the membrane is then to be divided by scissors on a finger thrust beneath it through the small primary opening. It is optional whether bleeding points are to be tied before entering the cavity or whether clamps are to be left *in situ*.

In the operative treatment of *penetrating wounds* of the abdominal wall it is best to enlarge the wound of entrance with the same precautions that are usually observed in formally opening the abdomen. Having done so, one should inspect the subjacent viscera, and then upon ascertaining the extent and character of the lesions

to be treated, should, if necessary, make additional incisions through the abdominal wall in one or other of the positions, and in the manner just described, or the wound should be still further enlarged. The treatment of the injuries of different viscera has been referred to under the description of their lesions.

Here it is proper to indicate the method of caring for prolapse of viscera, and for blood and foreign material which may be present in the peritoneal cavity.

Almost any of the viscera, whether injured or not, may prolapse through wounds of the abdominal wall, and then be injured, or infected, or become strangulated; and the procedure to be adopted depends upon which of these events has occurred.

In general terms, for purposes of treatment, it is always to be assumed that prolapsed viscera are infected; and whether a given viscus is to be returned or not will be decided by the possibility of rendering it practically aseptic or not, of repairing injuries present in it, or of restoring its circulation.

Prolapsed omentum should in any case be tied off and removed.

Prolapsed intestine, if strangulated, may be sutured *in situ*, or may be opened in such a manner as to form a fecal fistula which is to be closed subsequently, or it may be resected at once. If it has become infected it is to be subjected to very thorough mechanical cleansing with 0.5-per-cent. salt solution, and then returned after any injuries possibly present in it have been repaired.

Prolapse of the spleen calls for its removal if strangulated or irreparably injured, or for its return if it can be thoroughly cleaned and repaired.

Prolapsed portions of the liver are to be removed.

Prolapse of the kidney should be managed by removal if it is necrotic or very greatly injured; by mechanical cleansing, repair, and replacement of the organ if it be possible. However, in any case ample drainage must be provided by gauze leading from the site of the returned viscus to the surface.

Blood is to be completely removed from the abdominal cavity. This is done by scooping out clots with the hand and sponge, and by copious douchings with hot salt solution. Provision for subsequent drainage need not necessarily be supplied.

The entrance of foreign bodies from without or from the intestine, or the entrance of intestinal contents into the peritoneal cavity, is a fruitful source of peritonitis, and measures should be taken to prevent its occurrence. But once they have invaded the cavity and infected it, no time is to be lost in removing them and in neutralizing their consequences.

Intestinal contents are to be removed by scooping and sponging, and then not only the visibly soiled areas of peritoneum must be cleansed by the liberal use of salt solution, but the same procedure must be carried out with regard to the whole peritoneum, especially if considerable quantities of foreign material have escaped; and, if necessary, evisceration must be resorted to. Drainage must of course be provided in every case.

Drainage of areas of the peritoneum is best accomplished by the use of gauze—ordinary absorbent gauze sterilized, or gauze impregnated with iodoform. Gauze has the advantage over tubes of various kinds in several respects. Besides the perfect manner in which it enables all exudate to be carried to the surface, it decidedly promotes the formation of adhesions about itself, and consequently about the region drained, which is often infected, and further oozing is best checked by the pressure exerted by the gauze packing.

Gauze introduced for drainage purposes is used in ribbons, one or more of which are so placed as to lead from the area drained; or larger pieces of gauze may be packed into the region to be drained and brought out of the abdominal wound; or the Mikulicz dressing may be used. This consists of a piece of iodoform gauze about fifteen inches square, doubled back from its centre like an umbrella, and containing strips of gauze so arranged

that one after another can be withdrawn without disturbing the enveloping skirt, which is last to be removed.

The period for withdrawing drains varies somewhat with the purpose for which they have been introduced; gauze placed to stop oozing should be removed in from twenty-four to forty-eight hours, while that used to drain infected or inflamed areas is allowed to remain in place some days longer.

The treatment of the sequelæ of injuries, as fistulæ, ventral herniæ, etc., does not naturally come under the present title.

Perceval R. Bolton.

ABDOMINAL TUMORS, DIFFERENTIAL DIAGNOSIS OF.—The word tumor is used here not in the restricted sense of a neoplasm but in the etymological sense of a swelling. It is at once evident from this that a large number of pathological processes affecting all the organs contained in the abdomen and the tissues making up the abdominal walls must be considered. This was deemed necessary because we start with the assumption that in a certain given case a tumor has been found in the abdomen and it is necessary to discover what and where it is. All details of etiology, pathology, and symptomatology have been omitted except in so far as they have a direct bearing upon the differential diagnosis. For such details reference must be made to more special articles. Furthermore, the diagnosis of conditions which ultimately lead to the formation of demonstrable tumors has been omitted, and the discussion of such conditions will be limited to their course after the formation of a tumor. For example, when speaking of cancer of the stomach it will be assumed that a tumor has been discovered.

When confronted with an abdominal tumor, it must be remembered that the diagnosis should go beyond the mere recognition of the existence of a tumor in the abdomen. We must determine first the organ or tissue in which the tumor is located, and second the nature of the tumor. If the tumor is believed to be a malignant neoplasm, we must decide, if possible, whether the tumor arose in the organ in which it is discovered or is merely a tumor secondary to a primary tumor in some organ yet to be determined. If the tumor found is believed to be primary, secondary deposits in other organs must be sought. In other cases we must hunt for the cause of the tumor. If, for example, a certain tumor is thought to be a gall bladder distended with fluid, effort should be made to ascertain the character of the fluid and the cause and site of the obstruction which prevents the escape of the fluid from the gall bladder. With so broad a subject it is evident that only the more important methods, facts, and pathological conditions can be included.

After a brief discussion of the methods of examination employed, we will consider what might be called tumors of the abdomen as a whole, such as ascites, diffuse peritonitis, lipomatosis. Then the various organs will be grouped according to their relations to the colon, and each group considered in turn. The organs situated to the cephalic side of the transverse colon, the liver and gall bladder, the stomach, pancreas, and spleen, will be described first; then will follow the organs behind the colon, the kidney, adrenal bodies, and perirenal tissue; next will come the organs within the arch of the colon, the small intestines, mesentery and omentum, peritoneum, lymph glands, aorta, uterus, ovaries, bladder, spinal column, and lastly the colon, appendix, and walls of the abdomen. With each organ we shall as far as is possible take up first the circulatory disturbances, then the inflammatory processes, cysts, neoplasms, and malpositions. It is not necessary to state that this order cannot be followed absolutely, but it can be approximately, and will be found greatly to facilitate a grasp of this subject, probably the most difficult matter handled by the diagnostician.

METHODS OF EXAMINATION employed include the I. physical, II. chemical, and III. microscopic: the first having in general an especial bearing upon the localization of the tumor, while the second and third are of more value in determining the nature of the tumor.

I. *Physical Methods*—(A) Inspection. The patient should be placed on a firm narrow bed or table in such a way that the source of the light lies in a line with the median line of the body, either directly above or at the head or foot of the patient. The purpose of this is to avoid any uneven distribution of the shadows. The kind of light employed is usually a matter of indifference, but in cases in which there is reason to suspect the possibility of a jaundice the patient must be examined by daylight, for the well-known reason that no artificial light shows even the deepest shades of jaundice.

Take note first of the size of the abdomen, especially of any disproportion between the size of the abdomen and that of the other portions of the body. Next note the shape of the abdomen. Is the abdomen symmetrical? Are there any portions more prominent than the corresponding ones of the other side, or is the upper half out of proportion to the lower half? If any part appears large, does it appear sharply outlined or does it merge gradually into the surrounding parts? Does the surface of the enlargement appear smooth or nodular, and are the outlines rounded or irregular? Does the mass move; and if so, does it move with the respiration, the pulse, or independently of either? Almost any tumor of the abdomen may show respiratory or pulsatile movements (the exceptions will be stated later), but only a few show independent movements. These are tumors from the stomach, intestines, and uterus. Visible vermicular movements of the stomach and intestines are commonly seen in patients with thin abdominal walls and are not in themselves pathological. It is only when they are unusually intense and continuous and in combination with distinctly pathological symptoms that they need attention. The word vermicular quite accurately describes the motion, for it looks exactly as if some large worm were moving under the skin. The site and direction of the movement should be noted. In general the peristaltic movements of the stomach are limited to the upper and median portion of the abdomen and pass from left to right. Peristaltic movements of the stomach from right to left are pathological. The movements of the small intestines are central and irregular in direction. Those of the large intestine correspond to the relatively fixed position of the colon and vary in direction with the portion of the site affected. The peristaltic movements above the site of any stricture in the gastro-intestinal tract, either acute or chronic, are more active than normal, and therefore persistently exaggerated movements point to some obstruction, but do not in themselves prove such obstruction.

The independent movements of the uterus are of two sorts: fetal and uterine. The presence of the fetal movements is at times a most important point in the differentiation of abdominal tumors. The movements are altogether irregular in time and intensity, and may be simulated by the peristalsis of the small intestines. The expulsive contractions of the uterus are not often visible, but may be so.

Inspection of the abdomen includes attention also to any subcutaneous collateral circulation, either arterial or venous. Such circulation often gives the clew to the site of the obstruction, which necessitates a collateral circulation and may give some idea of the degree of the obstruction. Note also any localized oedema or inflammatory process.

Often much valuable information may be gained by changing the amount of gas in the stomach and intestines. Not only do we gain information as to the exact location and size of these organs, but we learn much of their relation to the tumor found. Various methods have been employed for this purpose, but the following require only such apparatus as should be in the armamentarium of every physician. The stomach may be inflated by means of a Seidlitz powder mixed after drinking instead of before, or one can use saleratus in solution followed by a little vinegar. This method is not entirely without danger, because the pressure resulting from the gas evolved cannot be accurately estimated. Accidents, however, are rare. Another method consists of the passage

of the stomach tube and inflation of the viscous by means of a pump. This has the advantage of enabling one to use as much or as little gas as desired, and permits the immediate removal of the gas if necessary.

The colon is inflated by passing the rectal tube well up into the descending colon and forcing in air by means of a pump, the ordinary bicycle pump being perfectly adapted to the purpose. A rather large, cone-shaped rectal tip is better than the rectal tube, for it prevents the escape of the air, but is not so easily supplied as the tube. As the air passes upward and distends the colon we are able to learn the exact course of the colon and its relations to the tumor.

Harris, of Chicago, has recently drawn especial attention to the value of the relation of the colon to abdominal tumors in the differential diagnosis of such tumors. He substitutes for the old and superficial division of the abdomen into nine areas—the right and left hypochondriac, lumbar, and inguinal regions, the epigastric, umbilical, and hypogastric regions—an anatomical division into four areas. The borders of these areas are not fixed by external points, but are located by the inner or mesial layer of the longitudinal colon and the inferior or caudal layer of the transverse colon. The resulting areas are a central area, surrounded by mesocolon; a right and left posterolateral area, lying external to and behind the mesocolon; and a superior area, lying above the transverse mesocolon. While the boundaries of these areas are not fixed, their position is easily ascertained by determining the position of the colon by air distention.

In the central area, surrounded by the distended colon, are found tumors of the omentum and mesentery, retroperitoneal tumors, localized peritoneal exudates, tumors of the small intestines, tumors of displaced and movable kidneys, and all tumors of the female generative organs rising into the abdomen.

In the superior region we find tumors of the liver, gall bladder, stomach, lesser omentum, pancreas, retroperitoneal lymph glands, and aneurisms of the celiac axis.

Tumors of the spleen pass forward close to the anterior wall, in front of the splenic flexure of the colon and the neighboring parts of the transverse and descending colon.

Tumors of the kidneys, suprarenal bodies, and the connective tissue bordering on these organs, tumors from remains of the Wolffian bodies, carry the colon inward and forward. But tumors from floating kidneys may appear in the central area, *i.e.*, surrounded by the colon.

(B) Palpation. This method of examination is of much more general application than inspection, for many tumors easily palpable are not visible. Palpation should always be preceded by thorough and certain evacuation of the bowels, otherwise fecal masses may lead to errors. The patient should be examined first in the dorsal position, but in some cases a lateral, a knee-chest, or an erect position will yield results not otherwise obtainable. The patient should relax the abdominal muscles as completely as possible. This is often easier when the thighs are flexed on the abdomen and the mouth held open. In difficult cases better relaxation is obtained if the patient is placed in a bath of warm water and examined in the bath. In still more difficult cases general anesthesia must be employed. Palpation should be made gently but firmly, and any pressure used should be applied gradually; counter-pressure from behind is often a help. Sometimes, and this is especially true when there is considerable fluid in the abdominal cavity, one obtains the best results by dipping the stiffly held fingers suddenly downward, depressing the abdominal walls to varying depths. Bodies can often be felt and outlined in this way that cannot be felt at all by the ordinary method of palpation.

Attention should be given to the following points: the location, size, shape, motility, and tenderness of the tumor. Note also any change in position or ease of palpation caused by distention of stomach and colon.

In all cases in which it is impossible absolutely to exclude a neoplastic origin for the tumor palpated, the rectum and vagina should be examined.

(C) Percussion. This method is far less valuable here than in examination of the chest, but should never be omitted, and in certain cases exceeds the other methods of examination in value. Its main uses are the determination of the position of the diaphragm, the shape of the upper border of the liver, the presence or absence of free fluid in the abdominal cavity, and the position and approximate size and shape of the stomach and colon after they have been distended by gas or fluid. Percussion is the main means of determining the relation of the colon and stomach to the tumor found, and what was said under the heading of Inspection in this regard could be repeated here; might perhaps have been more properly placed here, for percussion is used much more often than inspection for this purpose.

Tumors of the abdominal organs cause abnormal areas of dullness only when superficially located or of large size, and the resulting area of dullness is always smaller than the tumor.

Percussion is valuable in demonstrating the absence of areas of dullness normally present. Disappearance or reduction of the hepatic and splenic dullness is often of the highest diagnostic value. Disappearance of the posterior renal dullness is less so.

In isolated cases auscultatory percussion gives valuable results.

(D) Auscultation. Almost no results are obtained by this method. Peritoneal friction, either localized or diffuse, is sometimes heard. Arterial and venous tones and murmurs are common and usually of but little significance.

(E) Exploratory Puncture is often of the very greatest value, especially in determining the nature of the tumor. The details will be given later.

(F) Exploratory Laparotomy. In certain cases a complete diagnosis—*i.e.*, one which localizes the tumor and determines its nature—is impossible even after the most careful examination. In such cases an exploratory laparotomy is often justifiable, providing it can be made by a competent surgeon under favorable circumstances. Unless the patient presents some obvious contraindication to the operation, it can be done with almost no danger and often gives information which leads to definite curative treatment.

II. and III. The *chemical* and *microscopical* methods of examination can be more profitably discussed in the special paragraphs referring to the different organs.

Before taking up the various diseases of the abdominal organs leading to tumor formation, it should be expressly and emphatically stated that any examination of an abdominal tumor which omits a complete and careful examination of the entire body is criminally incomplete. Abdominal tumors are often merely symptoms of diseases of organs remote from the abdomen, and such primary disease can be discovered only by a complete examination of the body.

ENLARGEMENTS OF THE ABDOMEN AS A WHOLE.—This may occur as the result of accumulations of gas or fluid in the peritoneal cavity, from large amounts of gas in the intestines, from deposits of fat in the abdominal walls, omentum, and mesentery, and in rare instances from very large tumors.

Ascites.—This is the only common cause for extreme enlargements of the abdomen. The abdomen is enlarged in all diameters, but when the cavity is not completely filled, as is ordinarily true, the horizontal diameter when the patient is in the dorsal decubitus will be found considerably greater than the perpendicular diameter. The flanks are bulging while the umbilical region is flattened. The skin is often tense and shining, and under it can be seen the overdistended veins. Such veins are present in all well-marked cases of ascites irrespective of its cause, but are usually better marked in cases due to atrophic cirrhosis of the liver than in others. The umbilicus is flattened out or even bulging. Sometimes when the patient changes position, one sees the fluid changing position also, and one is reminded of the appearance of an incompletely filled sack when it is shaken.