CHAPTER XV

LAPAROTOMY

Anyone who opens the abdomen should be capable of dealing with any condition he may find there. (Sherren.)

EXPLORATORY LAPAROTOMY

A CORRECT diagnosis is the handmaiden of a successful operation. If, on opening the abdomen, we find what we expect, the operation is more likely to proceed smoothly, and on the whole it is bound to be done better. Atypical cases still provide a number of

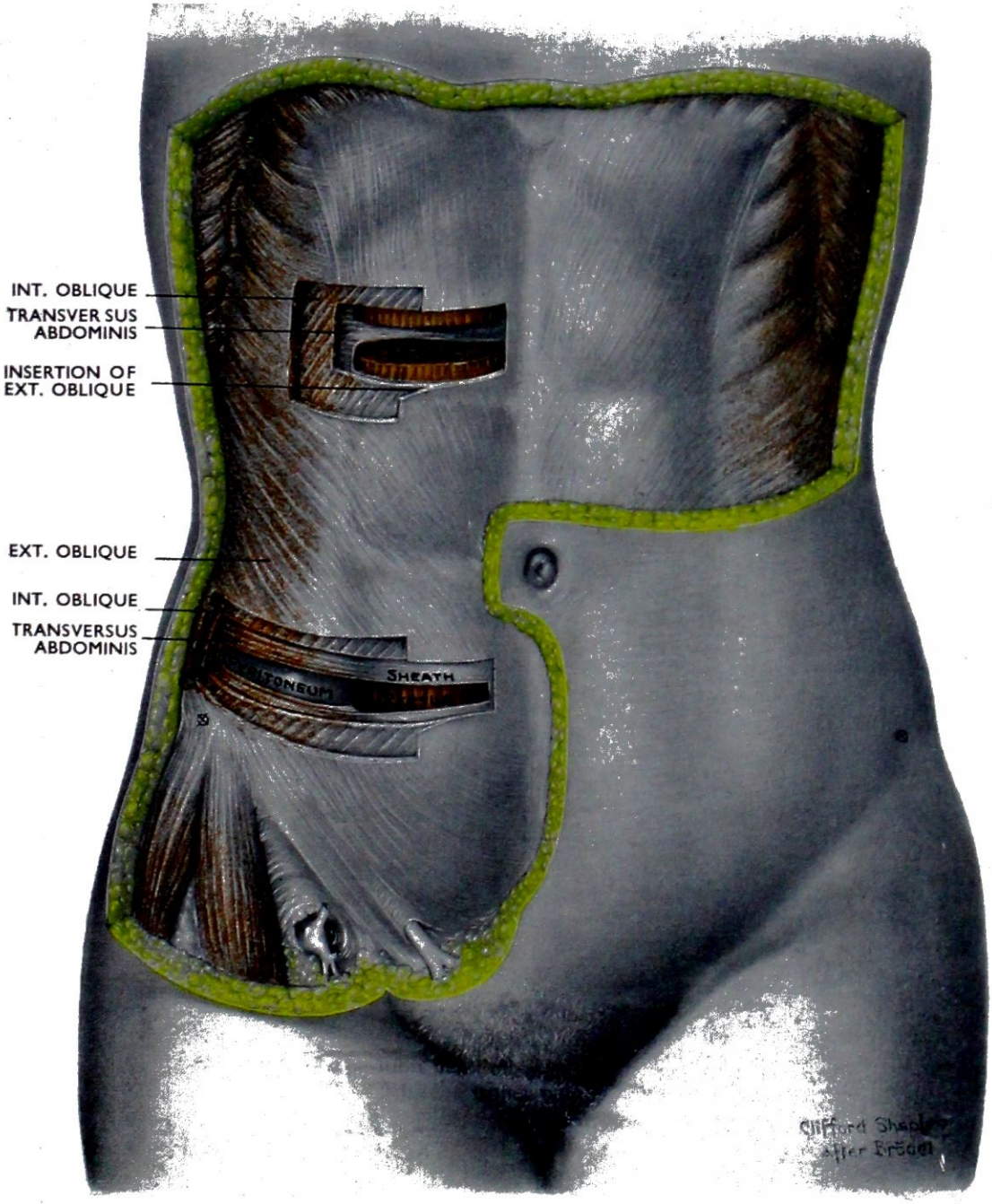


Fig. 189.—The anatomy of the abdominal wall, with special reference to the disposition of muscles encountered in the various abdominal incisions described in this work.

instances where an exploratory operation is the only course. We should, however, always strive our utmost to arrive at a pre-operative diagnosis. In cases of doubt a fundamental principle is to try to decide whether the upper or lower abdomen has to be opened—not always an easy matter.

If the abdomen has been opened in an unsuitable place, there are two possible courses to pursue : (1) To prolong the incision into the region of the lesion ; (2) To close the incision and reopen the abdomen elsewhere. Usually two small incisions are preferable to one large one, for the following reasons : (*a*) A large incision is difficult to sew up unless the anæsthesia is perfect and there is no intestinal distension ; (*b*) With an extended incision infection is liable to be distributed, especially from the lower to the upper abdomen ; (*c*) If wound infection follows, the larger the incision the greater are its attendant dangers.

Throughout the succeeding chapters reference will be made to particular incisions. *Fig.* 189 shows the relevant muscles. To commence with, it will be convenient to describe a standard method of opening and closing (*a*) the upper and (*b*) the lower abdomen.

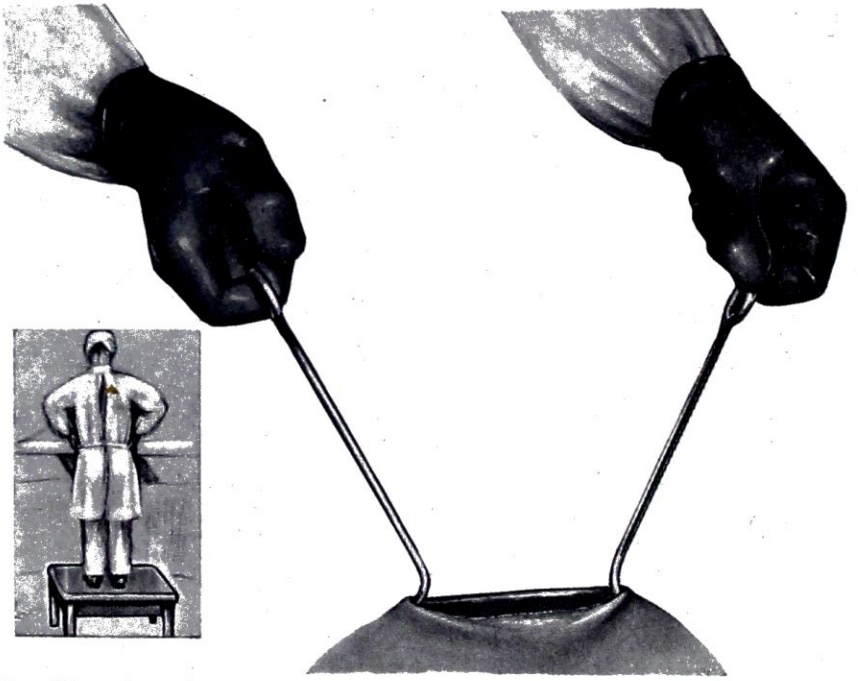


Fig. 190.—Wound hooks in action. The inset shows the assistant standing on a stool, whereby the hooks can be supported with less fatigue.

The Upper Abdomen : The Midline Incision.—When the lesion is situated in the upper abdomen the midline incision has much to offer. By employing this incision the abdomen is opened readily, and, what is more important, it is closed easily. The path traversed by the incision is practically avascular. Furthermore, the incision can be enlarged quickly. The incidence of post-operative hernia is not greater than that following most incisions.

Midway between the ensiform process and the umbilicus, exactly in the middle line, an incision about three inches (7·5 cm.) long is made—it need not be longer, for it can be enlarged upwards or downwards as circumstances demand. Towels are clipped to the skin edges in such a manner as to hide the clip beneath the towel. It is advantageous in the long run not to clip the towels at the extremities of the wound until it is ascertained that the length of the incision is adequate. The incision is deepened and the aponeurosis cut through. The aponeurosis is composed of white fibrous tissue, and practically no bleeding occurs. The peritoneum is opened in the lower third of the incision, and *slightly* to one side of the midline, the better to avoid entering the layers of the falciform ligament. The opening in the peritoneum is then extended upwards and downwards within the limits of the incision.

Closing the Incision.—Wound hooks are placed in the extremities of the incision (*Fig.* 190). These are lifted by the assistant, who will find it convenient to stand on a stool, for traction has to be maintained until the incision is closed. These hooks dispense with the necessity of placing forceps on the edges of the peritoneum. Silkworm gut sutures are passed at intervals of about three-quarters of an inch (2 cm.) on a large cutting needle. These sutures traverse all layers, and, having been passed, their free ends are

clipped independently in hæmostats. The aponeurosis is approximated by a continuous catgut suture, a moderate-sized curved cutting needle being used for the purpose (*Fig.* 191). After this layer has been closed the through-and-through sutures are tied firmly, but not too tightly (*Fig.* 192). *Not until this stage has been completed are the hooks removed,* nor is the upward tension on them slackened, for without their aid there is a danger of a

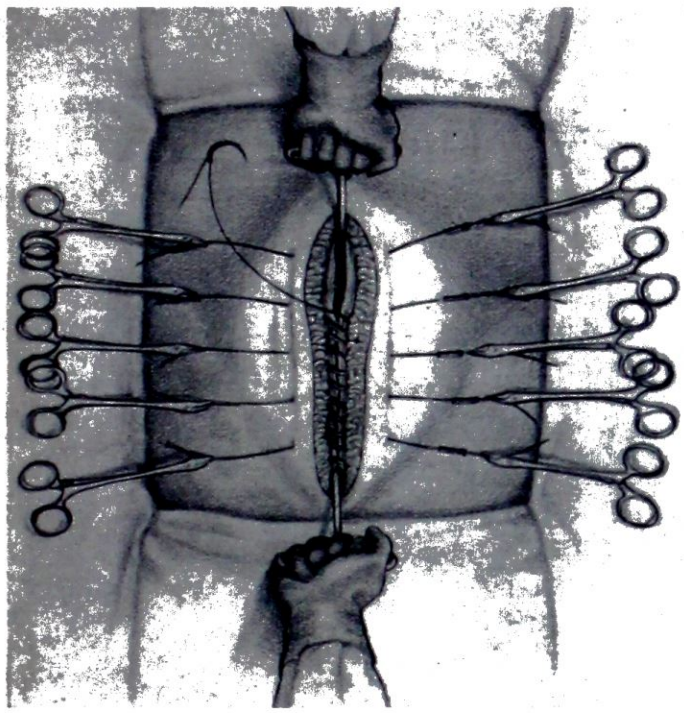


Fig. 191.—Closing the midline upper abdominal incision.

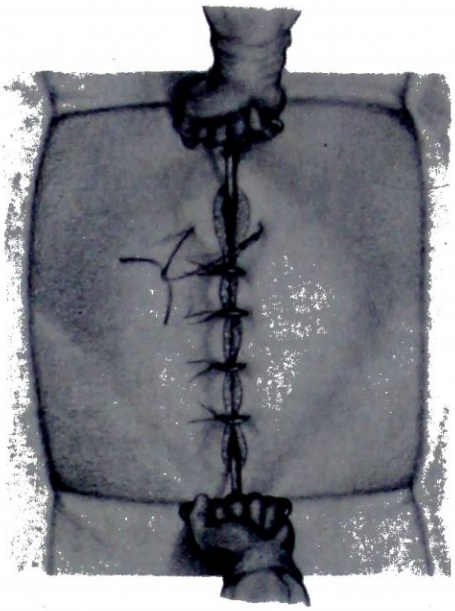


Fig. 192.—Closing the midline upper abdominal incision. The last through-and-through suture is being tied. The hooks are then removed, and a few skin sutures complete the closure.

loop of intestine being ensnared under a deep suture. Once the last deep suture has been tied the hooks are removed. The skin edges are then brought together by fine interrupted sutures between the deep stitches. The through-and-through sutures should be left in for thirteen or fourteen days. I have opened and closed the upper abdomen in this manner hundreds of times, and can recommend it unhesitatingly.

The Lower Abdomen: The Paramedian Incision.—The midline incision, so efficient in the upper abdomen, cannot be recommended in the lower. A strictly median incision below the umbilicus is very prone to give rise to a post-operative hernia, which is associated with the largest incidence of strangulation: therefore the right (or in selected cases, a left) paramedian incision is used.

An incision about five inches (12·5 cm.) long and one inch (2·5 cm.) from the middle line is made. Bleeding points are secured. Towels are clipped to the skin edges. The rectus sheath is incised within the limits of the incision. Hæmostats secure the medial cut edge of the sheath. The muscle is dissected out of its bed and retracted laterally (*Fig.* 193). The peritoneum is opened.

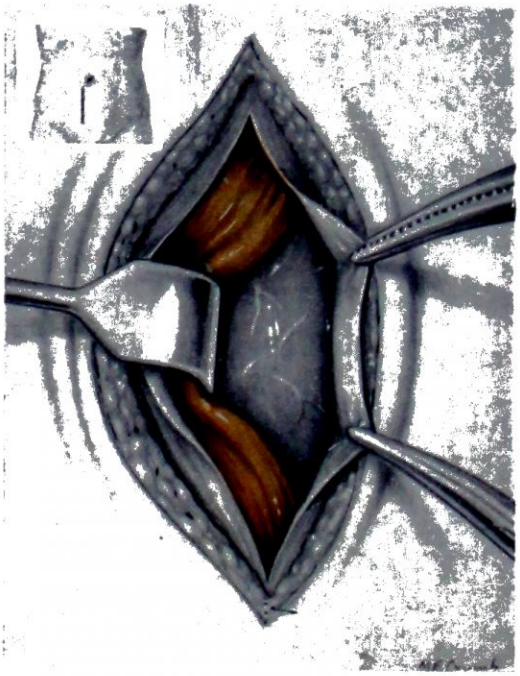


Fig. 193.—The right lower paramedian incision.

Alternative Procedure.—Instead of the rectus muscle being mobilized and retracted, it can be split vertically. Quick and efficient, this is most valuable in emergency operations. Whether the rectus muscle is split or retracted, bleeding from muscle is best arrested by under-running the mouth of the open

vessel with a ligature on a needle; I do not apply hæmostats to muscle. In the case of the split rectus bleeding usually comes from the free edge of the muscle, and it can be dealt with neatly by an X-shaped stitch, as shown in *Fig.* 194.

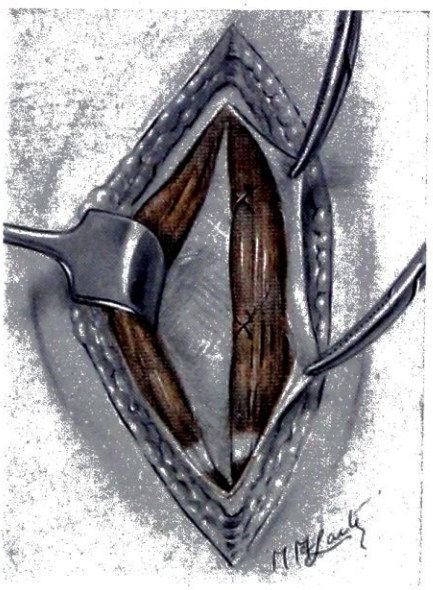


Fig. 194.—The split rectus incision. Note that the method of under-running bleeding points with a ligature on a needle has been employed.

A Method of Opening the Peritoneum applicable to all Incisions.—Wounding an underlying structure whilst opening the peritoneum is an error not infrequently committed by the beginner. The following method guards against this possible danger. The peritoneum having been displayed, it is picked up in dissecting forceps and elevated. With a little shake imparted to the instrument any structure lying hard up against the under surface of the peritoneum is likely to be disengaged. A hæmostat is applied to the pinched-up fold. The dissecting forceps are then momentarily removed, and the fold is shaken again by the hæmostat. The dissecting forceps once more pick up the elevated peritoneum at a convenient point near the hæmostat, which is handed to an assistant. Holding a scalpel nearly horizontally, the peritoneum is incised (*Fig.* 195).

A Method of Enlarging an Opening into the Peritoneum.—First the opening in the peritoneum is enlarged in an upward direction with scissors. It is then enlarged downwards in the following manner: the separated index and middle fingers are directed downwards beneath the peritoneum, which is severed with the scalpel deliberately (*Fig.* 196).

Closing the Lower Paramedian Incision.—Long hæmostats grasp the cut edge of the peritoneum. There should be forceps on each extremity and two on each side. The forceps on the extreme upper end should take a large bite of tissue so that the assistant can exert some upward traction

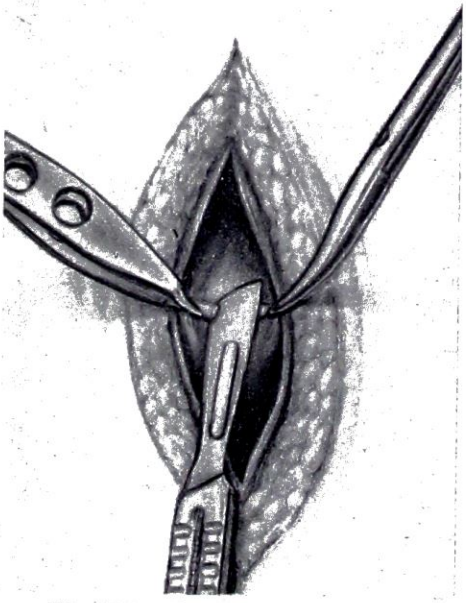


Fig. 195.—A method of opening the peritoneum applicable to all cases. Note that the scalpel is held practically flat.

Fig. 196.—Enlarging the opening into the peritoneum in the downward direction.

in this direction. When difficulty is experienced in approximating the peritoneum in spite of this traction, Sargent's depressor, or, better, a McNealy's rubber guard, is useful in keeping back unruly coils. When great difficulty is encountered in this respect, an abdominal pack

is introduced and Sargent's depressor applied over this. Commence by sewing up the inferior end of the incision. If the peritoneum is holding well, an over-and-over stitch is used. If the stitches tend to cut out, a large bite is taken on the under surface of the peritoneum parallel to its cut surface (*Fig.* 197). The lower part of the incision is usually the most difficult to close. As soon as we have got above the linea semilunaris, the peritoneal layer will nearly always hold its stitches.

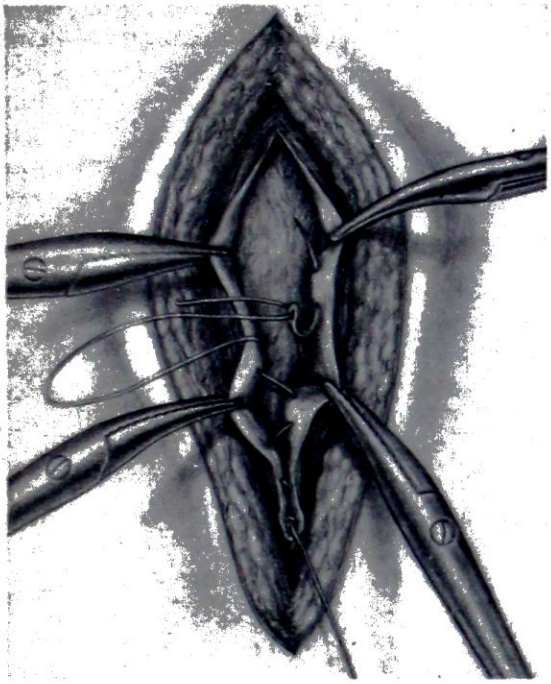


Fig. 197.—Approximating the cut-edge of the peritoneum in cases of difficulty. A bite is taken with the needle on the under surface parallel to the cut edge.

Closing the Peritoneum (applicable to all cases, unless stated otherwise).—When the edges of the peritoneum do not come together kindly, it is best to resort at once to interrupted stitches. In cases of real difficulty (the patient is straining, or the intestines are distended, or both) Ward's rolling stitch can be recommended. The virtue of this stitch is that the peritoneum is rolled on itself several times, giving a reinforced edge through which sutures will not tear out so readily. The stitch is difficult to describe, but easy of application. *Fig.* 198 should make the procedure clear. The stitch is passed into the wound and out through the rectus muscle or its sheath on the proximal side; into the wound and out through the rectus muscle or its sheath on the distal side; into the wound and out through the peritoneum on the distal side, and then tied. In cases of exceptional difficulty it is advantageous to pass two, or even three, of these stitches before tying any of them.

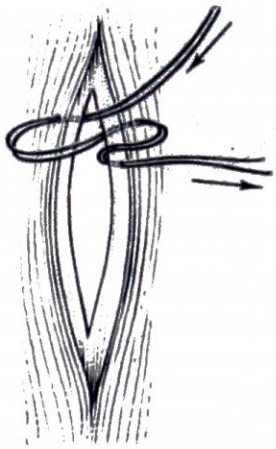


Fig. 198.—Ward's rolling stitch.

In order that the operator may become familiar with the stitch, and thus be able to apply it expeditiously, it is desirable to practise it in cases where it is not essential; as it is an excellent 'general purpose' stitch, there can be no possible objection to this recommendation.

The Gridiron Incision.—

Indications.—(1) It is the best incision for the removal of an acutely inflamed appendix; (2) It is occasionally of value as an avenue of approach in an acute abdominal catastrophe of uncertain origin. If unsuitable, the incision is closed readily.

Far be it that we should be cramped for room. The reverse is the case; but in the first instance the incision should be small. It can always be enlarged if necessary. Enlargement should be undertaken at the very first sign of difficulty, for the opening must be of sufficient dimensions for the appendix to be removed without dragging and pulling.

The incision is made at right angles to a line joining the anterior superior iliac spine to the umbilicus, rather nearer the former than the latter. The classical site for the incision (*Fig.* 199) may with advantage be subjected to a certain degree of variation. Thus, if on palpating the right iliac fossa under the anæsthetic (a step which should never be omitted when this incision is contemplated) the appendix, or omentum which surrounds it, can be felt, the incision is made over the centre of the lump. Again, if the appendix is judged to be retrocæcal, the incision is made a little higher and a little nearer the flank: and so on.

The skin having been incised and bleeding points ligated, towels are clipped to the wound edges. The external oblique aponeurosis and muscle, should any lie within the limits of the incision, are incised in the direction of their fibres. A long hæmostat picks up the medial cut edge, and a curved retractor is placed under the lateral margin. The

assistant holds the hæmostat in his left hand and the retractor in his right. The internal oblique is now divided in the direction of its fibres: the scalpel is held with its blade towards the middle line, and the superficial part of the muscle in the outer part of the wound is divided. The remainder of the muscle is split with the handle of the scalpel working in conjunction with the left forefinger. One burrows in this manner through the transversus abdominis also. As soon as the peritoneum is reached, the scalpel is laid aside and the split is made more complete by stretching the wound with the forefingers

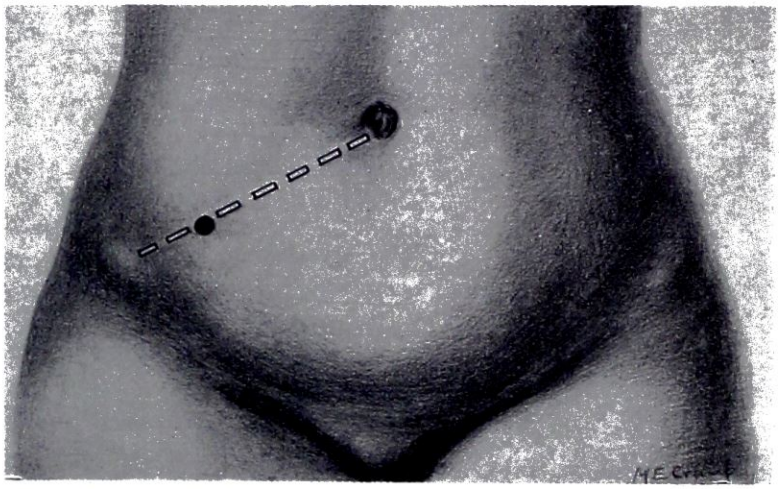


Fig. 199.—The classical site for a gridiron incision is over McBurney's point. McBurney's point lies upon the line shown 1½ in. (3·75 cm.) from the anterior superior iliac spine. This point is often incorrectly given more medially.

after the retractor has been removed. A pair of curved retractors is placed under the split transversus abdominis, and after displacing the extraperitoneal fat with a Lahey's swab (*see Fig.* 12) the peritoneum is picked up and incised in the manner described already (*see Fig.* 195). Once the peritoneum has been nicked, the opening is enlarged by stretching it with the handle of the scalpel and the forefinger. This method gives a circular hole which can be encircled with a purse-string suture when the time comes for the incision to be closed.

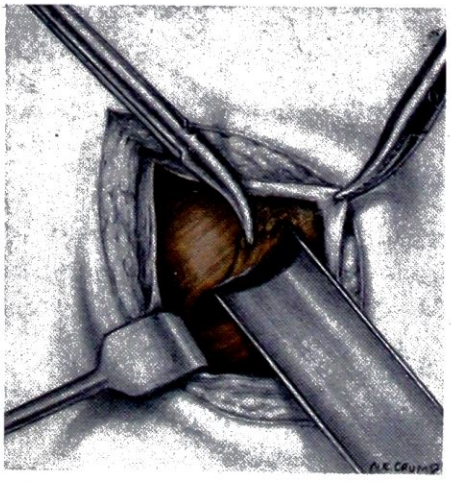


Fig. 200.—Enlargement of the gridiron incision. The internal oblique is detached from its insertion into the rectus sheath. A Sargent's depressor is used to protect underlying structures.

Finally, an excellent expedient is to pass the curved retractor under the peritoneum on the medial side and give the handle to the assistant to hold directly upwards (*see Fig.* 282). Thus the abdominal wall is lifted up whilst the surgeon peers into the wound to locate the cæcum, and incidentally notes anything else he finds, particularly the amount and character of the peritoneal exudate.

Closing the Gridiron Incision.—The edges of the peritoneum are picked up in hæmostats, and a purse-string suture is inserted and tied, thereby closing the peritoneum with a minimum amount of catgut. The edges of the split internal oblique and the transversus abdominis are approximated by a single catgut stitch applied in the form of an X, or two interrupted cotton sutures. Two interrupted stitches bring together the external oblique aponeurosis, and there remains only the skin to be stitched up. A glove drain under the skin is advisable in all except very early cases of acute appendicitis where the disease is confined to the mucosa.

Enlarging the Gridiron Incision.—If one is simply hampered for space in which to deliver the cæcum, the skin and external oblique are divided still further, after which the internal oblique can be split more completely and a limited degree of space is added to the incision.

What is more important is to have at one's command a method of extending the incision in order to trace an anomalous appendix upwards or downwards. More often it is in the upward direction that we have to follow the organ.

A Method of Gaining More Room in an Upward Direction.—The skin and external oblique incision may be extended in an upward direction. This is not always necessary, and if it is judged that only a moderate amount of extra room will be required this step is deferred.

Fig. 201.—The repair of the prolonged gridiron incision. When the suturing is completed, the suture line resembles a reversed L.

The medial cut edge of the external oblique is picked up in a hæmostat and retracted. A little blunt dissection between the external and internal obliques renders the insertion of the internal oblique into the rectus sheath demonstrable. This junction must be seen clearly. The narrow end of a Sargent's depressor, concave surface uppermost, is slipped under the peritoneum, and after peering along its surface in order to make quite certain that no structure intervenes, the internal oblique is severed from the rectus sheath and the underlying peritoneum likewise divided (*Fig.* 200). Usually a vessel requires attention on the medial aspect: this is whipped over with a needle carrying a ligature. When using this method it is surprising what a gain in space attends a prolongation of even one inch (2·5 cm.).

Closing the Extension.—A purse-string suture, so useful for closing the peritoneum in the case of an ordinary gridiron incision, cannot be recommended when that incision has been extended. The peritoneum should be closed after the manner which is usual in a laparotomy incision. The apex of the ⌟-shaped incision is picked up in a hæmostat, and this corner is sewn on to the rectus sheath opposite the split internal oblique. Interrupted sutures complete the repair, which when finished forms a neat ⌟ (*Fig.* 201). The rest of the incision is closed in the usual manner.

Fig. 202.—Battle's incision. The rectus sheath has been opened, and the muscle is retracted medially by the assistant's forefinger. Metal retractors are liable to injure the inferior epigastric vein.

Extension in a Downward Direction.—If more room is required in the downward direction, exactly the same principle is adopted with that part of the internal oblique which lies below the split in its fibres.

I have carried out the ⌟-shaped extension of the gridiron incision in over 400 cases. The incidence of post-operative hernia is almost negligible, and has only occurred in those cases in which prolonged suppuration has ensued. In two of these a secondary operation for the repair of the hernia had to be undertaken, and the reconstitution of the abdominal wall proved to be simple.

Battle's Incision.—

Indications.—(1) Pelvic appendicitis, particularly in women where disease of the adnexa cannot be excluded; (2) A similar incision to Battle's incision, only on the left side, is used when perforated diverticulum of the colon is suspected.

An incision about three inches (7·5 cm.) long is made a little to the lateral side of the middle of the right rectus muscle. After towels have been clipped to the wound edges the incision is deepened, and the rectus sheath is opened in the length of the incision. Hæmostats are placed on the lateral cut edge of the sheath, and the muscle is mobilized

medially. Any bleeding points in the muscle are whipped over with a ligature on a round-bodied needle. The assistant then draws the belly of the muscle to the left. This necessary retraction is performed preferably with the crooked index finger (*Fig.* 202), for metal retractors tend to wound the deep epigastric vein and cause troublesome bleeding. The inferior epigastric vessels are rather a bugbear, and certainly constitute a main disadvantage of this incision; if, however, the finger is used as a retractor they usually escape injury. The peritoneum is opened rather nearer the inferior end of the incision, the better to avoid two small nerves and the vessel which pass into the deep surface of the muscle. An endeavour to preserve nerves should be made; but they must often be divided or break when the intra-abdominal manipulations prove troublesome. I have been unable to satisfy myself that any harm results from the dissolution of their continuity.

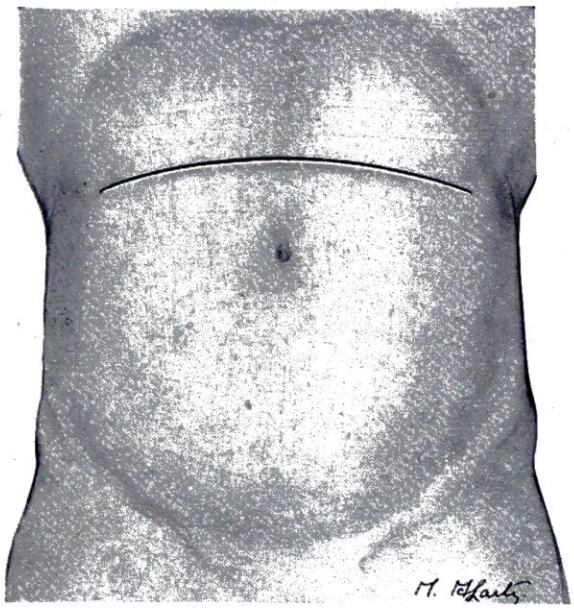


Fig. 203.—The transverse upper abdominal incision.

Repair of the Incision.—Is carried out in precisely the same manner as the lower paramedian incision—to wit, the peritoneum is sewn up, through-and-through sutures are placed through the skin and under the rectus sheath (usually one suffices), the rectus sheath is drawn together with interrupted catgut sutures, after which the skin is approximated.

The Transverse Upper Abdominal Incision, extending over one rectus abdominis only, is recommended when operation becomes necessary in a case of acute cholecystitis. It can also be used for splenectomy in cases of rupture of the spleen when the diagnosis is certain. If necessary, the incision can be extended across the abdomen, e.g., to repair a rupture of the liver. The incision passes across the chosen half of the abdomen at the level of the 9th costal cartilage (*Fig.* 203). The rectus sheath is divided in the length of the incision, and the rectus muscle likewise divided. This can be carried out by a

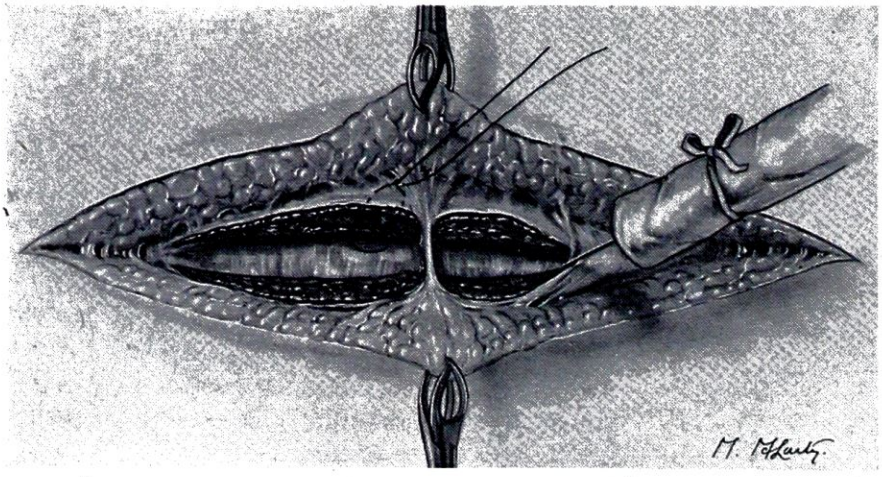


Fig. 204.—Dividing the rectus muscles with the diathermy needle. The method of occluding a bleeding point with a stitch is also shown.

diathermy needle (*Fig.* 204). It will be found that when the muscle-fibres are cut across, the rectus muscle does not retract within its sheath; the tendinous intersections prevent retraction. The vascularity of the rectus abdominis varies within wide limits. Sometimes there is hardly any bleeding at all; at other times numerous stitches have to be inserted. It is most desirable not to try to pick up bleeding vessels with a hæmostat, for this crushes and tears muscle-fibres, and often an ordinary ligature cuts through. If the bleeding point is under-run with a needle which at the same time traverses the edge of

the rectus sheath, hæmorrhage is controlled effectively. When hæmostasis is assured, the rectus abdominis is severed completely. The posterior rectus sheath and the peritoneum are incised. If the incision passes across the middle line, the ligamentum teres will need division between ligatures.

Closing the Incision.—The posterior layer of the rectus sheath with the peritoneum can be approximated easily. No attempt should be made to approximate the muscle.

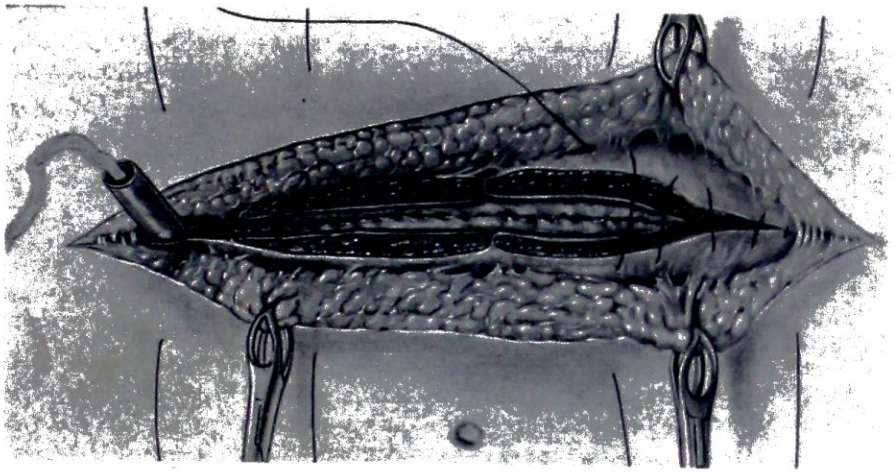


Fig. 205.—Transverse incision. Closing the anterior rectus sheath. When this layer is approximated accurately the cut muscle-fibres will be in apposition.

The next layer that requires suture is the anterior rectus sheath ; this can be accomplished by a continuous (*Fig.* 205) or, more usually, with interrupted sutures. Tension sutures are inserted. The skin incision is closed by interrupted stitches.

The Transverse Lower Abdominal Incision.—Is favoured by some surgeons. They regard this as an extremely good approach when the diagnosis of acute appendicitis is suspected but some other lesion in the lower abdomen cannot be excluded. The incision

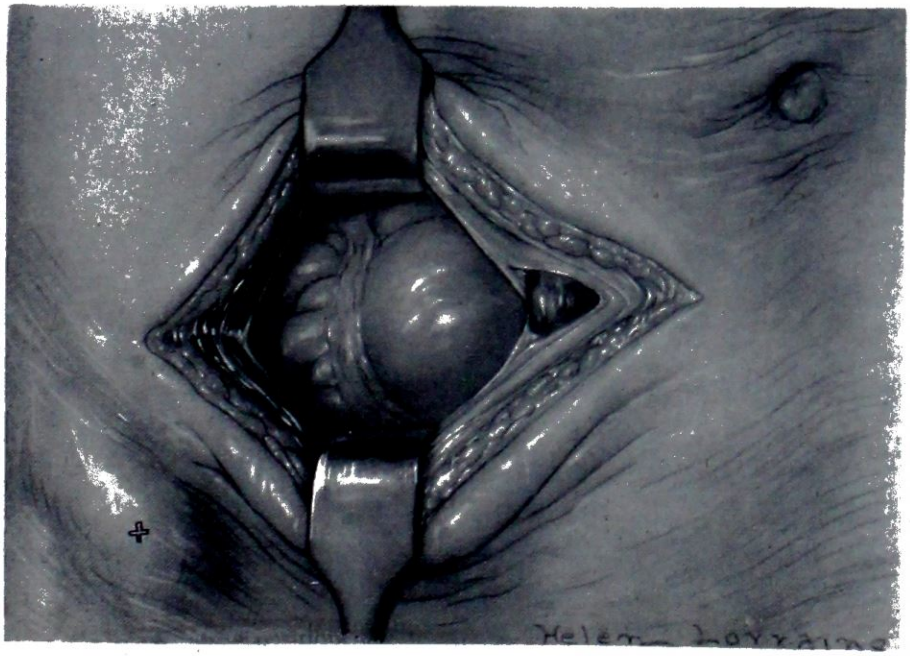


Fig. 206.—The transverse lower abdominal incision.

is made 1½ in. (3·8 cm.) above the anterior superior iliac spine, and extends to the edge of the rectus sheath. The external oblique is divided in the line of the skin incision, and so is the fleshy internal oblique. The peritoneum is opened (*Fig.* 206). The advantage of this incision is that, if more room is required, the rectus sheath is opened

by extending the incision medially, and the rectus muscle can be retracted, giving wide exposure.

Repair of the Incision.—The incision is closed in layers. It is necessary to coapt the internal oblique with more than usual care, using interrupted sutures.

Fig. 207.—Method of attaching stainless steel wire to a needle by means of a length of silk tied with a reef knot.

Closing Abdominal Incisions with Stainless Steel Wire.—Stainless steel alloy wire, S.W.G. 31, is employed. It is strong and supple, but there are two fundamental principles in its use: (*a*) Stainless steel sutures must be placed in the tissues without tension; (*b*) The wire must never be kinked, or it will break at the kink.

Ordinary needles can be used; the best method of attaching the needle to the wire is shown in *Fig.* 207. It can also be attached by being threaded through the eye and a short length twisted several times on itself. The wire can be purchased with eyeless needles attached, but the wire is liable to fracture at the join.

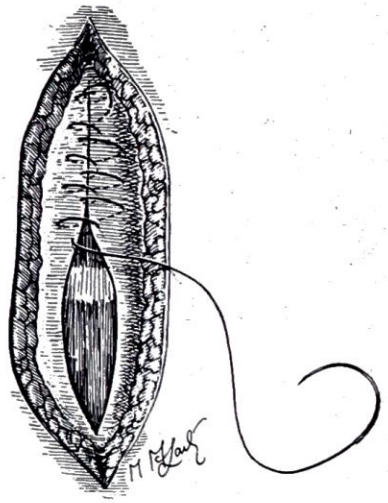
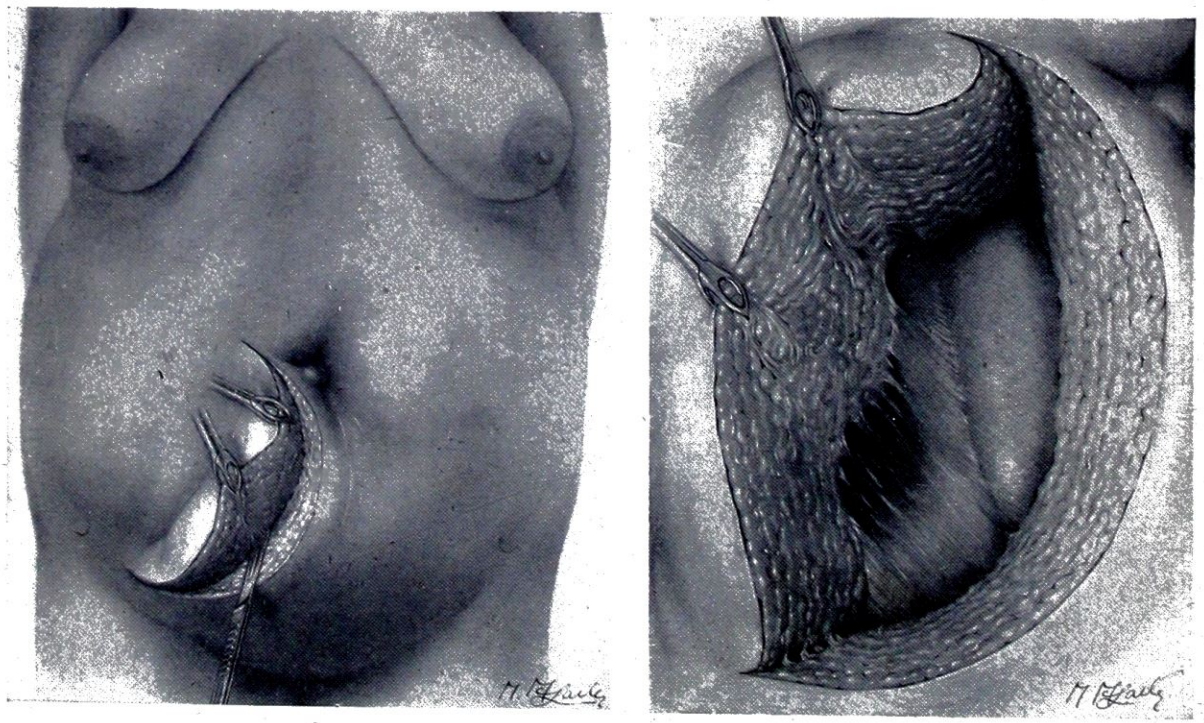


Fig. 208.—Closure of a paramedian incision with stainless steel wire, using the far and near stitch. (*After Abel and Hunt.*)

Technique.—The peritoneal coat is sutured with catgut or cotton in the usual manner. Taking, for example, the paramedian incision, it is the anterior rectus sheath that is united



A B

Fig. 209.—A, B, By raising a suitable flap, the musculature of the abdominal wall can be freely exposed, even when 6 in. or 8 in. (15 or 20 cm.) of subcutaneous fat intervene.

with the wire. Commencing above, the first stitch is passed through the tissues, and the wire is tied in a reef knot. The short end is gripped against the knot with a hæmostat, and cut close to the jaws. It is advisable to use an old pair of scissors for this purpose.

Throughout the insertion of the suture the assistant holds the wire in a loose, open loop, using both hands. As the needle is passed through the tissues he allows the wire to follow without tension, and catches it again as it is drawn out. By this means kinking is prevented. A good method of suture is to employ the far and near (i.e., figure-of-8) stitch (*Fig.* 208). Each 'far' stitch is passed through the anterior rectus sheath and the muscle about 1 cm. from the line of section, and is brought out of the incision to take a 'near' bite of the rectus sheath only. It is highly important that the stitch should be pulled no tighter than just sufficient to draw the cut edges together. At the lower end of the incision the suture is finished off by knotting in the same manner as it was commenced.

Stainless steel wire is used by a number of surgeons as a routine method for closing the abdominal wall. It certainly has much to offer in infected cases. Stainless steel cannot harbour micro-organisms, and granulation proceeds in its presence. The wire is sterilized by heat, and there is no risk of it introducing infection.

LAPAROTOMY IN THE IMMENSELY OBESE

These remarks concern laparotomy upon patients with rolls of fat in the subcutis of the abdominal wall. As often as not, and particularly when the patient is young, the abdominal musculature beneath this excessive fat is normal. A standard incision when made through six or eight inches (15 or 20 cm.) of subcutaneous fat causes the operator to be hampered by meagre exposure in the depths of the wound. Hilton Parry's suggestion is of considerable practical value. He advises that the appropriate area of the underlying abdominal musculature be laid bare by raising a flap, which can be varied to suit particular circumstances. *Fig.* 209 A and B show a flap suitable for exposing the aponeurosis of the external oblique of the lower right quadrant. It enables the operator to proceed with a lower paramedian incision, a Battle's incision, or a gridiron incision without hindrance. At the conclusion of the operation it is usually advisable to leave a corrugated rubber drainage tube through the dependent part of the incision for 48 hours, for fat-laden subcutaneous tissue is prone to become infected at the least provocation.

Thoraco-laparotomy.—*See* p. 398.

A GUIDE TO THE STUDY OF PERITONEAL EXUDATES

The abdomen is a temple of surprise, and it is only by experience that we learn to come to a conclusion quickly as to how to proceed when, as the result of laparotomy, intraperitoneal findings are at variance with pre-operative expectation. Amongst the most valuable guides to intraperitoneal pathology is the nature of the peritoneal exudate. The emergency surgeon is advised to take every opportunity to study these exudates by sight and smell. He is further advised to arm himself with a sterile fountain-pen filler. Much instruction and little waste of time will accrue from compressing the teat and filling the barrel (*Fig.* 210). Macroscopical characters of fluid become more apparent when viewed through glass. After the operation it is of the utmost importance to send this specimen of the exudate to the bacteriological department; it is much better than a swab. As the result of the bacteriological examination the surgeon will learn that sometimes the turbid fluid he considered to be pus is sterile—it is, in fact, a suspension of leucocytes; that at others, faintly opalescent fluid is full of organisms. The bacteriological study of peritoneal exudates is of abiding interest, and frequently it proves to be of great advantage to the patient in that, as a result of sensitivity tests of the organisms to antibiotics, if necessary the antibiotic in use can be changed to one best suited to overcome the infection.

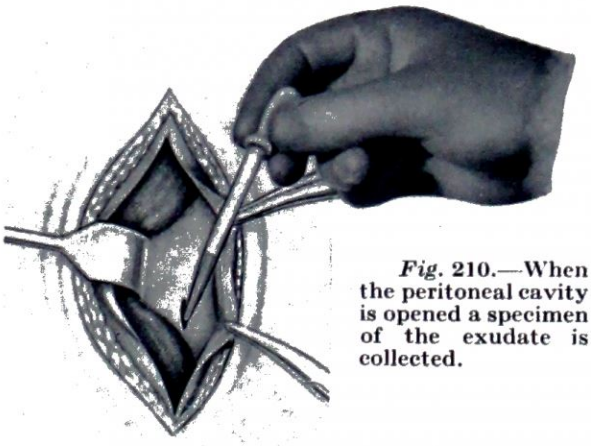


Fig. 210.—When the peritoneal cavity is opened a specimen of the exudate is collected.

The following table is a guide to the quick macroscopical appreciation of possible conditions associated with particular exudates.

PERITONEAL EXUDATES

Odourless purulent fluid	Perforated peptic ulcer Unperforated acute appendicitis Salpingitis Suppurating mesenteric lymph-nodes Early cases of diverticulitis with a minute perforation Pneumococcal peritonitis (soapy)
Purulent fluid with odour[1]	Perforated appendicitis Perforated colonic diverticulitis Perforated Meckel's diverticulum Other rarer perforation of the lower ileum or large bowel (e.g., perforation by a foreign body)
Bile-stained fluid (no trauma)	Perforated duodenal ulcer Perforation of the gall-bladder Perforation of a bile-duct Spontaneous bile peritonitis
Blood-stained fluid (no trauma)	Acute pancreatitis (look for fat necrosis) Primary streptococcal peritonitis Mesenteric embolism (musty odour) Very acute intestinal obstruction by a band Torsion of some intraperitoneal structure (i.e., torsion of ovarian cyst; torsion of the omentum)
Blood (no trauma)	Ruptured ectopic gestation Ruptured lutein cyst Spontaneous rupture of the spleen Rupture of an aneurysm (e.g., of the splenic artery)
Chocolate-coloured fluid	*Thin*: Volvulus of pelvic colon *Thin*: Necrobiosis of uterine fibroid (fishy odour) *Thick*—Ruptured chocolate cyst of ovary
Clear, straw-coloured fluid	Intestinal obstruction Inflammatory lesions of the mucosa not requiring laparotomy (i.e., gastro-enteritis) Tuberculous peritonitis
Clear, sticky fluid, variously tinged; often dark green	Ruptured ovarian cyst
Porridge-like material	Ruptured dermoid cyst: of ovary Ruptured dermoid cyst: of mesentery
Crystal-clear fluid	Ruptured hydatid cyst

Of necessity this table is incomplete. From time to time the findings are bizarre. I have encountered beer (perforated gastric ulcer patient inebriated, but with obvious peritonitis); urine (spontaneous rupture of the bladder); and, on a number of occasions, a considerable quantity of fæces, but no useful purpose is served by encumbering the table with oddities which must be recognized and dealt with on common-sense principles.

When it is possible (and usually it is impossible) to have there and then in the operating theatre the result of a microscopical examination of a stained specimen of the peritoneal exudate, not only can the diagnosis of primary peritonitis be made with assurance, but the difficulties and complexities of when, and when not, to drain the peritoneal cavity (this will be considered in Chapter XVIII) would disappear like dew before the sun.

[1] The foul odour of peritoneal exudate is often due to gas-forming anærobic streptococci, and not to *Esch. coli* as so many believe.

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CHAPTER XVI

BURST ABDOMEN

DISRUPTION of the sutured abdominal wound occurs in at least 1 per cent of emergency laparotomy incisions, excluding gridiron incisions, which are practically immune. In a recent series of 1000 laparotomies analysed by R. L. Marsh et al. the incidence of dehiscence of all layers of the wound, including the peritoneum, was 3·7 per cent. If urgent paramedian laparotomies for an infected focus (perforated peptic ulcer, perforated appendicitis, etc.) are alone considered, the incidence was no less than 10 per cent.

Surprisingly, analyses of large series of cases show that the accident is not related to the suture material employed. For instance, the incidence is not lower in incisions closed by stainless steel wire than in those sutured with catgut (Tweedie and Long ; Joergenson and Smith).

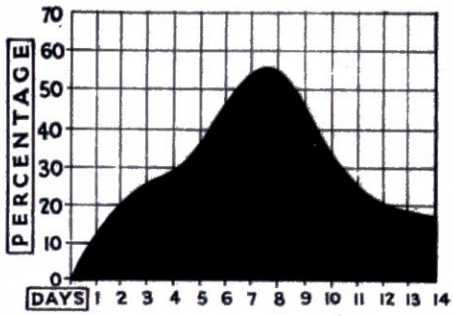

Fig. 211.—Time of disruption of the abdominal incision (Tweedie and Long's statistics).

Time of the Disruption.—Twenty-four per cent of cases occur between the second and the fifth days after operation ; 55 per cent between the sixth and the ninth days ; the remaining 21 per cent on or after the tenth day (*Fig.* 211).

Predisposing Causes.—

1. Hasty closure (from necessity).
2. Inaccurate apposition of the peritoneum.
3. Too early removal of tension sutures, which should remain in place for at least ten days.
4. Violent or persistent cough. Cough was a distressing symptom in a little less than half the cases (Joergenson and Smith).
5. Intestinal obstruction with distension.
6. Repeated vomiting (which should not be allowed to occur).
7. Persistent hiccup.
8. Infection of the wound.
9. Escaping pancreatic ferments.
10. Ascites.
11. Almost of equal importance are factors that retard wound healing : (*a*) Undernourishment, anæmia, advanced years, and malignant disease ; (*b*) A significant proportion of patients in whom disruption occurs have a low plasma-protein level, and particularly a low serum-albumin level ; (*c*) Vitamin-C deficiency definitely favours disruption as this vitamin is essential for the formation of collagen in tissue repair.
12. In most cases dehiscence of the deeper layers occurs some days before the wound actually bursts asunder ; indeed, it is probable that one or more of the peritoneal stitches snap or become untied within the first three days of operation. Sometimes the damage is done while the patient is coming round from the anæsthetic. A most potent factor in this respect is the violent coughing reflex set up if an endotracheal tube is withdrawn while the patient is but lightly anæsthetized.

Premonitory and Other Signs.—An otherwise unexplained, copious serosanguineous (pink) discharge from the wound is a forerunner of a burst abdomen in fully 50 per cent of cases. It is the most pathognomonic sign of impending wound disruption, and it signifies that intraperitoneal contents are lying extraperitoneally. When such a discharge occurs, the surgeon or his deputy should put on sterile gloves and palpate the immediate neighbourhood of the incision with great care. If a localized swelling can be felt, or a dehiscence detected in the deeper planes (especially when the abdominal musculature is rendered tense), arrangements should be made for the patient to be taken to the operating theatre for examination of the wound under anæsthesia.

In 50 per cent of cases the tell-tale serosanguineous discharge is absent, and the disruption occurs without warning. So it comes about that burst abdomens are of two varieties: the surgeon is summoned hastily because the wound has given way, and coils of intestine have prolapsed through the abdominal wall (*Fig.* 212). This is the common variety. The patient often volunteers the information that he felt 'something give way'. Pain and shock are often singularly absent. Less frequently the wound breaks open more quietly, revealing a mass of reddish tissue beneath. One hopes that this mass is the rectus muscle, but it nearly always turns out to be a coil of small intestine covered with granulation tissue. In other words, the abdominal wall has given way a few days previously, and the prolapsed coil has been covered only by the skin. Thus it comes about that if there is uncertainty as to the nature of the reddish tissue it is safer to ascertain this point in the operating theatre.

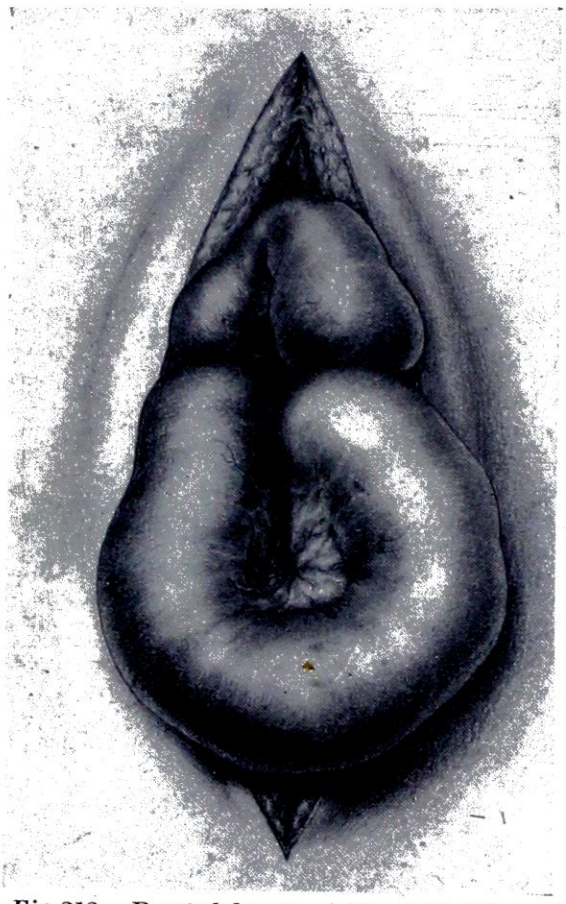

Fig. 212.—Burst abdomen. (*After A. M. Shipley.*)

First-aid Treatment.—In order to encourage the patient to lie quietly and to aid abdominal relaxation, a suitable dose of morphine is administered at once. The patient is exhorted not to cough, if he can possibly avoid it. The wound and prolapsed viscera are covered with sterile towels or packs wrung out in normal saline solution. These, in turn, are covered by abundant cotton-wool, and the whole is kept in place by a firmly applied many-tailed bandage. The patient must not be left for a moment. Should he desire to cough, the hands support the abdomen. The stomach is emptied with a gastric aspiration tube, which is left in place. An antibiotic with a wide range of activity, e.g., aureomycin, is injected intravenously.

Provided the patient is fit to undergo operation, arrangements are made forthwith. Even if the risk of operating is considered too great, unless the patient's condition is desperate he should be taken to the operating theatre for the non-operative treatment of burst abdomen (*see* p. 171).

RESUTURE OF THE ABDOMINAL WALL

When the patient's condition did not give rise to anxiety up to the time of the disruption, when shock is absent or responds readily to treatment, and when gross suppuration of the wound did not precede the bursting asunder of the wound, resuture is recommended.

Anæsthesia.—If, as is often the case, the patient has a severe cough, inhalation anæsthesia should be avoided, for the operation can be conducted under intravenous thiopentone and one of the curare-like drugs to ensure maximum relaxation. One per cent procaine infiltrated thoroughly into the subcutaneous tissues and the musculature along each lateral aspect of the abdomen 2–3 in. (5–7·5 cm.) from the wound produces a degree of anæsthesia and relaxation that permits resuture in spare subjects. To supplement local anæsthesia with a little thiopentone is a safe and efficient means of being enabled to carry out the operation fairly expeditiously.

Operation.—Prolapsed intestine and omentum are again washed with saline solution, and the skin of the abdominal wall is cleansed with ether, followed by alcohol. Blunt hooks placed beneath the extremities of the wound and a steady pull, mainly in an upward direction, are of great service; if the patient is conscious the assistant must be careful to avoid jerking these retractors. If the patient is relaxed and the intestine is not greatly distended, the viscera slide into the peritoneal cavity with trivial assistance. The greater omentum is spread out over them. It should be noted that if under half of the wound is disrupted one blunt hook only is used, and it is placed in the extremity nearest the

dehiscence. In these circumstances only the disrupted portion of the wound is repaired. When, as is more usually the case, more than half the wound is involved, the dehiscence is completed with the finger and, if necessary, scissors to cut the sutures : it is easier (and safer) to suture the whole of the incision afresh.

In order to protect the intestines and keep them in place, an abdominal pack is inserted, and on this is laid a Sargent's depressor (*see Fig.* 5, p. 2) or, if a McNealy's rubber guard (*see Fig.* 6, p. 2) is to hand, it can be used instead of the pack, and the Sargent's depressor may then be unnecessary. The edges of the wound will be seen to be œdematous and the peritoneum and posterior rectus sheath glued together and retracted beneath the rectus muscles. Obvious pieces of catgut and other suture materials are removed from the wound.

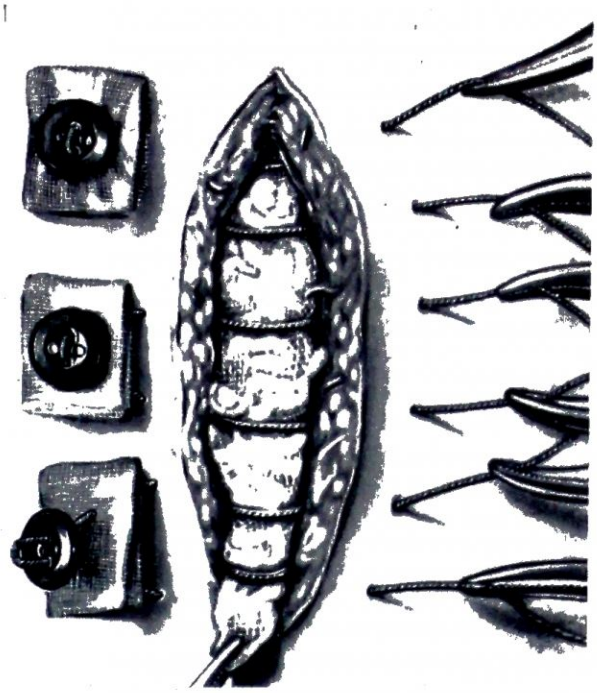

Fig. 213.—Very stout mattress silk sutures are passed through all layers. The illustration shows trouser buttons with petroleum-jelly gauze beneath to prevent cutting in. If these are not available, pieces of $\frac{1}{8}$ in. (3·2 mm.) diameter rubber tubing threaded on the mattress can be substituted.

It is useless to attempt to resuture the abdominal wall in layers. The œdematous retracted edges of the peritoneum are difficult to define, and will probably cut out when an attempt is made to approximate them.

Either of the following methods of resuturing the abdominal wall will be found to be satisfactory ; they do not differ in principle—only in the matter of suture material.

Great reliance can be placed in through-and-through mattress sutures, but the suture material must be *really strong* : heavy silk or stainless steel wire about 28 (or larger) gauge. Although stainless steel is somewhat difficult to pass, its advantage over silk is that it does not harbour infection. Silk has been tested in the crucible of experience, and unless one is accustomed to suturing with wire, this grave emergency is not the time to commence to do so.

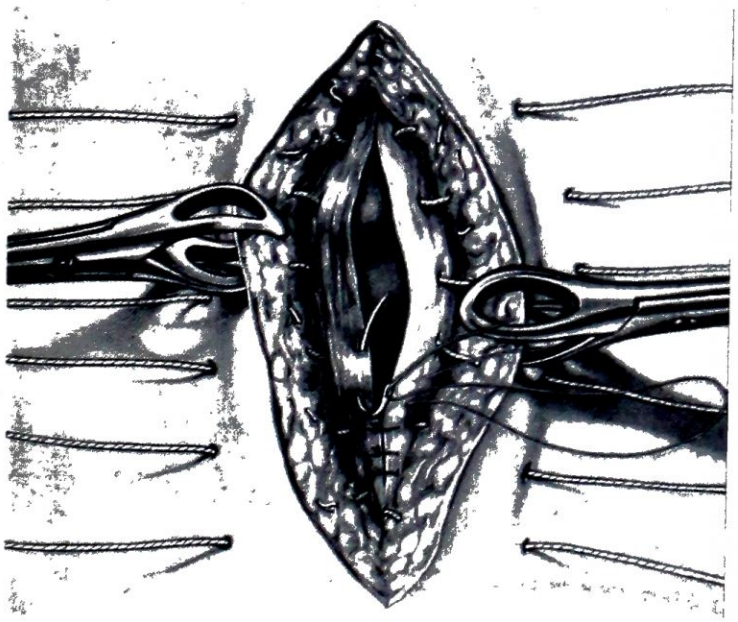

Fig. 214.—Method of closing the aponeurotic layer. The skin is dissected back on either side, and the needle is passed parallel to the wound edge, as shown.

Resuture using Thick Silk.—Employing a large curved cutting needle, the thick silk sutures traverse the abdominal wall quite an inch (2·5 cm.) from the edges of the wound (*Fig.* 213). Some device to prevent the mattress sutures cutting into the skin must be employed. The best is trouser buttons with petroleum-jelly gauze beneath, but fairly stout pieces of rubber tubing suitably threaded on the mattress can be substituted. When tying these through-and-through sutures it is essential to be certain that a coil of intestine has not been entrapped beneath one of them ; also that the abdominal pack, which remains until the last of them is to be tied, has not become entangled. As emphasized already, these mattress sutures are the mainstay, and are probably quite adequate to ensure

the integrity of the secondary closure. There is, however, a feeling of security in reinforcing them. The skin is reflected from the abdominal wall for a short distance on either side, care being taken not to cut the through-and-through sutures. Using interrupted stitches, preferably of very stout catgut, the needle is inserted parallel to the wound edge (*Fig.* 214). A grip of healthy tissue is thus obtained. Sufficient gaps between these stitches must be left to permit drainage. No intraperitoneal drainage is employed. The skin is approximated loosely. Corrugated rubber drainage of the subcutaneous tissue is advisable.

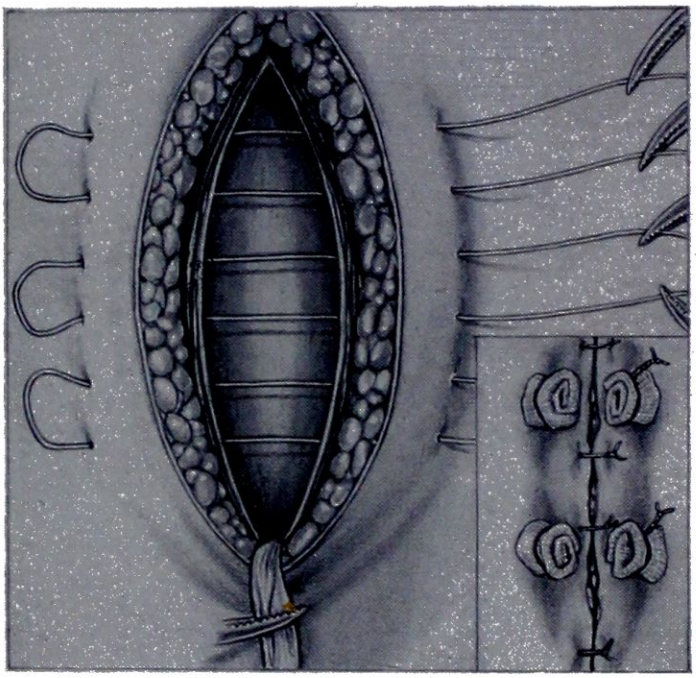

Fig. 215.—Stainless steel sutures passed through all layers of the abdominal wall. McNealy's rubber guard in use. (*Modified from Farquharson.*)

Resuture with Stainless Steel Wire.—The passage of this stout wire is made much easier if the wire is attached to the needle in the manner shown in *Fig.* 207, p. 164. The precautions regarding avoiding kinks in the wire, as described on p. 165, must be taken. The mattress sutures are passed through the abdominal wall in exactly the same manner as detailed for silk sutures. After all have been inserted (*Fig.* 215) they can, with advantage, be tied over swabs (*Fig.* 215, *inset*). Taking the precautions described already to ensure that each and all the sutures do not entrap a coil of intestine or the abdominal pack, the ends of the wire, to which hæmostats are attached, are tied by twisting; the first twist is the all-important one, for upon it depends the amount of tightening of the wire, which must be just sufficient to bring the cut surfaces of the abdominal wall into close apposition. Six to eight twists being accomplished, the ends are clipped fairly short, and their sharp extremities are twisted over towards the skin.

After resuture of the abdominal wall has been completed by either of the two methods described, the wound is painted with an antiseptic, and a large number of layers of gauze is applied. The dressings are retained by a many-tailed bandage over wool.

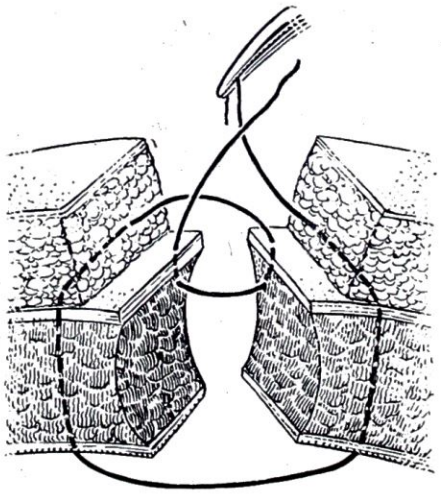

Fig. 216.—The Smead stitch.

The Smead Stitch for resuturing the Abdominal Wall.—When the general condition of the patient is good, abdominal distension is not great, and the anæsthetic provides perfect relaxation, the Smead stitch (*Fig.* 216) to approximate the peritoneum and the muscular layers can be used with advantage. The wound is closed from its extremities until only a few sutures in the centre are required to complete the closure. The sutures[1] should be placed about 1 cm. apart and the deep part of each about 1 cm. from the edges of the wound. The Smead method of suture permits closure of the skin with a row of interrupted sutures, and avoids the ugly cross-hatching

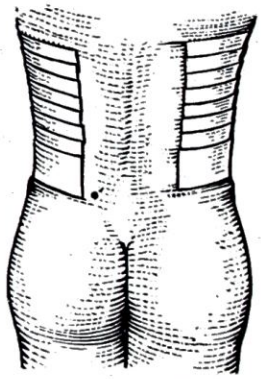

Fig. 217.—Showing how straps of encircling adhesive plaster should be applied (posterior view).

[1] Mersheimer and Winfield advise No. 00 cable wire for this purpose. It is easier to tie than stainless steel wire, and equals the latter in its non-irritating qualities.

scars that are inseparable from the use of through-and-through stitches. In strength, the Smead stitch compares favourably with the through-and-through variety.

Dressing the Wound.—Whatever method of suture is employed, after dressings have been applied the wound should be strapped by the imbrication of straps of adhesive plaster encircling two-thirds of the circumference of the trunk (*Fig.* 217). If it is to hand, an equally effective method is to apply a ready-made abdominal corset (*see Fig.* 221, p. 173).

NON-OPERATIVE TREATMENT OF BURST ABDOMEN

The advantages of well-conducted non-operative treatment should receive careful consideration. For a patient in poor condition there should be no option. It is also advised when the patient has a severe cough or other pulmonary complication. Another indication is a grossly infected wound before the disruption.

The method does not preclude the possibility of resuture of the abdominal wall when the patient's condition improves sufficiently ; on the other hand the method *per se* is often surprisingly successful although, of course, the incidence of post-operative ventral hernia is high.

Fig. 218.—The surgeon, exhorting the patient to relax, applies even pressure on the gauze-covered coils to reduce them into the abdomen as far as possible. The assistant makes certain that the plaster on the left has adhered firmly.

Technique.—When possible, it is preferable to undertake the treatment in an operating theatre. If it is necessary for the measures about to be described to be carried out with the patient in his bed it is of fundamental importance for the surgeon and his assistant to be masked, gowned, and gloved.

Only after the sedative has taken effect are the first-aid dressings removed. It is best to confine skin preparation to ether (which removes grease and therefore favours the adhesion of adhesive plaster) and alcohol. Even these relatively bland substances should be kept from coming into contact with the vulnerable serosa of the intestines. When coils of intestine are obviously soiled, they should be cleansed with dripping wet saline soaked swabs. Pieces of gauze wrung out in saline solution, so that they are merely damp, are prepared, each being of such a size as to cover and overlap the protruding viscera. After the coils have been gathered into the centre of the wound, a layer of gauze is applied and the surgeon reduces the prolapsed viscera as far as possible, and holds them with cupped hands, while the assistant tucks the edges of the gauze under the lips of the wound. Three to five such layers are applied. Strips of adhesive plaster (not flexible adhesive plaster) are cut. In the case of a disruption of a vertical incision, they should be long enough to extend across the abdomen from one posterior axillary line to the other. The skin is dried by the assistant, who removes her gloves, and applies a strip of adhesive plaster to the left side of the abdominal wall (*Fig.* 218). In order to make sure that it has adhered, she keeps it pressed on to the skin, while the surgeon takes the free end of the plaster and, rendering the strip taut, draws it across the gauze-covered protrusion (*Fig.* 219). The surgeon likewise takes precautions to ensure firm adhesion to the skin, and at the same time makes sure that the strip is really tight. Both surgeon and assistant keep up the pressure

Fig. 219.—The assistant, still ensuring that the plaster on the left adheres, places her right hand on the abdomen before the surgeon removes his left hand to take charge of the free end of the plaster.

until the plaster has stuck. The centre of the wound is treated first. Overlapping strips are applied above and below with the same care until the whole wound is covered. Each day, observing the same aseptic precautions, the adhesive plaster is re-applied. This is necessary, for within 24 hours the adhesive strips become slack, mainly because (if they have been applied properly) the evisceration is less. To prevent greater protrusion, should the patient cough or strain, the adhesive strips are removed and replaced one at a time. During this process it is desirable to change some of the outer pieces of gauze which are saturated with sanguineous secretion.

In certain instances, infiltration of procaine into the abdominal wall is helpful in effecting relaxation. It should be noted particularly that *the gauze square lying in immediate contact with the intestines should not be removed for four or even five days.* By this time it will be found that it is loose and can be peeled off without difficulty. When this has been done it should be possible to coapt the wound edges, especially if a good result to an enema was obtained half an hour previously.

AFTER-TREATMENT (All Cases)

Paralytic ileus is of such frequent occurrence that transnasal gastro-intestinal aspiration is advisable for some days in all patients whose intestines have prolapsed. Full supportive treatment includes fluids intravenously, blood transfusion, oxygen if required, antibiotic therapy, a high-protein intake, and vitamins. When resuture has been undertaken the through-and-through stitches should remain in place for 14–18 days, and then every other one removed. From thence forward, until sound healing has occurred, the wound must be supported by corsettage.

The remote after-care will include regular examination for the development of a ventral hernia.

THE PREVENTION OF BURST ABDOMEN

Unless the surgeon and those who care for the patient during the post-operative period strive to keep the possibility of wound disruption in mind, the incidence of a burst abdomen will continue to remain at least 1 in every 200 laparotomies, and if emergency laparotomies are alone considered, this incidence will be doubled. What happens is that after a case has occurred, suitable precautions are taken for a time but the memory of the case soon fades, and it requires another case to focus the team's attention on the simple, but all-important, measures detailed below—precautions that, if taken in time, will reduce the incidence of this complication very considerably.

(*a*) *The Surgeon.*—The most essential single aspect in the prevention of wound disruption is the intimate approximation of the edges of the peritoneum, so as to prevent the entrance of an omental wedge (W. I. Wolff). At the close of the operation in any patient who had a pre-operative cough, is (or is likely to become) distended, or is suffering from malnutrition, the surgeon will do well to apply corsettage to the abdomen instead of the more usual form of dressing.

(*b*) *The Anæsthetist* should avoid removing an endotracheal tube while the cough reflex is present. The provision of a Hewitt's airway while the patient is coming round from the anæsthetic will do much to prevent undue straining while the patient is regaining consciousness.

(*c*) *The House Surgeon,* on the surgeon's instruction, should as a routine ensure that the patient is receiving an appropriate intake of vitamin C and proteins. He should know that early ambulation, by preventing atelectasis, has probably lowered the incidence of this complication. If the patient has a hacking cough, the house surgeon should consult a medical colleague how best to keep the cough in subjection without detriment to the lungs. From the time he commences his duties, he should be alive to the significance of a sero-sanguineous discharge from a wound, and report it at once.

(*d*) *The Nursing Staff* should apply suitable abdominal corsets, without necessarily being asked to do so. This is such an excellent method of dressing abdominal wounds that it should be applied as a routine after all urgent laparotomies, and to the laparotomy wound of any patient who develops a cough, becomes distended, or is suffering from malnutrition.

Laparotomy corsets can be made of sheet adhesive plaster. A neat method of making a corset is that devised by Sir Robert Kelly. A piece of strapping is folded longitudinally,

not quite in the midline, its sticky side out. Nicks are made with scissors in the fold (*Fig.* 220 A) just large enough to allow a dressmaker's hook, but not its flattened arch,

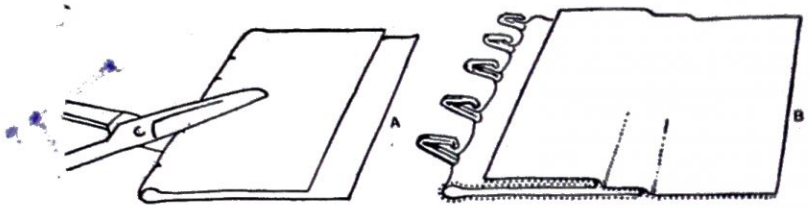

Fig. 220.—Kelly's method of fixing hooks to adhesive strapping.

to be pulled through. When enough hooks have been inserted, a second piece of strapping is placed over the first, sticky side down (*Fig.* 220 B). The strapping is fixed to the skin

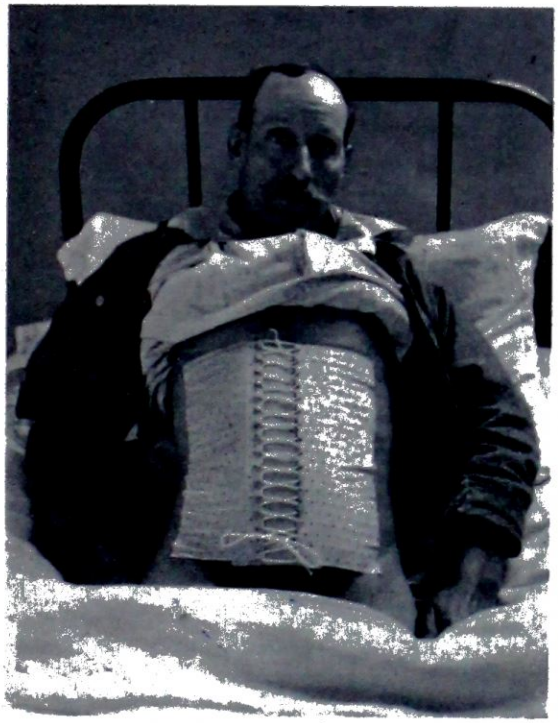

Fig. 221.—An abdominal corset in use.

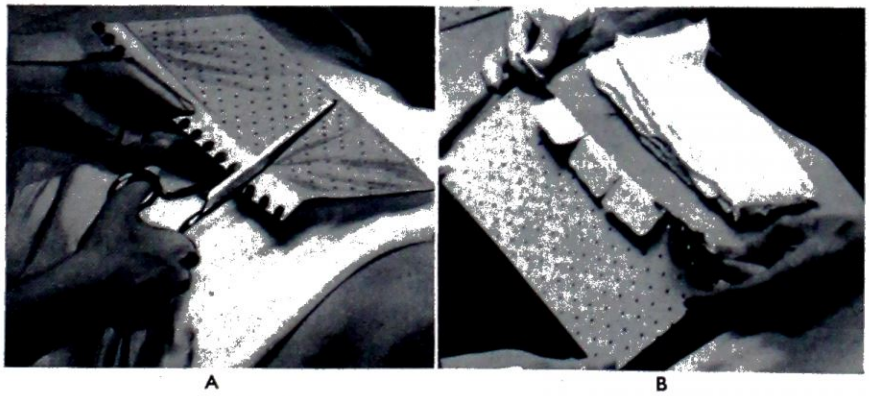

Fig. 222.—A, The reinforced edge of the corset is cut with strong scissors. B, When thus sectioned, the corset can be moulded to the shape of any abdomen.

parallel with and about one and a half inches (3·8 cm.) from the edges of the wound. The hooks are then laced with a length of stout silk.

An exceedingly good form of laparotomy corset is one ready made for use—it is usually required in a hurry. The ready-made corset[1] (*Fig.* 221) answers admirably, and

[1] Made by Charles Thackray Ltd., Leeds.

may well be at hand, for sooner or later it is sure to be needed. It is a good practice to section the corsets, as shown in *Fig.* 222 A and B. They are then less rigid and fit to the contour of the abdomen.

Mortality following burst abdomen varies very considerably in different reported series. It is as low as 11 per cent, and as high as 40 per cent. A mean may be taken from recent statistics of the Mayo Clinic, where the mortality is 18·1 per cent. What must be taken into consideration is that in all hospitals a certain number of the patients die after disruption of the wound, not on account of the disruption but from their disease, e.g., advanced malignant neoplasms.

G. P. McAdams gives the necropsy findings in 10 cases of burst abdomen, which disclosed diffuse peritonitis in 6, a fistula of the small intestine in 2, atelectasis in 1, and what appeared to be death from post-operative shock in the remaining case. Lowering of the mortality can only come about by very skilful choosing of those cases that should be treated by immediate resuture, those that should be treated by delayed resuture, and those in whom non-operative treatment should be employed.

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CHAPTER XVII

THE ABDOMINAL WALL AND THE EXTRAPERITONEAL TISSUE SPACE

THE importance of some of the conditions described under this heading lies in the fact that they mimic an intraperitoneal lesion. Many of them call for the surgeon's diagnostic acumen rather than his operative skill, but they should not be relegated to a back seat on that account.

HÆMATOMA OF THE RECTUS MUSCLE (TEARING OF THE INFERIOR EPIGASTRIC ARTERY)

This clinical entity occurs in three dissimilar types of individual, viz., elderly women, often thin and feeble; athletic muscular men, usually below middle age; and pregnant women, mainly in multipara and late in pregnancy.

The site of the hæmatoma is most often below the level of the linea semilunaris, where the posterior sheath of the rectus abdominis is lacking (*Fig.* 223), but it is not always in this situation.

Fig. 223.—The course of the inferior epigastric vessels. Note the site of the linea semilunaris. (*After Cullen.*)

A thin, pale woman of 56 sought advice concerning a lump in the left hypogastrium which, she said, had appeared suddenly while coughing two days previously. When the recti abdominales were rendered tense, it was apparent that the mass was beneath the abdominal musculature. Three days later the lump was much less tender and more in evidence. It was considered probable that the mass was a neoplasm, and the bout of coughing had called attention to the lump. Laparotomy revealed blood and clots between the peritoneum and the left rectus muscle. After a considerable amount of clot had been removed, the inferior epigastric artery was seen spurting—it had been torn right across.

In most cases it is the tearing asunder of the artery and possibly the vein that is the causative lesion, and rupture of the adjacent muscle-fibres plays an insignificant part.

Unless there is bruising or ecchymosis of the overlying skin, which is unusual in early cases, the diagnosis is difficult. One should always consider the possibility of hæmatoma of a rectus abdominis if an exquisitely tender lump appears in relation to this muscle after a bout of coughing. The conditions with which the hæmatoma is frequently confused are,

in the female a twisted ovarian cyst, and in both sexes, when the lump is on the right side, an appendix abscess. The sign most likely to be of value in differentiating a hæmatoma of the abdominal wall from these conditions, namely tensing the abdominal musculature, is often inapplicable because of the intense pain it causes.

A navvy was admitted with a tender lump in the right iliac fossa. He stated that he had experienced sudden pain in the right side while striking with a heavy hammer, eight hours previously. I paid little heed to the history of an accident, and thought the tender mass was probably an appendix abscess. At operation a surprisingly large quantity of blood and blood-clot was found between the deep surface of the rectus muscle and the fascia transversalis.

Again, the differential diagnosis between a strangulated Spigelian hernia (*see* p. 433) and a hæmatoma of the rectus abdominis is sometimes impossible. The absence of vomiting favours the latter, while a plain radiograph of the abdomen sometimes gives positive evidence of the former.

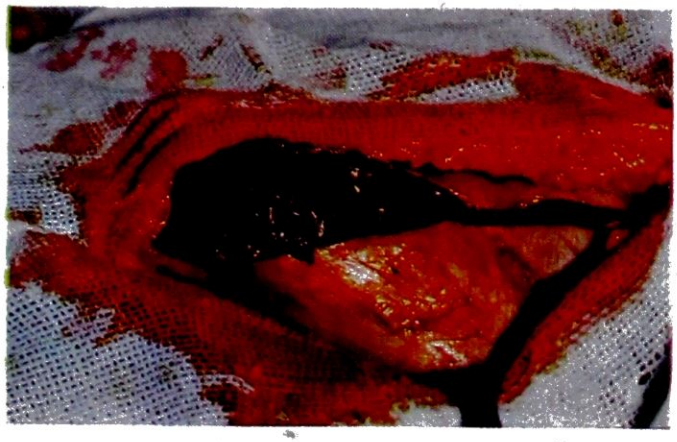

Fig. 224.—In this case of spontaneous rupture of the inferior epigastric artery, after the rectus sheath was incised blood-clot immediately extruded itself. (*W. F. Walker.*)

Hæmatoma of the rectus abdominis with tearing of the inferior epigastric artery is a supremely important diagnosis during pregnancy. If operation is performed, the fœtal mortality is 25 per cent (Sheehan). On the other hand, in the rare event of the diagnosis being certain, small as it is, one must take into consideration the danger to the life of the mother. Surprising to relate, the hæmorrhage into this closed space from a comparatively small artery can prove fatal. Hobbs's patient, a pregnant woman, died one hour after admission to hospital from the severity of the bleeding. At necropsy 3 pints (1·42 l.) of blood were found in the abdominal wall beneath the left rectus muscle.

Treatment.—In the majority of cases of hæmatoma of the rectus abdominis muscle, because of the concomitant tearing of the deep epigastric vessels, it is safer to operate. It is true that, with rest, resolution of a comparatively small hæmatoma is probable, but occasionally under expectant treatment renewed hæmorrhage has caused the hæmatoma to rupture into the peritoneal cavity. For this reason, as well as for uncertainty in diagnosis, expectant treatment should be reserved for those cases where the lump is small and ecchymoses in the overlying skin make the diagnosis certain. Operation consists in evacuating blood (*Fig.* 224) and clot and ligating bleeding vessels, if such can be identified. It is usually futile to attempt to repair the muscle—the stitches merely cut out. When hæmostasis is perfect the wound can be closed without drainage, but, if there is oozing, a corrugated rubber drain should not be omitted.

SPONTANEOUS THROMBOSIS OF A SUPERFICIAL EPIGASTRIC VEIN

This is a condition that is seldom described in the literature. Thrombosis of a superficial epigastric vein gives rise to pain in one or other iliac fossa; when situated on the right side, the symptoms are liable to be mistaken for those of appendicitis. On examination, beneath the skin there is an elongated, firm, pencil-like elevation which, in the early stages, is extremely tender (*Fig.* 225). Patients observed with this condition have been spare men; it is probable that the thrombosed vein is obscured when the abdominal wall is well covered with fat. Like other cases of thrombosis, the condition resolves, and all that is required is one week's rest in bed.

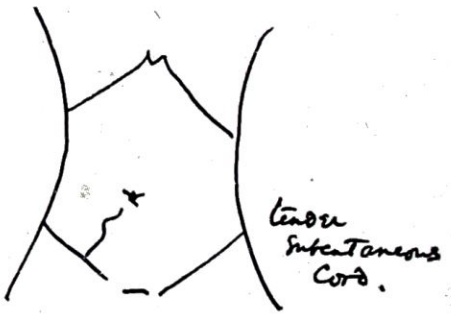

Fig. 225.—Facsimile of the diagram accompanying the notes of a case of spontaneous thrombosis of the right superficial epigastric vein.

POST-OPERATIVE CELLULITIS OF THE ABDOMINAL WALL

Pseudo-cellulitis (Post-operative Air Entrapment).—In case the reader is unfamiliar with the phenomenon of air entrapment in the subcutis after laparotomy, a brief description of this innocuous condition will be given.

Around the incision—indeed sometimes a considerable distance from it—unmistakable crepitation can be elicited. Although there are no general signs, those who have not seen or heard of the condition, on finding this crepitation, fear that gas gangrene is developing. Left alone, this curious surgical emphysema disappears in the course of a few days.

True Cellulitis can occur in any of the planes of the abdominal wall. Always a serious condition, the deeper the cellulitis the more it is to be feared—the zenith in this respect being cellulitis of the retroperitoneal tissues. (*See* p. 186.)

It should be noted that in superficial cellulitis of the abdominal wall crepitation is often detected; this is much more frequently due to *Esch. coli* than to the organisms of gas gangrene.

Superficial Cellulitis.—Because of pyrexia, the abdominal wound is inspected. That superficial cellulitis has developed cannot be mistaken. The earliest sign is that the stitches become embedded in the œdematous skin. Later there is a blush extending over a variable distance from the incision or the stitch holes. One should assemble the necessary materials to obtain a specimen of purulent fluid for bacteriological examination, together with a fine scalpel and a hæmostat for removal of a stitch, and a probe. The instruments are sterilized, and having scrubbed up and donned gloves, the wound is gently, but systematically, palpated for an area more indurated and tender than the remainder. This is a most important examination. If such an area is found, the stitch in the immediate vicinity is removed. It is usually necessary to separate the skin edges over a tiny area. If even one drop of serum or sero-pus escapes, one is rewarded by being given the opportunity to determine the infecting organism and its sensitivity to antibiotics.

Since a mixed infection is the rule, while awaiting the report, an antibiotic with a really wide antibacterial range is required, and the choice falls on one of the tetracyclines.

Laparotomy corsets should be applied. The wound is covered with a dry dressing; fomentations are not recommended. If no exudate is obtained, the examination must be repeated on the following day, but no further stitches are removed unless there are definite indications for so doing. Probing the deeper planes of the incision is sometimes rewarded by a gush of pus.

Cellulitis complicating a Fæcal Fistula seldom spreads for more than 1 in. (2·5 cm.) around the incision. The differential diagnosis between excoriation of the skin (*see* p. 529) and this condition must be made. Especially in artificial light, it is sometimes difficult to be sure which of these two conditions is present, but if induration can be felt, it is certainly cellulitis.

Spreading Cellulitis.—In spreading cellulitis the œdema and redness continue to extend from the edges of the wound towards the flanks.

Spreading cellulitis seems to occur under stereotyped, although divergent, circumstances, of which the following may be taken as leading examples.

Type A. After Operation for Strangulated Umbilical Hernia.—This is the most preventable type. If proper attention is given to the preparation of the skin (*see* Chapter XLV) and the subcutis is drained, even without antibiotic therapy the condition is unlikely to occur.

Type B. Commencing in a Stab Wound made Well Posteriorly in Cases of Retrocæcal Appendicitis.—Of necessity such stabs traverse vulnerable retroperitoneal tissues and a considerable thickness of fleshy muscle. In cases of frank appendix abscess a stab incision in this position is not necessary. In other cases (e.g., gangrenous retrocæcal appendicitis), fearing this complication, it is better to insert a soft drain, e.g., a Penrose wick drain, via a gridiron incision or, if a paramedian incision has been employed, through a counter-incision in the anterolateral abdominal wall.

Type C. As a Complication of Intestinal Leakage, e.g., after resection and anastomosis, especially of the large intestine.

The management of spreading cellulitis is similar to that described above, but should these measures prove inadequate, it is advisable to make an incision into the inflamed area on one or both sides, rather than to open up the laparotomy incision and risk a burst abdomen; however, incision is best avoided until undoubted softening occurs in some part

of the indurated area. The exception to this rule is in spreading cellulitis following partial colectomy, where, in addition to providing free drainage down to the site of the anastomosis, it may be advisable to perform urgent proximal colostomy.

Deep Cellulitis is more difficult to diagnose. Often the incision appears to be healing well. The leading signs are brawny œdema towards one or both flanks. Not infrequently there is œdema of the scrotum or vulva as well. These signs usually develop about the fifth day after operation, i.e., later than superficial cellulitis. Antibiotic therapy is the mainstay of treatment. Tenderness is variable, but when it persists it is a signal that an incision is required. The incision is made in the area of greatest tenderness. The muscle layers are incised cautiously until pus or purulent fluid is encountered. Drainage is most necessary.

Gas Gangrene of the Abdominal Wall is surprisingly rare. The presence of malodorous pus containing gas is more likely to be due to a commencing fæcal fistula than to gas gangrene. When, however, the skin takes on a bronze tinge, that is so characteristic of gas gangrene, and the wound discharges dark, blood-stained fluid with a 'mousy' odour, and crepitation can be elicited, no time should be lost in opening the wound and excising its gangrenous margins. Next, non-contractile, non-bleeding, and therefore non-viable muscle must be sacrificed ruthlessly, with the knowledge that a large ventral hernia is inevitable. It is usually necessary to saucerize the wound, leaving only the diaphanous peritoneum at its base. Into this excavation hydrogen peroxide is instilled, after which the wound is irrigated with saline solution in order to remove debris. The wound is filled with gauze moistened with hydrogen peroxide. Into the muscles at the periphery is injected, at intervals, 100,000 units of polyvalent anti-gas-gangrene serum. The systemic treatment of gas gangrene with antibiotics and anti-gas-gangrene serum is described on p. 132.

PROGRESSIVE POST-OPERATIVE SUBCUTANEOUS GANGRENE

This distressing clinical entity (also known as Meleney's ulceration because it was Dr. F. Meleney, of New York, who brought the condition to notice) is fortunately rare. Most of the reported cases have followed abdominal operations for a perforated viscus,

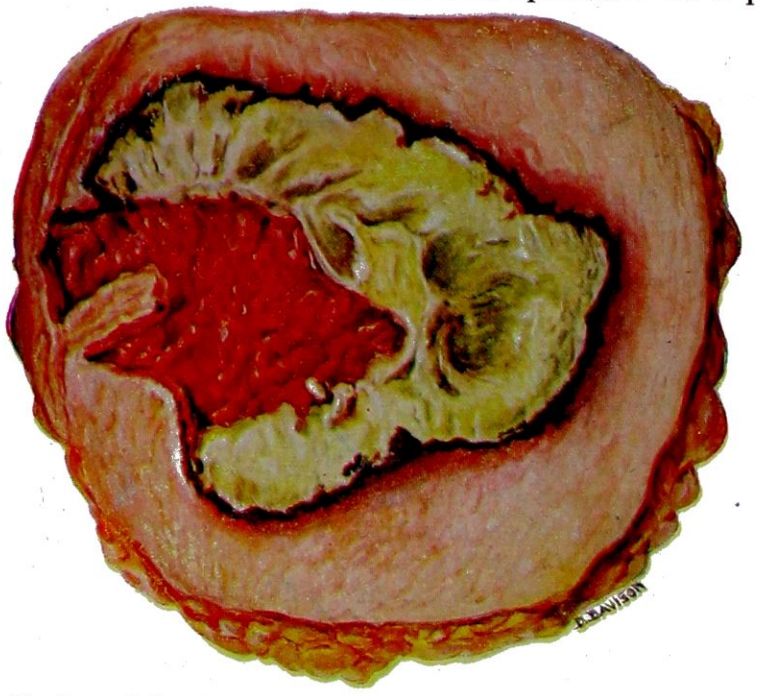

Fig. 226.—Portion of the abdominal wall excised in a case of progressive post-operative subcutaneous gangrene following an operation for a perforated duodenal ulcer. (*H. T. Cox.*)

notably that occurring in connexion with acute appendicitis, but the superficial tissues around empyema and suprapubic wounds are not exempt. There is severe pain in the wound, but only somewhat late in the course of the complication are constitutional symptoms much in evidence; they then take the form of (comparatively) apyrexial increasing toxæmia. This curious superficial gangrene (*Fig.* 226) progresses slowly, but relentlessly.

Meleney has shown that the condition is due to symbiotic infection of a non-hæmolytic streptococcus and (usually) the *Staph. aureus hæmolyticus.*

Treatment.—Excision of the involved area, formerly the standard method of treatment, is now unnecessary. To start with, systemic penicillin and streptomycin are employed, but if the sensitivity tests of the causative organisms so indicate, these antibiotics are changed. The report by Meleney of 5 cases treated with bacitracin, in 4 of which penicillin had proved ineffective, indicates that the administration of bacitracin is the treatment of choice.

The best local application is zinc peroxide paste. It is essential for the zinc peroxide powder to be sterilized in an oven at 140° C. for four hours before use. Zinc peroxide powder and sterile water (equal parts) make a smooth cream.

The paste is applied directly to the wound, and covered with two layers of gauze impregnated with the paste; this, in turn, is covered by petroleum-jelly gauze. The dressings are changed daily. This treatment is continued for fourteen days, by which time the area should present a clean, healthy, granulating surface, to which skin grafts can be applied.

In all the infections of the abdominal wall described above general treatment is most necessary, for it is probable that the patient's defensive mechanism is defective. Anæmia must be corrected with iron or small blood transfusions, and a high-protein diet with ample vitamin intake is advisable.

OMPHALITIS

When the umbilical cord becomes infected, with antibiotic therapy (penicillin and streptomycin, unless sensitivity tests dictate otherwise) the inflammation often remains strictly localized. By employing warm, moist gauze dressings, the crusts separate, giving exit to purulent exudate. Exuberant granulation tissue frequently forms, and requires the application of silver nitrate. After the granulations have been destroyed epithelialization occurs rapidly.

Infection of the umbilicus is liable to spread along the defunct hypogastric arteries and umbilical vein (*Fig.* 227). The fact that these vessels are separated from the abdominal cavity by only a single layer of peritoneum and a little areolar tissue makes the vulnerability of the peritoneal cavity to invading umbilical infections at once apparent. Necropsy studies have shown that the lumina of these vessels may contain only partially organized clot up to 50 days after birth. Consequently infection of the peritoneum via the umbilicus is possible until the age of six weeks.

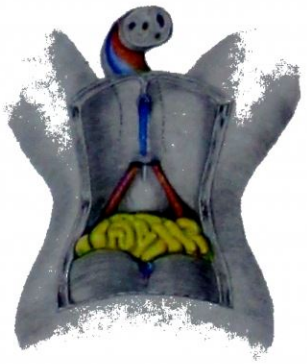

Fig. 227. — Seven months' fœtus, showing disposition of the umbilical vessels and the allantois from within the abdomen. (*After Max Brodel.*)

In any given case, one or more of the following complications may supervene :—

1. Cellulitis of the Abdominal Wall is often the precursor of :—

2. Abscess of the Abdominal Wall, which occurs particularly along a hypogastric artery or, less frequently, in association with the falciform ligament (umbilical vein).

If gentle pressure exerted below or above the navel causes a bead of pus to exude from the umbilicus, it is extremely probable that a deep abscess associated with one of the defunct umbilical blood-vessels is present. Employing extreme delicacy, the tiny umbilical opening is investigated with a fine probe. If the sinus leads downwards along the course of a hypogastric artery, the probe is removed and a grooved director is passed down the tract. The full thickness of the abdominal wall is divided with a scalpel, keeping strictly to the groove of the director. Only in this way can opening the peritoneum be avoided with assurance. It may be possible to open an abscess above the umbilicus by the same technique, but usually it has to be drained by a direct incision in the middle line.

3. Extensive Ulceration of the Abdominal Wall is treated in the same way as progressive post-operative subcutaneous gangrene (*see above*).

4. Septicæmia can occur by infection entering the blood-stream via the umbilical vein. In addition to the usual signs of a blood-stream infection, jaundice is liable to occur. If abscesses (e.g., dactylitis) develop, they must be drained; in particular an abscess above the umbilicus should be sought.

5. Peritonitis carries a bad prognosis. If an abscess of the abdominal wall is present, it should be drained; it is failure to drain such an abscess early enough that is often the

cause of the peritonitis. In the first place the treatment of the peritonitis is conservative. When an appreciable amount of peritoneal fluid is present, the insertion of an intraperitoneal suprapubic drainage tube should not be delayed. In both septicæmia and peritonitis blood transfusion is indicated.

SUPPURATING DEEP ILIAC LYMPH-NODES

Acute inflammation of the deep iliac lymph-nodes forms a clinical entity that has not received the attention it deserves; it is far from rare, and often gives rise to serious symptoms. Acute appendicitis (when the right side is involved), acute purulent arthritis of the hip-joint, and acute osteomyelitis of the upper end of the femur are the conditions

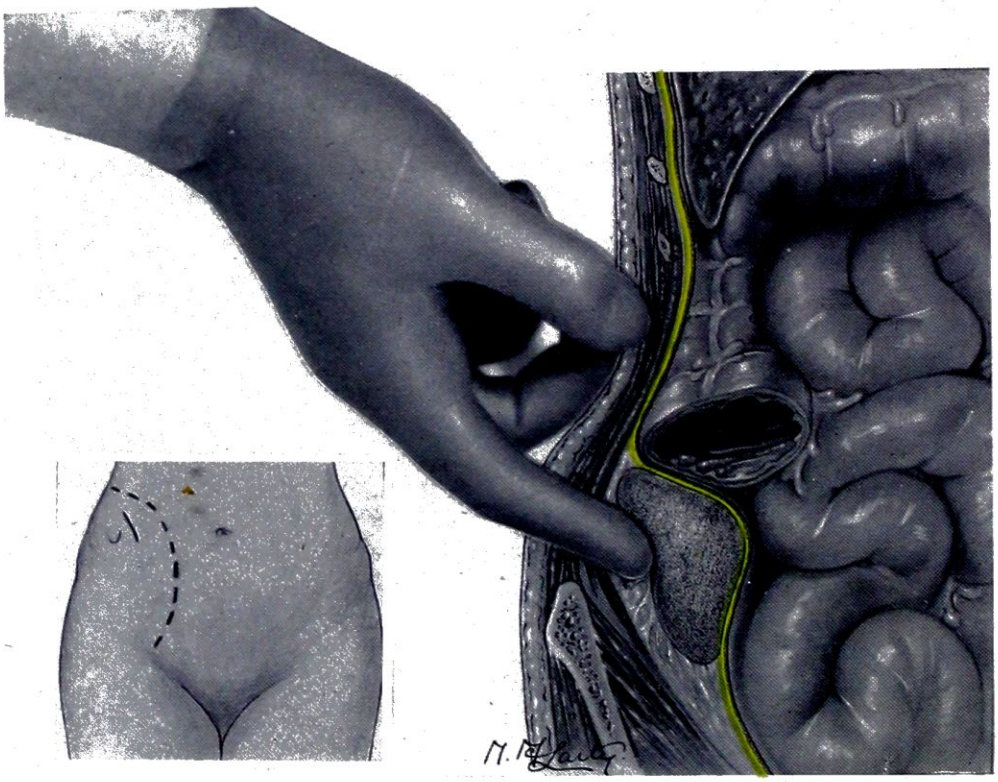

Fig. 228.—Incision for draining suppurating deep iliac lymph-nodes, and method of opening an abscess connected therewith.

which are particularly likely to resemble it. To fail to recognize the condition, or confound it with those diseases that it mimics, is likely to prove a serious matter. Psoas spasm is a leading feature, particularly in the early stages of the disease. Curiously, the superficial lymph-nodes are quite often uninvolved, which adds to the difficulty in diagnosis. In about three-quarters of cases a focus of infection in the shape of a scratch or a sore can be found in the relevant areas drained by the deep lymph-nodes.

Once a confident diagnosis has been made, there is no occasion to operate for at least a few days. With antibiotic therapy, over 30 per cent of cases resolve slowly (2 to 3 weeks). In cases where the swelling is not getting smaller, or there are other reasons to suspect an abscess has formed, operation should not be delayed. The incision should be made on the medial side of the anterior superior iliac spine (*Fig.* 228), care being taken that the peritoneum is not opened. If by error (usually in diagnosis) the peritoneum is opened and the abscess is found to be extraperitoneal and unconnected with the appendix, the peritoneum should be closed and the abscess drained through a lateral stab incision.

Case 1.—A fish-frier, aged 39, suddenly felt pain in the right groin which later spread over the whole abdomen. He vomited twice and went to bed. Thirty-six hours later he was sent to hospital and diagnosed as acute appendicitis. On examination the right thigh was slightly flexed but could be extended voluntarily. The superficial inguinal lymph-nodes on the right side were found enlarged and tender. A tender lump was found above the inguinal ligament. On examining the leg an infected blister was found on the heel. Three days later an extraperitoneal abscess was drained.

Case 2.—A boy, aged 7, was admitted as ? osteomyelitis of the head of the femur, ? left-sided appendicitis. He was gravely ill. The left thigh was flexed 30° and the spine was arched from the bed. There was an indurated painful swelling just above the inguinal ligament. The superficial inguinal lymph-nodes were not enlarged. Over the shin there was a healing sore. Eight days later pus was evacuated by an incision below and internal to the anterior superior iliac spine.

Case 3.—A youth, aged 17, whilst coming out of a picture palace, experienced acute pain in the right groin. He went home to bed. Two days later he got up and went to work. After half an hour he had to return home. Soon afterwards he vomited five times. On the sixth day he was admitted to hospital. His right hip was flexed and he looked very ill. He had passed no urine for twelve hours, and the bladder was distended. A catheter withdrew normal urine (reflex retention). Tenderness was marked just above the inguinal ligament. The superficial inguinal lymph-nodes on the right side were enlarged and tender. No primary lesion could be discovered on the limb. Three weeks later the symptoms had abated entirely. A complete urinary investigation was negative. Appendicectomy was performed and the organ was found to be normal.

Case 4.—A boy, aged 7, had pain in the abdomen for a week. On examination the right hip was flexed. Extreme tenderness and some rigidity were present in the right iliac fossa. As there was no sign of a testis on the right side a diagnosis of ? torsion of an abdominal testis was made. Under the anæsthetic a lump was felt in the right iliac fossa. The peritoneum was opened through a gridiron incision. The appendix was normal and accessible, so it was removed. The lump was found to be extraperitoneal. After closing the peritoneum the fascia transversalis was stripped laterally off the internal oblique until the abscess wall was reached. The abscess was then drained through a stab incision and the original wound closed. A thorough examination of the limb did not reveal a primary focus.

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CHAPTER XVIII

DRAINAGE OF THE PERITONEAL CAVITY, THE RETRO-PERITONEAL SPACES, AND THE ABDOMINAL WALL

A CYNIC has remarked: "Books are no good, for what book tells you when to put in a drainage tube?" While recognizing that there is an element of truth in this remark, an earnest endeavour will be made in this chapter, and in the appropriate sections of the chapters that follow, to set out when, when not, and how to drain the multitudinous wounds, incisions, anatomical spaces, and pathological cavities that the emergency surgeon encounters or creates in the course of his work.

Many of these endeavours to expound the principles of drainage will fail, and fail miserably, unless the operator explains to those who will be in attendance upon the patient why he inserted the drain and how he wishes it to be managed. The time to do this is before the patient leaves the operating theatre, and the surgeon will find that usually it is safer to dictate written instructions. If this simple injunction is not heeded, sooner or later there is bound to be trouble. When the surgeon has not complete confidence, founded on personal knowledge, in those who are looking after the patient, he should attend to the drain himself, or at least personally supervise its management.

Indications for Draining the Peritoneal Cavity.—The past thirty-five years have seen a great change in the matter of drainage of the peritoneal cavity. Nowadays tubes are not inserted in order to be on the safe side; indeed, Lawson Tait's maxim "When in doubt, drain" has been revised, and "When in doubt, don't drain" is the watchword. Tolerance in the matter of drainage has done much to enhance convalescence. Fæcal fistulæ (often the result of pressure necrosis of a tube on the gut wall) are less common. Secondary hæmorrhage from pressure necrosis of the external iliac artery (due to the obsolete practice of passing a tube via a lateral appendix incision into the pelvis) is an almost unheard-of tragedy. Post-operative hernia is less common. Above all, the danger of post-operative intestinal obstruction is minimized. Omitting unnecessary drainage and lessening the time drainage tubes are left in situ have undoubtedly played a part in improving results.

The great indications for drainage are: (1) The presence of a considerable quantity of free purulent material in the peritoneal sac; (2) When perfect hæmostasis is impossible; (3) The presence of an abscess; (4) When leakage of bile is anticipated or has, in fact, occurred.

> "*Tell me, I beseech thee, wherein thy great strength lieth*"—*Judges* xvi. 6.
> (Douai Version.)

Many surgeons seem to regard the peritoneum as being possessed of occult powers to resist and destroy pathological organisms—some unexplained property not vouchsafed to other tissues. On numerous occasions while dissecting a veil-like hernial sac, or mobilizing a sheet of peritoneum in the course of some abdominal operation, I have reflected on this hypothesis, and have always come to the conclusion that it is unsatisfying. While admitting that the peritoneum can readily absorb fluid, and even fine particulate matter, it is best to regard the *peritoneal exudate* as possessing the bactericidal properties that befriend the surgeon's efforts. Surely it is the very frailness of this metaphorical cobweb of endothelium that allows an unbridled migration of leucocytes and a swift and copious outpouring of serous fluid rich in natural antibodies, and, if they are in the circulation, antibiotics.

To drain or not to drain the peritoneal cavity; that is the question. Those who are opposed to drainage stated that animal experiments demonstrate that it is impossible to drain the whole peritoneal cavity for more than a few hours, which is certainly true. Furthermore, necropsies following tube drainage show that within forty-eight hours that part of a drainage tube within the peritoneal cavity becomes isolated by plastic adhesions. After that time the drainage tube, having become shut off from the general peritoneal cavity, continues to drain the sinus it has produced for itself, and to drain that only.

Notwithstanding, one must not lose sight of the fact that if a drain is properly placed it will provide a means for pus to escape, instead of accumulating in the locality served by the drain.

It is to be deplored that sometimes the desire to be 'up to date' outweighs the canons of common sense and the dictates of reasoning. Sir Alan Newton did not exaggerate when he lamented that "many appear to believe that it is tantamount to surgical incompetence to drain the abdomen". He went on to show that at the Royal Melbourne Hospital the slavish following of the fashion of omitting drainage without really studying the problem led to residual abscesses and more serious complications. It is only too true that in spite of the fact that the pioneers of 'when in doubt, don't drain' were careful to stipulate that they wished to rationalize drainage (i.e., not to have a rule of thumb; not to drain without reason) many would-be followers of the newer régime looked askance at those who continued to drain. They lost sight of the fact that some exponents of drainage at the least provocation obtained first-class results, not, I believe, because of the unbridled drainage, but because they had the services of trained ward Sisters, who personally carried out the after-treatment taught them by the exponent. It is a truism that the *properly-managed* drainage tube can do little harm.

Weighty evidence of the value of drainage in cases of perforated appendicitis is furnished by Fowler and Bollinger. In 128 cases of perforated appendicitis treated by appendicectomy *without drainage*, but with full parenteral antibiotic therapy, 19 developed an intraperitoneal abscess (usually in the pelvis), 6 an abscess of the abdominal wall, while 4 suffered from severe paralytic ileus. One patient sustained a burst abdomen. Most of these severe complications could have been prevented by appropriate drainage.

When to drain is, to a large measure, founded upon the physical characteristics of this exudate (*see* p. 166). One must realize that milky fluid is not necessarily pus (the milkiness may be due to live leucocytes); that slightly red-tinged, clear fluid may be a most lethal emulsion of streptococci; that an astute surgeon uses his nose as well as his eyes, consequently "Is the exudate odourless or not?" is a consideration that assumes a position of cardinal importance. There are grades of odours, and different odours, that are impossible to describe. In conjunction with the physical characteristics of the exudate the pulse-rate must be taken into consideration. When the surgeon considers that the pulse-rate is elevated because of peritonitis he should be more ready to drain than not to drain.

In this work it is our aim neither to sew up completely without a reason nor to drain without a reason. Having elected to drain, we (I include the reader) are not ashamed of our act; on the contrary, we noise it abroad and instil into our team the reasons for its employment. Last, but not least, we are resolved not to leave turning, shortening, substitution for another, and, above all, the final removal of the tube—all incidents of prime, nay vital, importance—to the vagaries of chance.

How Long should an Intraperitoneal Drainage Tube be left in?

An intraperitoneal suprapubic drainage tube, while often a life-saving measure, becomes, if unattended, a menace. After forty-eight hours the tube must be turned and it should be shortened. It is only by attention to these points that a fæcal fistula and intestinal obstruction can be avoided. Picture a drainage tube passing into the rectovesical pouch; coils of intestine must be in juxtaposition to the tube. If the tube is left undisturbed, pressure necrosis of an adjacent coil of intestine is almost bound to occur; that such neglect favours intestinal obstruction is equally evident (*Fig.* 229). After being in place for forty-eight hours the retaining stitch should be cut, the tube turned, and a safety-pin inserted through the tube. Usually on the third day the tube should be shortened considerably. Unless there are reasons to the contrary, it is a good practice to remove the tube[1] on the third day and substitute a piece of corrugated rubber, but there is no fundamental objection to leaving a *short* tube through the abdominal wall.

There is seldom any difficulty encountered in placing a piece of corrugated rubber along the track left by a recently removed suprapubic drainage tube, particularly if the

[1] When a comparatively large intraperitoneal tube has been removed it is worth while remembering that a knuckle of small intestine may enter the aperture which persists for a short time in the abdominal wall. In the event of symptoms of intestinal obstruction arising suddenly soon after the removal of the tube, as a first step in their investigation a well-lubricated gloved finger passed into the track will enable prolapsed intestine to be felt, and reduced into the abdominal cavity. To fill the track with petroleum-jelly gauze will prevent recurrence.

tube employed was a large one. On the other hand, especially in other situations and in all when the diameter of the tube was less than half an inch, it requires skill greater than that to be expected of an average nurse to place the soft rubber material suitably. In such cases a large rubber urethral catheter can be recommended. It is passed along the

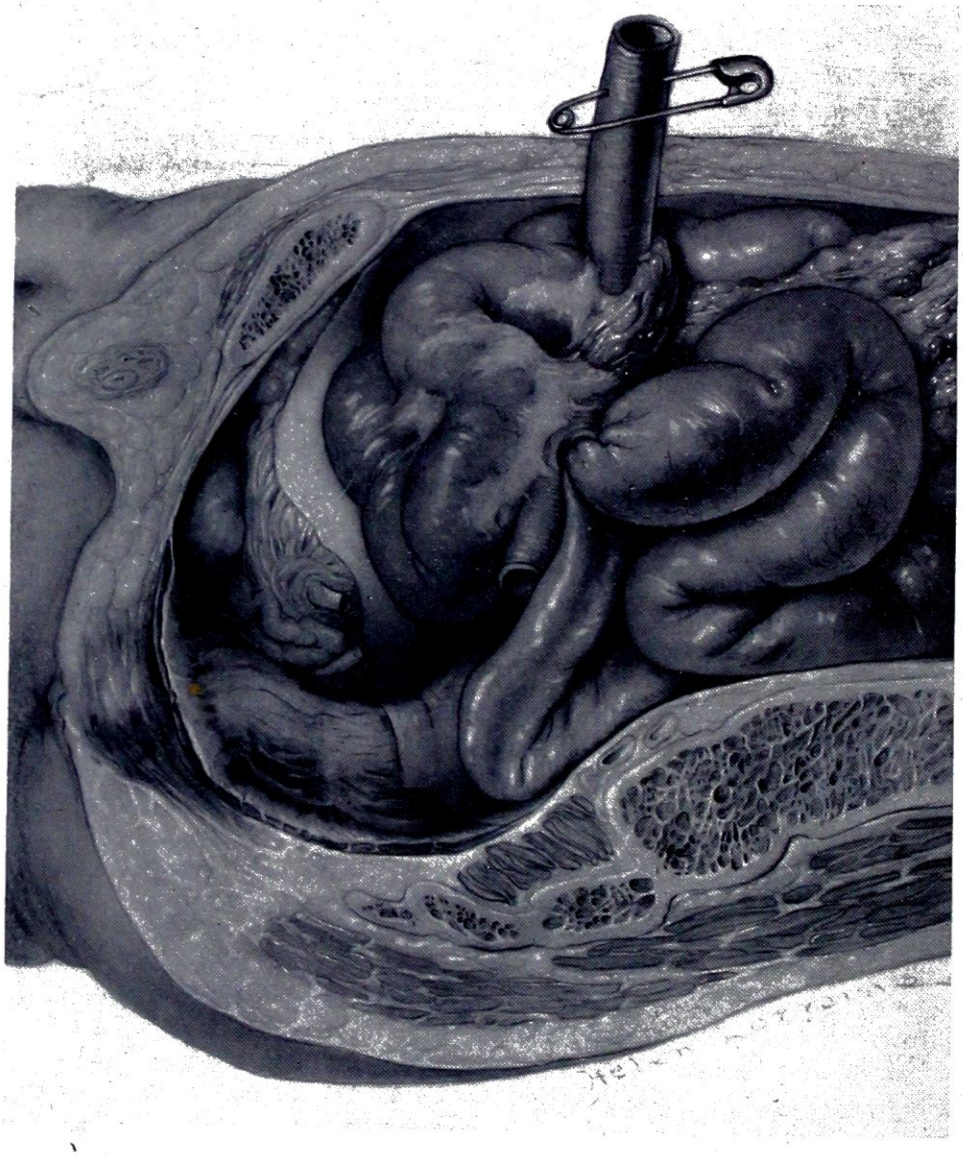


Fig. 229.—The menace of an unattended drainage tube reaches its zenith in the greatest indication for its intelligent use. Note the coils of small intestine clinging to the tube, and a portion of a coil becoming sucked into a lateral hole. Who can wonder that intestinal obstruction is imminent?

track but only sufficient of the catheter to go through the abdominal wall is retained. A good-sized safety-pin transfixes the catheter at the chosen point, and the excess is cut off (*see Fig.* 230). This is not wasteful ; the excess of the catheter can be put back into the drainage tube stock, while the portion in use can be boiled and used over and over again.

In the case of *a localized intraperitoneal abscess*, drainage should be continued until the exudate becomes serous. After ten days a sinus will become established, and by that time the tube can be removed entirely, even if the exudate is still purulent.

Drainage of the Abdominal Wall and the Retroperitoneal Tissues.—When, after the removal of an infected focus or suture of a perforated viscus, it is deemed safe to close the peritoneal cavity, the advisability of draining the abdominal wall requires lenient considera- tion. In this instance the watchword should be " When in doubt, provide some form of drainage ", even if it be only a narrow strip of rubber glove in the subcutaneous tissues. Drainage of the superficial layers of the abdominal wall cannot possibly do any harm, and in a rather high proportion of cases if such drainage is omitted, convalescence will be delayed

DRAINAGE MATERIALS AND METHODS OF ANCHORING THEM

Fig. 231.—The 'bank-roll' method of storing drainage tubes ready for sterilization.

Fig. 233.—Various types of rubber drains: A, Glove drain; B, Corrugated rubber drain; C, Rubber drainage tube.

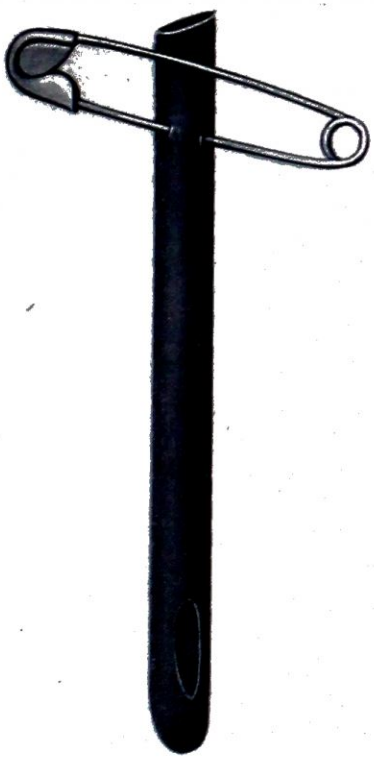


Fig. 230.—The end of a rubber catheter transfixed with a safety-pin is very suitable material for keeping open the track through the abdominal wall after a drainage tube has been removed.

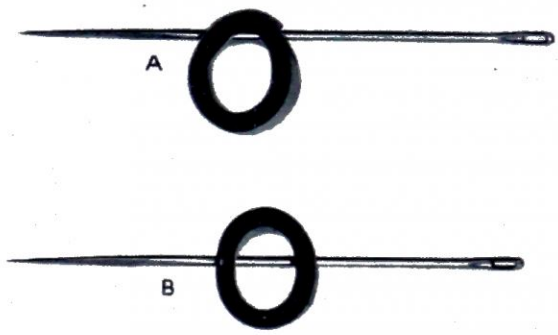


Fig. 234.—A, Correct method of passing a stitch through a drainage tube; B, Incorrect method—when the suture is tied the lumen of the tube will be almost obliterated.

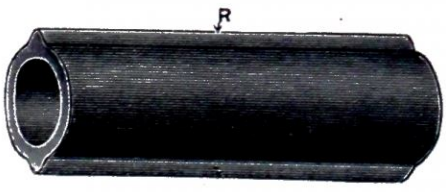


Fig. 235.—Greenwood's rubber drainage tube. The anchoring stitch passes through one of the ridges (R) and thus cannot constrict the lumen of the tube. Also leakage at the point of perforation by the stitch is obviated.

by wound infection. In cases where the retroperitoneal tissues are unquestionably infected, as is pointed out in several sections of this work, the freest possible drainage should be provided, and there should be no hurry to take out the drainage tube or tubes. They should, however, be turned after forty-eight hours.

In order to counteract the popular teaching that *all* drainage tubes should be removed after forty-eight hours, when dealing with a drainage tube in the perirenal tissues, an excellent dictum is : " It is better to leave a tube in the perinephric space a week too long than take it out a day too early ".

MATERIALS FOR, AND METHODS OF, DRAINING THE PERITONEAL CAVITY

Rubber versus Plastic Tubing.—Polythene is less irritating to the tissues and, unlike rubber, does not become easily and deeply infected. Polythene tubing loses some of its pliability at each sterilization, becoming more rigid, whereas rubber can be boiled over and over again. Polythene is much more suitable for use in the Tropics, where rubber becomes useless in a very short time.

Drainage Tubes.—In every emergency operation these should be at hand. The ' bank-roll ' method (*Fig.* 231) of storing a selection of rubber drainage tubes is very

Fig. 232.—A suprapubic drainage tube about to be inserted. Note that various tubes are being offered, in order that the surgeon may make his own selection.

convenient. The roll is sterilized by boiling, and when a drainage tube is required the packet is unrolled and placed before the surgeon (*Fig.* 232), who selects a tube to his liking (*Fig.* 233).

Before use, the distal end of the tube is bevelled. Most surgeons cut one or more side holes, but considerable thought should be given to this step ; it should be remembered that side holes render that part of the tube beyond a side hole ineffective, and that the ingress of fluid through a large side hole is likely to attract a portion of small intestine, which not only blocks the hole until the tube is turned, but is a probable cause of angulation that may lead to intestinal obstruction. Side holes should, therefore, be small.

Corrugated Rubber is a valuable form of drainage material. It can be cut so as to contain 2, 3, or 4 corrugations. Corrugated rubber is employed when it is desired to drain the deeper layers of the abdominal wall. Several references to it will be made in this work.

Glove Drain.—A piece of rubber glove about 1 in. (2·5 cm.) wide and 2 in. (5 cm.) long, rolled longitudinally into a scroll, is excellent when it is considered advisable to drain the

subcutaneous tissues only—for instance, when hæmostasis of the abdominal wall is not perfect.

All drainage tubes and other drainage material should be anchored to the skin by a stitch. In the case of a drainage tube the stitch should pass through one side of the tube, and not through its centre (*Fig.* 234): if a stitch traverses the middle of the tube, when the stitch is tied the tube will be compressed. Greenwood's drainage tube (*Fig.* 235) is an improvement on the simple circular tube. The stitch is passed through the ridge.

Insertion of a Suprapubic Drainage Tube.—Suprapubic drainage, the best method of draining the pelvis and general peritoneal cavity, is required most often after the abdominal cavity has been opened already by another incision. When this is the case

Fig. 236.—Supplementary suprapubic drainage. Making the incision.

Fig. 237.—Supplementary suprapubic drainage. Method of inserting the tube.

suprapubic drainage may be carried out as follows: through the original incision the left hand is introduced in the case of a laparotomy wound, or the fingers of the left hand in the case of a gridiron incision, and the middle line above the pubis is sought from within. The median plane is recognized easily by touch as a shallow trough between the two recti. By running the finger up and down in this groove it is ascertained that nothing intervenes between the peritoneum and the gloved finger. Having selected the point above the symphysis pubis, the index finger is passed to the left and the middle finger to the right of the midline. Exerting upward pressure with these two fingers, cut down between them (*Fig.* 236). The cut extends to the peritoneum. If the latter is opened, so much the better; if not, the index finger pushes up the peritoneum, when it is picked up in a hæmostat and incised. The drainage tube, held in a pair of forceps (*Fig.* 237), is guided by the index finger, and once within the peritoneum is grasped and conducted to the bottom of the rectovesical pouch. After it has been ascertained that the tube is lying correctly, it is anchored to the skin by a stitch. Often another stitch is required to close the skin snugly but not tightly about the tube. The excess tubing is cut off; it is a mistake to cut it flush with the skin; it should project above the skin level about half an inch. Before the dressings are applied, it is an excellent practice to place a sterile safety-pin through the tube to prevent it being lost within—a rare but embarrassing complication (*Fig.* 238).

Alternative Method.—Some experienced operators find a thimble on the left index finger a useful instrument. A disadvantage is that the thimble robs one of the sense of touch, and as a consequence it is possible to wound a coil of intestine when cutting down upon the encased finger-tip.

Fig. 238.—Radiograph showing a drainage tube which was lost in the peritoneal cavity. A safety-pin through a suprapubic drainage tube prevents this accident. The other tubes shown are a catheter in the rectum and a second catheter through the suprapubic incision.

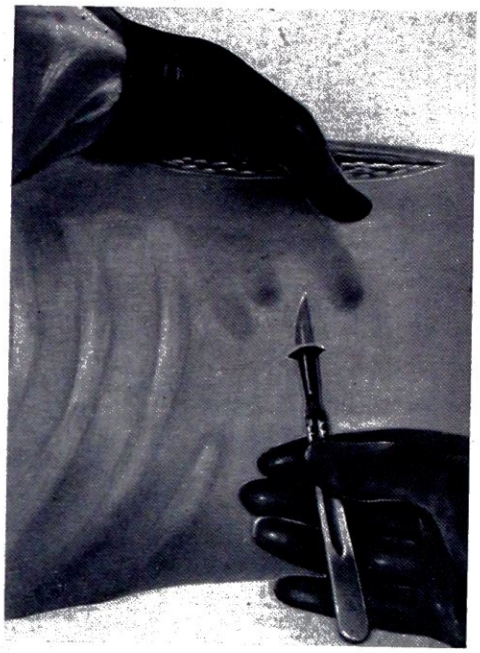


Fig. 239.—Drainage of Rutherford Morison's pouch. Making a stab incision in the flank.

Inserting a Tube into Rutherford Morison's Pouch.—Rutherford Morison's right kidney pouch will hold a pint of fluid without overflowing into the general peritoneal cavity or into the lesser sac. As a rule drainage of this pouch is required when the abdomen has been opened already. A stab wound is made in the flank towards the tip of the 11th rib (*Fig.* 239), coils of intestine being guarded carefully during the whole manœuvre. A long hæmostat is passed through the counter-incision, and its point made to emerge in the

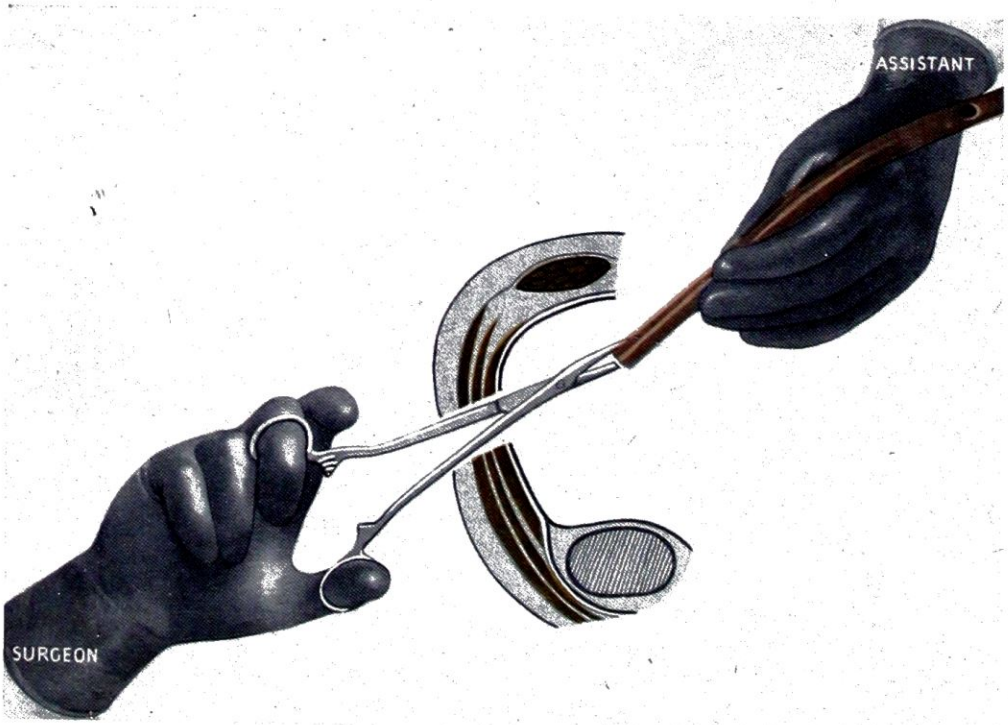


Fig. 240.—Drainage of Rutherford Morison's pouch. Drawing the tube through the abdominal wall. It should be noted that the eye of the tube is towards the assistant.

laparotomy wound. The jaws of the forceps having been opened widely, the end of a drainage tube is insinuated between them in such a way as to grasp the whole thickness of the tube. By withdrawing the forceps the end of the tube is pulled through the abdominal wall. It is important to see that the assistant does not insert the end of the tube containing the side hole into the awaiting jaws of the forceps; this end is required in the peritoneum (*Fig.* 240). When the tube is in place satisfactorily, it is anchored to the skin with a stitch.

Other Sites for Drainage.—Drainage through the original incision certainly should be avoided in the case of a paramedian incision, for as soon as the tube has been removed the rectus muscle will form a flap over the drainage hole; if the rectus is split, this objection is over-ruled. Likewise direct drainage can often be obtained through a transverse incision situated over the lesion. An objection to tube drainage through a laparotomy incision is that it weakens the scar. Mainly for this reason, many surgeons favour drainage through a stab incision whenever possible. The objection to a stab incision, especially one towards the flank, is that it favours development of cellulitis in the abdominal wall in the vicinity of the stab.

A drainage tube should always be so placed that there is a straight course for the pus to escape to the exterior; this should be the guiding principle of its placement—not whether the tube passes through the incision or through a counter-incision.

ISOLATING THE UPPER FROM THE LOWER ABDOMEN FOR DRAINAGE PURPOSES

The entire supracolic area of the peritoneum can be isolated from the infracolic area by suturing the greater omentum to the abdominal wall. The calls for this in emergency surgery are few; examples are: (1) cases of extensive rupture of the liver where seepage of bile is certain to occur; (2) when the peritoneal cavity is opened accidentally while draining a subdiaphragmatic abscess.

ALTERNATIVE METHODS OF DRAINING THE PERITONEAL CAVITY

Sump Drainage.—To remove purulent fluid from the bottom of a cavity, e.g., the rectovesical pouch, as soon as it arrives there, is appealing, especially when at operation a large quantity was removed by suction, and more is likely to form. Sump drainage fulfils this desideratum. The partial vacuum created by the pump encourages free fluid to flow towards the sump. With a Stedman's fitting attached to a fairly large intraperitoneal suprapubic drainage tube, sump drainage can be carried out via a small catheter connected to a suction pump (*Fig.* 241).

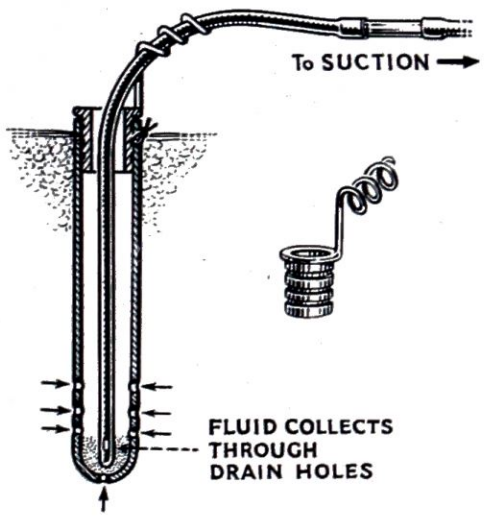


Fig. 241.—Sump drainage with a Stedman's fitting.

Cleland's Sump Drain[1] (*Fig.* 242) is made of Portex vinyl ether—a flexible plastic that allows the outer, or sump, portion of the drain to bend with the movements of the body. The inner tube is held in position by a collar tight enough to prevent the inner tube from falling out during sterilization, yet loose enough to allow it to be removed for cleaning. The tube is made in two sizes.

After 48 hours the stitch retaining the outer tube of a sump drain should be cut, and the tube turned.

Fig. 242.—Cleland's plastic sump drain.

The Penrose Wick Drain consists of ½-in. Penrose soft latex tubing (which in texture is like small Paul's rubber tubing) containing a wick of gauze (*Fig.* 243). The technique of its placement and the length of time it remains in situ differ so much from ordinary

[1] Portland Plastics Ltd., Bassett House, Hythe, Kent.

tubing that the following details should be studied closely. Being non-rigid, the Penrose wick drain is suited particularly to draining the peritoneal cavity through the original incision (*Fig.* 244). In early peritonitis only one drain is used ; usually, however, especially in cases of more extensive peritonitis, two drains are employed. As Reynolds points out, if two Penrose drains are placed together many folds develop between them ; these folds result in spaces that are free from encircling omentum and coils of intestine, so that along

Fig. 243.—A Penrose wick drain.

these spaces intraperitoneal exudate is likely to find its way to the exterior. The surgeon must replace all viscera in the position they are likely to occupy during convalescence before the drains are inserted, otherwise they are liable to become kinked and ineffective. Tight closure of the abdominal wall around these drains occludes the lumen of the potential spaces alluded to. Likewise, Penrose drains are rendered useless if they are placed through small stab incisions. In order to function fully, the opening about the drain should admit the tips of two fingers readily. To ensure that the drains remain at the site they are expected to drain, they should be anchored to the nearest point of the fatty tissue of the abdominal wall. For this purpose a very fine (No. 1) plain catgut is used. The drain cannot then be removed with ease for six or seven days. In the occasional case, when it is found to be still anchored for more than seven days but the patient is fit to return home, he may be allowed to do so and the drain or drains are removed at a subsequent visit. The absolutely non-rigid character of these drains renders them incapable of causing pressure necrosis, and they can remain in the peritoneal cavity for a comparatively long time with absolute safety. The drains are not disturbed until the patient is afebrile, or nearly so, and then they are removed in stages. As a rule removal is commenced on the sixth or seventh post-operative day, but, if the patient is pyrexial at this time, removal of the drains is postponed for as long as the pyrexia persists. Shortening of them can commence as soon as they are loose.

Fig. 244.—Penrose wick drainage in use after appendicectomy for a perforated retro-cæcal appendix with some purulent fluid in the pelvis. (*After Massie and Vance.*)

INTERNAL DRAINAGE

Normally, under the influence of decreased intra-abdominal pressure occasioned by the upward movement of the diaphragm during expiration, aided by capillary attraction, a thin film of peritoneal fluid travels continuously in an upward direction to the subdiaphragmatic spaces. Experimental evidence shows that the fluid, together with coloured particulate matter (and bacteria), is absorbed avidly by the subdiaphragmatic peritoneum, and passes into the subperitoneal lymphatic network. Particulate matter has been found in the lymph-nodes above the diaphragm after a few minutes.

When there is an outpouring of many ounces of peritoneal fluid, and, perhaps, in addition the contents of the stomach or duodenum escape into the peritoneal cavity through a perforation, it is extremely doubtful if the forces just described can counter-balance the influence of gravity. In all probability excess of free fluid within a peritoneal cavity unobstructed by adhesions, given the opportunity, runs downwards.

After the abdomen has been opened, air enters, and if the patient is nursed in a sitting position, which is usual, the entrapped air obeys the laws of gases and comes to lie under the diaphragm, where it can be demonstrated radiologically, until it is absorbed. The same phenomenon is seen in many cases of perforated peptic ulcer, air having entered through the

Fig. 245.—Common disposition of pools of exudate when a patient is kept in the horizontal position.

perforation. So long as an air-lock remains beneath the diaphragm, the normal upward current of peritoneal fluid is not operational. In these circumstances, and when the amount of fluid is too great for it to be absorbed quickly, it obeys the laws of gravity, and pools in dependent portions of the peritoneal cavity (*Fig.* 245).

POSTURE, WITH SPECIAL REFERENCE TO FOWLER'S POSITION

In cases of peritonitis, it is obviously most desirable to favour the pooling of purulent fluid in the pelvis (*Fig.* 246) or, if the infection originated in the lower abdomen, to prevent it spreading in an upward direction. There can be no possible objection to Fowler's position—even high Fowler's position—in the case of a child with peritonitis. So great an authority as Gross, of the Boston Children's Hospital, emphasizes that children are almost immune to phlebothrombosis decubiti, and he employs this position. In adults with peritonitis, during the first 48 hours after admission, it is highly desirable to take advantage of the benefits of Fowler's position, provided it can be maintained without undue risk of encouraging venostasis in the lower extremities—and, given the services of a special nurse, it can.

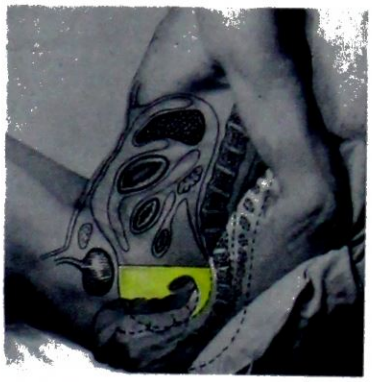


Fig. 246.—When the aid of gravity is invoked, in the absence of adhesions, much of the exudate gravitates to the pelvis.

Nursing Details.—

Propping up is accomplished by five pillows, but four will be sufficient if a back-rest is employed. Many surgical beds are provided with an adjustable back-rest. Of all the pillows, the one behind the neck is the most important to the patient; it must be so arranged as to support the neck without any muscular effort.

Preventing slipping down is the major problem, and requires considerable personal attention and determination to provide the best means of support. An extremely good method, which in no way retards venous return from the lower limb, is a well-padded board 8 in. (20 cm.) wide and as long as the breadth of the bed. To have two boards of this size bolted together with right-angled metal brackets aids stability. Then comes the difficulty of providing for the various lengths of leg. The simplest and best method is to have a hole bored in each end of the vertical (padded) board, pass a length of strong blind cord through each hole, and tie the cords to the corresponding side of the bedhead. The position of the board can then be adjusted to meet the particular patient's requirements (*Fig.* 247). Even an ill patient can brace himself against the board. A small soft pillow should be placed beneath the heels, to relieve pressure in this situation. When no board can be procured in time, a wooden box at the foot of the bed (*Fig.* 248) is a satisfactory makeshift. A very ill patient may be unable to brace himself against the foot support. If, after

lifting him up on three or four occasions, it is found that he soon slips down again, the position should be abandoned.

Elevating the head of the bed: In high Fowler's position, 18-in. (45-cm.) wooden blocks are placed beneath the legs of the head of the bed; in low Fowler's position, 6-in. (15-cm.)

Fig. 247.—An adjustable padded footboard to prevent the patient slipping down in bed.

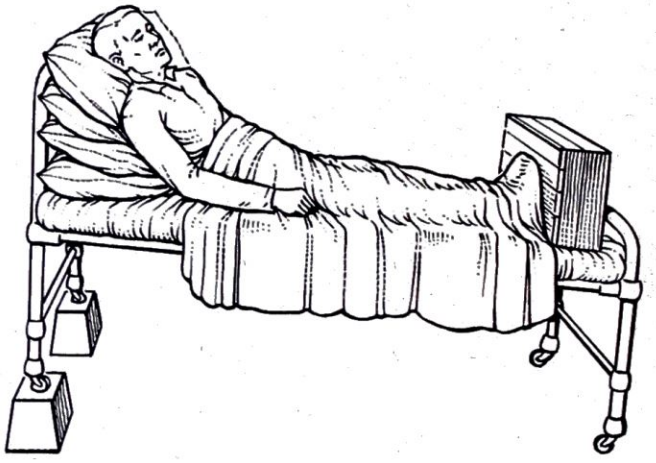


Fig. 248.—A wooden box at the foot of the bed to prevent the patient slipping down.

blocks are used. Better than blocks is an adjustable fitting supplied by Hoskins & Sewell, of Birmingham. This bed-lifter (*see Fig.* 191A) can be attached to any bedstead, and permits the bed to be wheeled about without alteration of the patient's position. According to whether the peritonitis is diffusing or more strictly localized, high or low Fowler's position is chosen. The high position is not required after 48 hours, and the low position

Fig. 249.—The semi-recumbent position aided by blocking the foot of the bed.

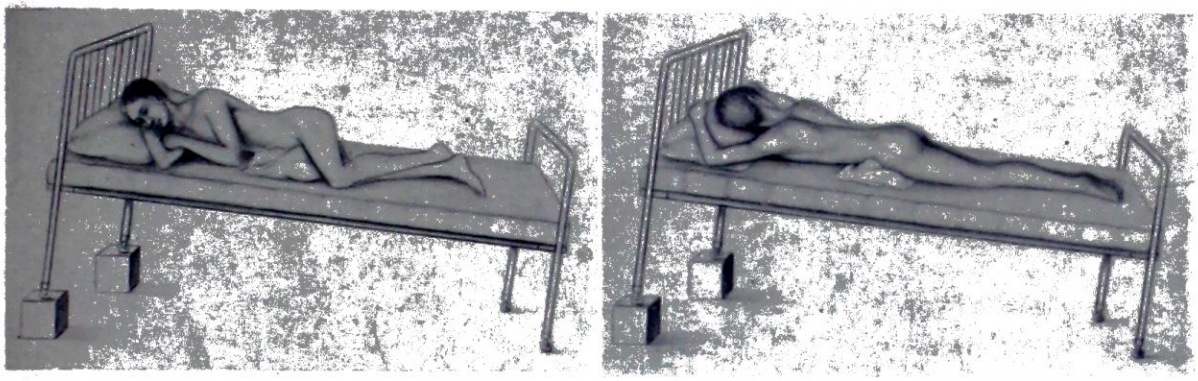
can often be abandoned after three days, when it can be presumed that localizing adhesions have formed. The patient can then lie in the position he finds most comfortable, but the sitting position is to be preferred, as it facilitates respiration, feeding, and reading. To prevent the patient slipping down, the foot of the bed can by this time be safely raised on 4-in. (10-cm.) or 6-in. (15 cm.) blocks (*Fig.* 249). This has the advantage of aiding venous return from the lower extremities.

Other Expedients for invoking the Aid of Gravity.—

Lateral Decubitus.—In the case of drainage of an abscess localized in an iliac fossa, or when Rutherford Morison's pouch has been drained through a counter-incision, in the absence of suction drainage the patient should be encouraged to lie on the affected side by placing a pillow under the opposite loin. By this means the aid of gravity is invoked.

Prone Postural Drainage.—The prone position of draining the peritoneal cavity should be used more often. Obviously it is mechanically sound. As seen in *Fig.* 250,

the left leg is flexed slightly, and the right leg is straight. The patient lies in this position from a half to three hours, and in many cases of pelvic peritonitis pus literally pours out of the suprapubic drainage tube. Another great advantage of the prone position is that it admits of considerable variation in posture (*Fig.* 251). These changes do much to relieve the weariness of any fixed position, and obviate the ever-present menace—venostasis and thrombosis.



Figs. 250, 251.—Methods of combining prone and Fowler's positions.

Additional Aids in preventing Phlebothrombosis Decubiti.—By ordering the legs to be exercised from the very first day of a patient being nursed in Fowler's position and also prescribing pulmonary gymnastics, and by seeing that these measures are carried out faithfully, the surgeon will be spared a number of cases of pulmonary embolus.

In well-equipped clinics it is possible to order the desirable massage and pulmonary exercises to be carried out by especially trained personnel. To those without these facilities, the following simple formula will be found useful and effective. Ask the nurse in charge to see that the patient draws up each leg three times a day, and then takes three breaths and fills his lungs to the uttermost. If the patient is well enough, in order to impress these instructions upon both the patient and the nurse, say "Nurse will not give you your meals until you have done your exercises"!

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CHAPTER XIX

GASTRIC, DUODENAL, AND INTESTINAL ASPIRATION

GASTRIC ASPIRATION

No patient should be allowed to suffer the misery of repeated vomiting. In intestinal obstruction, paralytic ileus, peritonitis, acute dilatation of the stomach, post-operative vomiting, and indeed in all conditions where vomiting is repeated, the stomach content is watery and can be aspirated easily. Only in comparatively rare instances, where both nasal passages are obstructed, is it necessary to employ the oral route. There is a wide field for the application of gastric aspiration. The practitioner might well carry an aspirating tube and use it in the patient's home, for instance, before a patient with intestinal obstruction, or a perforated peptic ulcer, is transported in an ambulance. Gastric aspiration can, if necessary, be continued during an operation (*Fig.* 252).

Fig. 252.—Continuous gastric aspiration during operation for intestinal obstruction under spinal anæsthesia.

In this country usually a Ryle's tube (*Fig.* 253) is employed; the Levin tube (*Fig.* 254) is used widely in the U.S.A. My gastric aspiration tube[1] (*Fig.* 255) was designed to empty the stomach by the nasal route when this measure was required urgently. The tube is a little easier to pass than a Ryle's tube, for in the distal end there is a coiled spring that helps to stiffen it. Rubber tubes should be sterilized by boiling. A Portex[2] polythene gastric aspiration tube has the advantages of being less irritating to the nasal passages and, unlike rubber, does not perish in a hot climate. Its disadvantage is that after boiling it is too soft to pass until some time after it has cooled; if sterilized by boiling and then stored, it is too stiff to pass with safety and it must be softened in hot water and allowed to cool to the required pliability.

[1] Made by the Genito-Urinary Man. Co., 28a, Devonshire Street, London, W.1.
[2] Portland Plastics Ltd., Bassett House, Hythe, Kent.

Passing the Tube.—The tube is lubricated with liquid paraffin. The nasal route for the passing of the tube is much the better. There are occasions when nasal obstruction prevents this route from being chosen, but they are comparatively infrequent. The alternative route (the mouth) must then be utilized, but an indwelling tube through the mouth is liable to cause nausea and other discomforts ; in addition, the patient is inclined to chew the tube, whereas once the tube is in place via the nose, it can be tolerated with minimum discomfort.

Fig. 253.—Ryle's tube.

Choosing the nostril which is the more patent, and having cleansed it, the bulbous end of the tube is pushed along the floor of the nose. The passage past the turbinates is assisted by tilting the tip of the nose upwards with the left finger and thumb. Retching occurs ; instruct the patient to swallow. If he continues to retch, instruct him to sip and swallow some water ; a glass half-filled with water should be at hand. Once the end of the tube has passed the level of the cricoid cartilage, as a rule the tube can be passed onwards easily. That the end of the tube has reached the stomach can be ascertained by the aspiration of gastric contents. If little or nothing is aspirated, put the end of the tube near the ear. If, by mischance, the tube has entered the trachea, blowing will be felt and heard.

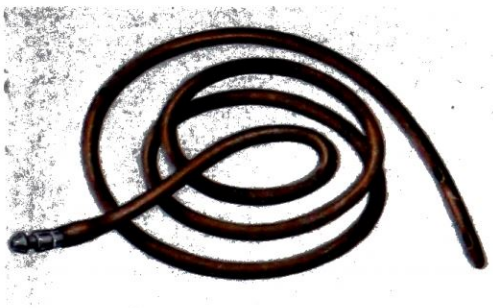

Fig. 254.—The Levin tube.

In cases of intense rigidity of the abdominal wall due to acute peritonitis, notably perforated peptic ulcer, it should be realized that the diaphragm and its crura are also tonically contracted ; so much so, that the latter may tightly embrace the lower end of the œsophagus. If there is reasonable doubt as to whether the tip of the gastric tube is within the stomach, and facilities exist, a radiograph with a portable machine will settle the doubt.

Refinements in Technique.—While a gastric aspiration tube is usually passed without anæsthetizing the mucous membrane it traverses, there is much to be gained by adopting a less crude method (*Figs.* 256–261). The additional trouble entailed brings a rich reward. All patients experience less discomfort ; the tube can be inserted more often in the case of a nervous patient, who would otherwise create formidable or insurmountable obstacles to its passage ; rhinitis, initiated by trauma, and its attendant evils are minimized. When the end of the tube has been proved to be in the stomach, withdrawal of it for 2 in. (5 cm.) will allow the portion in contact with the nasal mucous membrane to be smeared with sulphanilamide ointment or, better, aureomycin cream 3 per cent. The tube is then advanced again for 2 in. and the ointment is carried into the nose. Each day the tube should be pulled down, cleansed, lubricated with the cream, advanced again, and fixed in position. The surgeon is urged to make it a standing order that the portion of the tubing in contact with the nostril is kept smeared with one of these ointments.

Fig. 255.—Hamilton Bailey's tube.

Fixing the Tube in Position.—Once the tube is in place satisfactorily it can be strapped to the cheek with adhesive plaster.

Special Cases.—

Unconscious Patients (without a swallowing reflex).—The easiest way to introduce the gastric aspiration tube in an unconscious patient is to pass a Magill's tube, well lubricated both inside and out, past the pharyngeal sphincter. The gastric aspiration tube is passed down the Magill's tube. When the former has reached the stomach, the latter is withdrawn

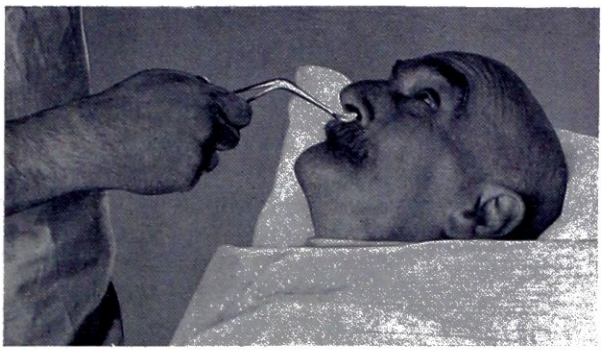

Fig. 256.—The patient sits up with his head supported at the angle shown. The wider nostril is cleaned and the nostril is packed with wool soaked in 2 per cent anethaine.[1]

Fig. 257.—2 ml. of anethaine are poured into a medicine glass; the patient gargles the solution for half a minute, and then swallows it.

Fig. 258.—A tumbler of water is handed to the patient. The tube is passed down the nostril after the cotton-wool has been removed. Steadying the patient's head while he drinks, the tube is passed onwards.

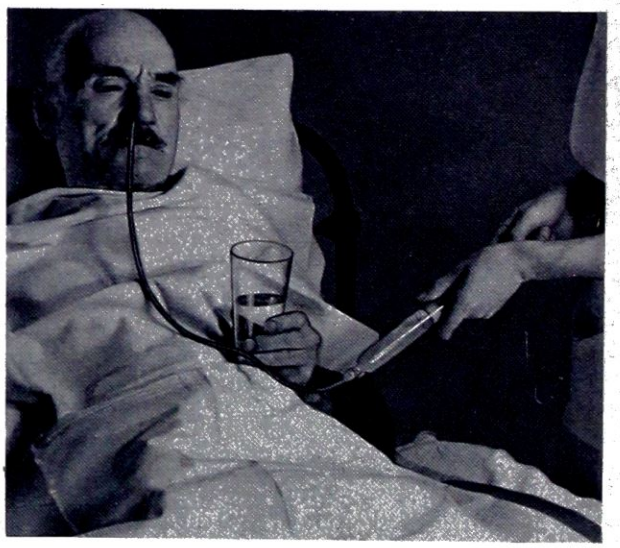

Fig. 259.—As soon as it is judged that the end of the tube is in the stomach, the sister is asked to attempt aspiration. If fluid is not withdrawn, the tube is passed on farther.

Fig. 260.—Once the tube is satisfactorily in place it is fixed to the cheek with adhesive plaster.

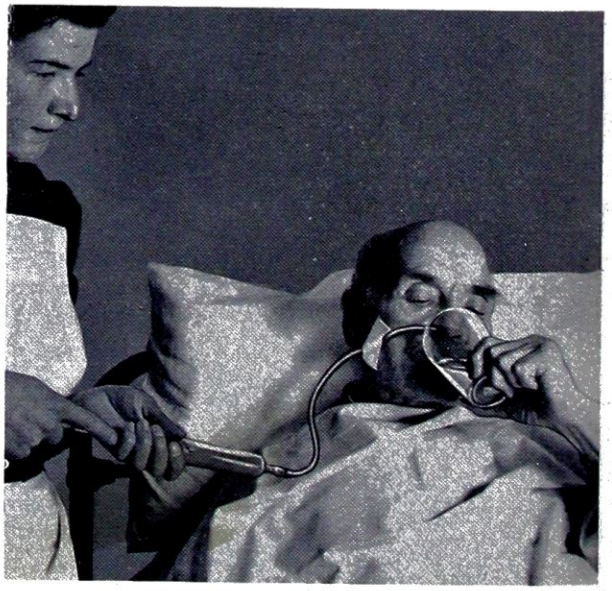

Fig. 261.—Aspiration is continued. The patient drinks the remainder of the water in the glass, which is aspirated promptly, and this helps to wash out the stomach.

[1] Anethaine (Glaxo Laboratories, Greenford, Middlesex).

(Frankis Evans). That the tube has reached the stomach, and has not entered the trachea, is proved by aspirating gastric contents. On the other hand, if nothing is withdrawn, listen at the end of the tube for a blowing sound ; impingement of air on the ear is proof positive that the tube has entered the air-passages. This point, which seems insultingly elementary, must never be forgotten while intubating the unconscious.

Refractory, Non-co-operative Patients.—Efficient surface anæsthesia (*see above*) reduces the number of failures by at least 30 per cent. If this fails, sodium luminal, 3 gr. intramuscularly, should be injected 20 minutes before attempting to pass the tube.

Emptying the Stomach, and Keeping it Empty.—Aspiration can be carried out by any well-fitting syringe ; for instance, a Janet's 6-oz. (180-ml.) syringe with a metal plunger is often admirable for the purpose. The use of the adaptor illustrated in *Fig.* 262 allows the end of any pattern of gastric aspiration tube to be fitted to a Record syringe with such accuracy that there is no loss of suction.

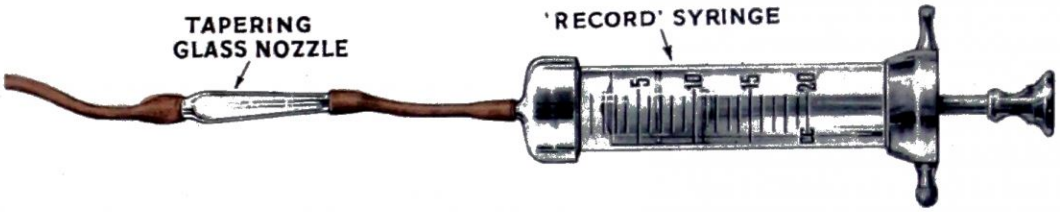

Fig. 262.—Glass and rubber tubing adaptor, extremely easily constructed, makes a perfect fitting for a Record syringe.

Gastric aspiration should be done *only by hand* ; an electric suction pump, Wangensteen's apparatus, and other mechanical devices can never replace a special nurse. A gastric aspiration tube is liable at any time to become blocked, most frequently by gastric mucosa being sucked into the eyes of the tube, and it requires immediate human attention to keep it patent ; without such attention the patient's life is in jeopardy.

Measuring the Fluid aspirated.—All fluid aspirated must be measured and charted. It is necessary to instruct the nurse as follows : assume that the gastric aspiration tube was passed at 9 a.m. The patient is allowed 1 oz. (30 ml.) of fluid each hour. All the material aspirated from the stomach is collected in a bucket. At, say, 3 p.m., the contents of the bucket are measured and the amount he has drunk is subtracted therefrom. This will give the total quantity of regurgitated fluid during that six hours. This is charted and the same procedure is adopted for the next six hours.

When should the Tube be Removed? As a rule, at the end of 48 hours. There are many occasions when obviously the tube should be boiled and re-inserted within half an hour. There are other occasions where it is judged that its function can be dispensed with ; in which event it is wise to warn the patient that if he experiences nausea, he must report the matter at once. Should he do so, or if the nurse hears even a muffled hiccup, she must be prepared to re-insert the tube. There are still other occasions when it is essential to know whether antiperistalsis is proceeding, i.e., whether the patient would vomit if the tube was not in place ; considerable help can be obtained from what may be called a ' gastric motility test '.

The Gastric Motility Test.—The patient is asked to drink ½ pint (284 ml.) of barley water coloured with cochineal or indigo-carmine. If, after 1½ hours, none of this coloured fluid can be aspirated, it is proof positive that the stomach is passing its contents onwards and aspiration is no longer necessary.

INTESTINAL ASPIRATION

Intestinal aspiration is a boon in the preparatory stages of acute or chronic intestinal obstruction and a life-saving measure in paralytic ileus. The dangers of its pre-operative employment for more than a few hours in acute intestinal obstruction, and for less or not at all, if strangulating obstruction cannot be ruled out, are set out on p. 413.

Intestinal Intubation with a Miller-Abbott Tube.—The Miller-Abbott tube (*Fig.* 263) is of considerable length, and has its lumen double throughout, viz. : ●. The small channel is used to inflate the balloon, the larger to aspirate the intestinal contents. A new bag is required for each patient. The bag must not be tied too tightly, or it will obstruct the lumen

of the tube. There are a number of marks and numerals along the length of the tube. The only ones of real importance are : 45 (—), 60 (=), and 75 (≡).[1]

Testing the Tube.—Syringe water through the compartment of the tube which is to be used for suction. Inflate the bag with 20 ml. of air, and observe whether inflation is maintained. If you are doubtful, test the bag for leaks under water, using moderate pressure. Having completed these tests, deflate the bag.

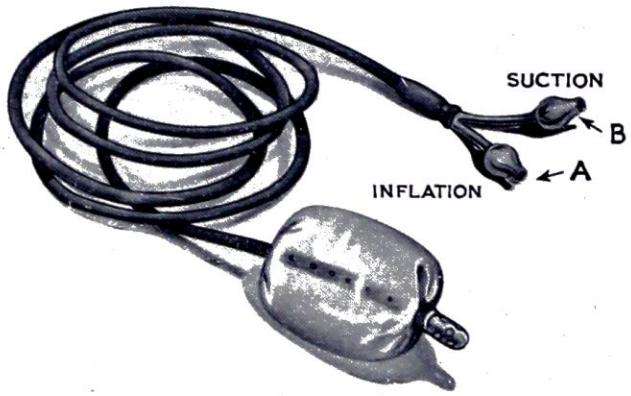

Fig. 263.—The Miller-Abbott tube. The tube is made by G. P. Pilling & Son, Philadelphia. The nipples A and B do not fit British-made syringes. Messrs. John Bell & Croyden Ltd., Wigmore Street, London, have altered these nipples so that A fits a Record syringe and B a Janet's syringe.

Marking the Tube.—The approximate distance from the patient's nostril to the pylorus is estimated, and marked on the tube with ink.

Rendering the Tube surgically clean.—It is not essential to have the tube sterile, but it should be as clean as it can be made without injuring it. Wash it in soapy water, rinse in plain water, and then immerse it in spirit for five minutes. Allow the spirit to evaporate before use.

Surface Anæsthesia (*see* p. 196) is most desirable in this instance.

Method of Passing the Tube through the Nose.—Even a collapsed bag is bulky. The following expedient simplifies the passage of the bag through the nose. A Ryle's tube is passed until the bulbous tip can be seen or felt in the pharynx. It is grasped with a long hæmostat and brought out through the mouth (*Fig.* 264).

The metal end of the Miller-Abbott tube fits the butt-end of the Ryle's tube snugly. Thus attached, the bag, lubricated with liquid paraffin, can be piloted down the nose into the pharynx and out of the mouth by pulling on the forward end of the Ryle's tube, which is then disconnected. The patient is given a short rest and a little water to drink. Several inches of the nasal end of the Miller-Abbott tube are lubricated. Grasping the tube between the finger and thumb about 1 in. (2·5 cm.) above the bag, the tip is directed into the commencement of the œsophagus while the tongue is hooked forwards with the left index finger. Quickly the left hand takes on the role of advancing the tube in the pharynx, while the right pulls on the tube entering the nose. Thus the mouth is cleared of 'slack'. If the patient brings up the bag, the process must be repeated. There should be no undue difficulty in getting the bag into the œsophagus, and if the patient drinks, the bag will be carried down by peristalsis, as can be seen by the well-lubricated tube being drawn into the nose without the assistance of the operator. Once the tube is in the stomach, it is filled with 30 ml. of air and is drawn back until the balloon is felt to come up against the cardiac orifice. The balloon is deflated and advanced until the 45 (—) mark is at the nostril. The patient is turned on to his right side with his left knee drawn up. He should drink water at frequent intervals. A proportion only of this fluid is aspirated. When the stomach contains fluid it is traversed more easily by the tube and the pylorus is more likely to be open. The difficult part of the

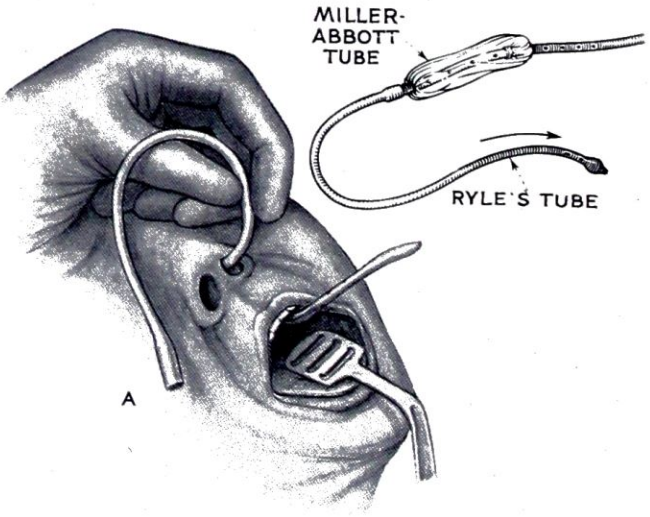

Fig. 264.—A method of passing the bag of a Miller-Abbott tube through the nose. A Ryle's tube is passed as shown. Into the butt end, A, of the Ryle's tube fits the metal end of the Miller-Abbott tube. Firm continuity of the two tubes is thereby established (*inset*).

[1] 45 (—), 60 (=), 75 (≡), refer to cm. measured from the tip of the tube.

intestinal intubation is to get the tip of the tube through the pylorus. It has been accomplished in twenty minutes, but it may take 24 hours. *Figs.* 265–267 should be studied at this juncture. With the patient partaking of water at frequent intervals, and the bag deflated, the contents of the stomach are aspirated. If the tube becomes blocked irrigation is employed. While this is going on, the deflated bag is slowly, but steadily, advanced 1 in. (2·5 cm.) every 10 minutes, keeping the entering tubing well lubricated. It is advanced

Fig. 265.—With the tube in this position—

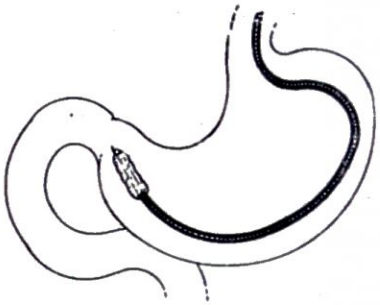

Fig. 266.—There is enough slack to allow the bag to enter and pass the pylorus.

Fig. 267.—When too much tubing is passed into the stomach it spells failure for the reason that is obvious.

until it is judged by the mark made on the tube previously that the pylorus has been reached ; usually this is between the 60 (=) and the 75 (≡) cm. mark. In order to prevent the temptation of pushing in too much tubing, the tubing should be strapped to the nose (not the cheek) with adhesive plaster. Now is the time for patience. Every half-hour the balloon is inflated with 10 ml. of air, and one tries the tension on the tube for the hoped-for tugging sensation which signifies that the bag has passed the pylorus. The aspiration of undiluted bile or intestinal contents—undiluted by the water the patient is imbibing—also signifies that the tube has passed the pylorus. If the bag has definitely passed the pylorus, inflate with a further 15 ml. of air, making 25 ml. in all.

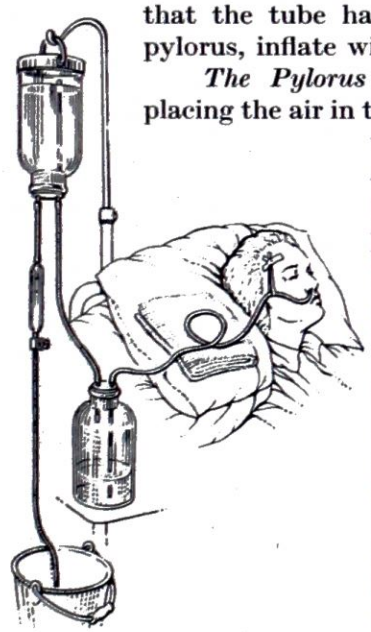

Fig. 268.—Continuous intestinal aspiration by hydrostatic negative pressure. (*After Rodney Smith.*)

The Pylorus cannot be Negotiated.—Try replacing the air in the tube with 10 ml. of water, and wait for 1–2 hours. The additional weight sometimes favours the passage of the bag through the pylorus. Another excellent expedient is to fill the deflated bag partially with 2–3 ml. of metallic mercury. 10–15 ml. of air is necessary to drive the mercury into the bag ; the air is then aspirated. When either of these expedients is used it is necessary to withdraw the tube to the 45 (—) mark and the whole process of advancement is repeated. If these measures fail, the tube will have to be left in the stomach as a gastric aspiration tube.

Fig. 269.—Radiograph of the Miller-Abbott tube in position in the ileum. In this case the patient had a barium enema and also barium had been injected down the tube. In this way the actual point of obstruction is demonstrated.

When a portable X-ray apparatus is available far less skill and patience are required. The first thing to do is to manœuvre the tube into the position shown in *Fig.* 266. Probably the bag will then be carried through the pylorus in a few hours, provided the amount of tubing inserted into the stomach is not sufficient to allow coiling in the wrong direction.

The pylorus has been passed : The inflated bag is kept inflated. The patient is allowed to swallow about 6 in. (15 cm.) of the tube every half-hour, aspiration being carried out at frequent intervals. As gas and fluid are sucked out of the gut the intestinal walls contract and, regaining their tone, force the balloon onwards. In order that there should be no obstacle to the feeding of the tube into the nose, it is supported by a loop of tape fixed to

the forehead by adhesive strapping (*see Fig.* 268). In this way the tube is carried down to the point of the obstruction (*Fig.* 269), or, in the case of paralytic ileus, to the inactive segment of gut which it is so vital to empty. The tube can be left in place for days, if necessary.

Continuous Intestinal Aspiration.—Provided it is very carefully supervised by the nursing staff, continuous intestinal aspiration can be employed. The negative pressure water pump (*Fig.* 268) can readily be constructed, and answers the purpose admirably.

Removing the Tube.—As with the gastric aspiration tube there should be no haste in withdrawing it. The tube can remain in position without aspirating the contents, and only when it is evident that a relapse is improbable is the tube removed. The bag is deflated, and with gentle traction the tube is withdrawn slowly, taking about ten to fifteen minutes over the process.

INTESTINAL INTUBATION WITH A CANTOR TUBE

The Cantor tube is a single-lumen tube with a large internal diameter—18 F. The holes in the side of the tube are oval in shape, and very much larger than those in the Miller-Abbott tube; this renders blocking of the tube by particulate intestinal matter most unlikely. To the tip of the tube is cemented a rubber bag $2\frac{1}{2}$ in. (6·25 cm.) long (*Fig.* 270). The tube, which is radio-opaque, is calibrated thus: 17 in. (42·5 cm.) from the balloon end of the tube there is a marking 'S' (when the marking 'S' appears at the naris the tube has reached the stomach). Six inches (15 cm.) beyond this is the second marking 'P' (pylorus); 6 in. beyond 'P' there is a third marking 'D' (duodenum). When the marking 'D' appears at the nose there is sufficient tubing to carry the balloon through the duodenum. From that point onwards the tube is calibrated in feet.

Fig. 270.—The balloon end of the Cantor tube. (Actual size.)

Preparing the Tube for use.—

1. Employing a 10-ml. syringe mounted with an 18-gauge needle, 5 ml. of mercury is injected into the balloon through the last lateral hole.
2. All the air in the balloon is aspirated with the syringe immediately after injecting the mercury.
3. The stylet of a 21-gauge needle is passed through the last lateral hole until it reaches the interior of the balloon. A piece of braided silk is wound around the tube twice, over the place where the bag is cemented to the tube. It is tied very tightly. When the stylet has been removed there is a minute opening through which gases, but not mercury, can escape. The end of the tube is dipped in liquid paraffin.

Preparing the Patient, and Passage of the Tube.—

1. Morphine, $\frac{1}{6}$ gr. and atropine, $\frac{1}{100}$ gr. are administered half-an-hour before the tube is to be passed. The side of the nose chosen for the passage of the tube is anæsthetized as described on p. 196. The balloon is grasped between the thumb and the index finger, permitting the mercury to run into the neck of the balloon. The bag is folded into a cone, and with the patient sitting and the head hyperextended, the bag is passed into the nose as far as it will go. Releasing the digits permits the mercury to run into the distal end of the bag.
2. When the balloon has dropped into the nasopharynx the patient, sitting upright, takes one drink of water, with the result that the balloon passes rapidly into the stomach, and the letter 'S' is seen at the nostril. The contents of the stomach are aspirated while more tubing is inserted slowly, until the letter 'P' presents.
3. The patient is turned on to his right side, inclining the face downwards. The foot of the bed is raised 12 in. (30 cm.). This position is maintained for two hours, at the end of which time:—
4. The patient is placed in Fowler's position and an additional length of tubing is passed, bringing the letter 'D' to the nose. This position is maintained for two hours, during which time another 4 in. (10 cm.) of the tubing is passed.
5. After a further two hours a radiograph is taken to ascertain the position of the tube.

THE PASSAGE OF AN INTESTINAL ASPIRATION TUBE VIA A GASTROSTOMY (RODNEY SMITH)

From time to time cases are encountered where an intestinal aspiration tube cannot be made to pass the pylorus, yet it is felt that to empty the small intestine by intestinal aspiration is essential for the patient's recovery. There are other cases where at the conclusion

of an operation for intestinal obstruction it is most desirable to commence intestinal aspiration with as little delay as possible. In either of these contingencies the passage of an intestinal aspiration tube via a stab gastrostomy solves an otherwise extremely difficult problem. If necessary, the operation can be undertaken under local anæsthesia. In any event, the stomach must be emptied by means of a gastric aspiration tube before the operation, and kept empty during the operation.

Operation.—

1. A short upper right rectus-splitting incision is made, and the pylorus is displayed.
2. A stab incision is made through the left rectus muscle and the distal end of an intestinal tube, with its balloon collapsed, is passed through it, and withdrawn through the main incision (*Fig.* 271 A).

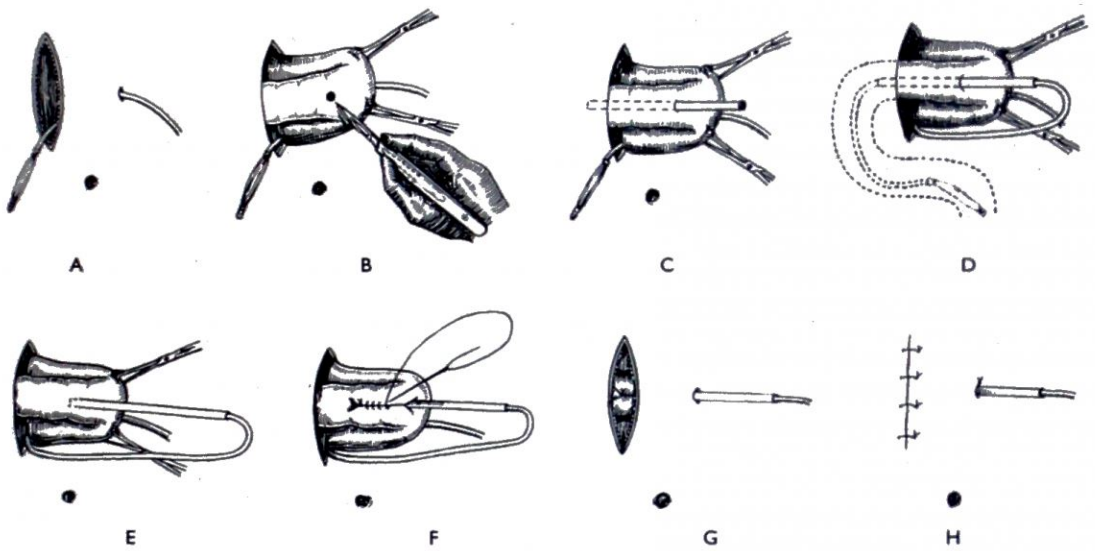

Fig. 271.—Introducing an intestinal aspiration tube through a stab incision in the pyloric antrum. (*After Rodney Smith.*)

3. The pyloric antrum is drawn into the wound, and a stab incision is made 1 in. (2·5 cm.) proximal to the pylorus (*Fig.* 271 B).
4. A rigid tube, large enough to transmit the intestinal tube and its bag, is passed into the stomach and insinuated through the pylorus into the first part of the duodenum (*Fig.* 271 C).
5. The intestinal tube is lubricated and passed through the rigid tube, onwards until its tip has negotiated the duodenojejunal flexure (*Fig.* 271 D).
6. The rigid tube ensheathing the intestinal aspiration tube is partially withdrawn, so that its distal end comes to lie in the pyloric antrum (*Fig.* 271 E). The tube in question is fixed in this position with a single catgut suture passing through it and the stomach wall.
7. Four-fifths of this tube is now embedded, as in Witzel's gastrostomy (*Fig.* 271 F). The suture line is reinforced with interrupted cotton stitches.
8. The stomach is returned to the abdomen, and the slack of the intestinal tube is withdrawn through the stab incision, as also is the unembedded proximal fifth of the rigid tube (*Fig.* 271 G). The latter is anchored to the skin by a single stitch.
9. The right rectus incision is closed (*Fig.* 271 H).
10. The balloon of the intestinal tube is inflated.

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CHAPTER XX

PERITONITIS

In this chaper we will deal with *principles* in the treatment of diffuse peritonitis and peritonitis of obscure origin, rather than that where the focus of origin is known. One must strive to arrive at a diagnosis, or at any rate a reasoned pre-operative hypothesis, of the source of the peritonitis. Unless a primary focus can be found and dealt with, the outlook is very grave. A correct pre-operative diagnosis and a good anæsthetic are more than half the battle.

Antibiotic Therapy in Peritonitis.—In order to prevent unnecessary repetition in subsequent chapters dealing with special forms of peritonitis, it will be convenient to set out the principles of antibiotic therapy in peritonitis here. Finality has not been reached, and as yet it is a matter of opinion as to which antibiotic or combination of antibiotics is the most efficacious, especially in the absence of bacteriological guidance. Of course, if a specimen of purulent peritoneal fluid has been obtained, and sensitivity tests indicate a certain antibiotic, this is given.

Combined Penicillin and Streptomycin.—For an adult, penicillin 500,000 units and streptomycin[1] 0·5 G., both intramuscularly 12-hourly, have been used extensively with considerable satisfaction. A disadvantage of this dual attack is that resistant strains of organisms develop more quickly than when aureomycin or terramycin is employed.

Aureomycin.—Penicillin and streptomycin, despite their proved worth, fail on occasions to control bacterial peritonitis. Intravenous aureomycin, with its wider antibacterial range, has proved even more efficient in reducing mortality. Prior to the introduction of a buffered aureomycin hydrochloride, the incidence of chemical phlebitis was extremely high. Aureomycin buffered with sodium glycinate has practically eliminated this complication. The method of administration is extremely simple. The powder is mixed with 50 ml. of sterile distilled water and injected directly into a vein, about five minutes being taken to complete the injection.

When the diagnosis of peritonitis is made pre-operatively, 0·5 G. of aureomycin is administered intravenously. Post-operatively 0·5 G. is given twice daily, and continued until the patient's condition has improved to the point where fluids can be taken by mouth. Thereafter the drug is given orally 0·5 G. twice daily.

Aureomycin has proved to be the most effective agent for use in the treatment of peritonitis (Wright et al.). In children the dose should range from 0·3 G. to 0·5 G. intravenously twice daily, depending on the age and the weight of the child.

On no account should aureomycin be given with penicillin, as there is an antagonism between these two substances.

Terramycin, like aureomycin, is a singularly effective antibiotic in the treatment of peritonitis. For an adult 1 G. should be given intravenously every 12 hours for 2–4 days, followed by 0·5 G. orally every 6 hours for a period of 8–10 days. Terramycin has been found to be effective in some severe cases of peritonitis when penicillin and streptomycin have been unavailing after a trial of several days (Reiss et al.).

It should be noted that systemic administration of any antibiotic is completely incapable of preventing the development of either wound infection or fascial slough.

GRAVE DIFFUSE PERITONITIS

When the pulse is feeble and in the neighbourhood of 140, and the abdomen drum-like, or other combination of signs make it undeniable that peritonitis is diffuse, the interests of the patient are served best by adopting a conservative attitude for two to six hours, or even longer, during which time no effort is spared to get him into the best possible condition. The bulwarks of conservative treatment are as follows :—

1. Fowler's position, if the pulse is not too feeble.
2. An hourly or half-hourly pulse-rate.

[1] Dose for a child 0·25 G. 12-hourly, and for an infant 0·25 G. 24-hourly.

3. Gastric aspiration.
4. A plasma infusion, followed by continuous intravenous dextrose-saline.
5. A circulatory stimulant, e.g., methedrine.
6. Antibiotic therapy.
7. Blood transfusion, preferably with fresh blood, is required if the hæmoglobin has fallen below 70 per cent.

As a result of these measures, in all but the moribund, some improvement in the general condition (*Fig.* 272) takes place. As improvement sets in, once again the opportunity is taken of making a clinical examination with a view to determining the primary

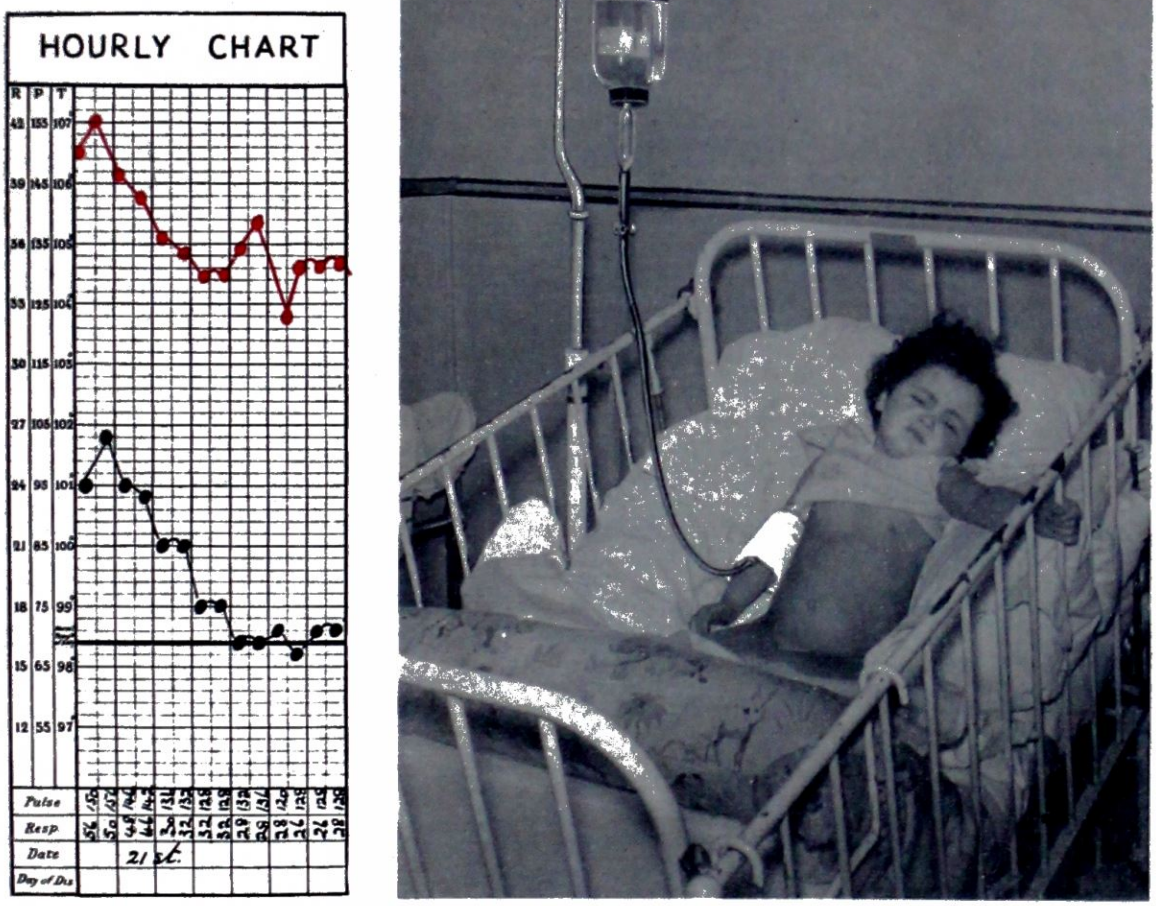

Fig. 272.—Child with diffuse peritonitis. Hourly pulse chart is shown. With intravenous saline solution and Fowler's position improvement occurred and a perforated gangrenous appendix was removed 14 hours after admission. Recovery.

focus, if such is in doubt. A plain *radiograph of the abdomen*, with the object of demonstrating the presence or absence of gas beneath the diaphragm, is most desirable. When possible, a *serum-amylase test*, to help to exclude acute pancreatitis, should be performed. In cases where there is free fluid in the peritoneal cavity, *peritoneal puncture* is a possible means of diagnostic assistance, but it must only be carried out in the manner described on p. 362.

A time has now been reached when the weighty decision whether to operate or not to operate must be made. In the chapters that follow, where the source of the peritonitis is not in doubt, e.g., perforated appendicitis, perforated peptic ulcer, acute pancreatitis, etc., this decision is discussed in detail. In this chapter, where diffuse peritonitis of doubtful origin is being considered, there is little choice. If the patient rallies sufficiently for operation to be undertaken, to take the current when it serves undoubtedly gives the patient his best chance. On the other hand, when after consultation it is considered that the risk of operation is too great, the Ochsner-Sherren treatment of peritonitis (*see* p. 232) is obligatory, at any rate for the time being, and in a few cases the infection becomes localized (*see Fig.* 280, p. 215).

We will assume that the patient in question has responded sufficiently to be placed in the category that immediately follows :—

Diffuse Peritonitis : Condition of the Patient, Fair.—

Quick in, quick out, and drain. (J. B. Murphy.)

The first step, and one of great importance, is to lay a sterile towel on the prepared abdomen, and to palpate the abdomen under the anæsthetic. Sometimes this is rewarding—a lump, e.g., a mass connected with a perforated diverticulum of the colon, hitherto impalpable, gives the answer to the conundrum " Where is the abdomen to be opened ? " When, as is more usual, this examination is negative the best procedure is as follows : open the abdomen by a gridiron incision and inspect the appendix. At any rate the appendix can be scrutinized by this route. When the appendix is found to be perforated the search is ended. If the appendix is inflamed, but not perforated, perform appendicectomy and pass the organ to someone in the theatre to slit up. *If the appendix is more inflamed on the outside than the inside, the organ is innocent—search elsewhere.* By way of a gridiron incision a suprapubic drainage tube can be inserted accurately into the rectovesical pouch after a special suprapubic stab wound has been made.

Unless clinically there is some definite hint as to where to open the abdomen, the foregoing method will be found to be a practical one. A gridiron incision can be performed quickly, and, should it prove to be unsuitable, it can be closed quickly.

For a reason that will be brought forward presently, when it is necessary to make another incision, it is advised to defer the closure of the gridiron incision until the last step of the operation.

Must the Abdomen be re-opened[1] *Elsewhere, and if so, Where ?* :

1. Bile-stained fluid is indicative of a perforated duodenal ulcer. At least it is proof positive that the upper abdomen must be opened. Especially when the amount of fluid in the peritoneal cavity is considerable, and no definite food particles are discernible, perforated gastric ulcer is a possible cause. In such cases considerable help may be derived from asking the anæsthetist to inject 30–60 ml. of 1 per cent solution of methylene blue down the gastric aspiration tube (*see* p. 272).

2. Through the gridiron incision the last 2 ft. (60 cm.) of the ileum can be examined, and a perforation of the terminal ileum or Meckel's diverticulum can be found, or excluded.

3. The character of the exudate (*see* p. 166) is often a valuable guide. If it smells, it is the lower, rather than the upper, abdomen that should be explored. On one occasion, when there was a quantity of odourless fluid in the abdomen of a muscular man in his thirties, a swab on a holder was passed through the gridiron incision towards the pelvic colon. On removing it, the swab smelt. An incision in the left iliac fossa revealed a perforated diverticulum of the pelvic colon.

4. In the female it is sometimes possible to inspect the right Fallopian tube through a gridiron incision, and if the exudate is odourless and wells up from the pelvis, this certainly should be attempted.

5. Consider the possibility of acute pancreatitis, although this should have been ruled out by a serum-amylase test. Sometimes there is a prodigious outpouring of free fluid in this condition, and the fluid is not necessarily blood-stained. It is never milky (i.e., opaque ; semipurulent) or bile-stained.

If uncertainty still prevails, a right paramedian incision is made equally above and below the umbilicus, and of sufficient size to allow the hand to be passed into the peritoneal cavity. By systematically palpating (*a*) the stomach ; (*b*) the duodenum ; (*c*) the gall-bladder ; (*d*) the pancreas ; (*e*) the kidneys ; (*f*) the pelvis ; and (*g*) the left iliac fossa the causative lesion can often be discovered, and, by extending the incision upwards or downwards, it can be displayed. In the minority, intra-abdominal palpation is unfruitful. The incision must then be enlarged, first upwards in the male (to allow inspection of the stomach, duodenum, gall-bladder, and pancreas), but first downwards in the female (to inspect the adnexæ and pelvic colon). In both sexes both extensions may be required to make a thorough exploration, which must include inspection of the pancreas and an

[1] There are two reasons for advocating two comparatively small incisions (one of which is a gridiron incision) rather than one long paramedian incision. (*a*) If one wound becomes infected, the other does not necessarily do so ; (*b*) There is a greater danger of wound dehiscence in one long incision (*see* p. 156).

examination of the whole of the large and small intestine, together with its mesentery (for suppurating lymph-nodes or a ruptured mesenteric cyst). If nothing can be found to account for a profuse odourless peritoneal exudate, one must assume that the case is one of primary peritonitis and, a suprapubic drainage tube being in position, close the incisions. At what stage of the proceedings this is done must be left to the judgment of the surgeon.

Additional Valvular Cœcostomy.—Experience has shown that, when a patient with considerable peritonitis develops a post-operative fæcal fistula, he usually recovers. This was the starting point of providing a small vent in the cæcum at the conclusion of an operation for widespread peritonitis with much distension. Those who employ the method are well pleased with it. Others state that the method has been outmoded by the use of a balloon-ended intestinal aspiration tube. However, it is so often extremely difficult not only to get the balloon to enter the duodenum, but also for it to be propelled to the lower ileum, that in many circumstances subsidiary cæcostomy should have pride of place.

A portion of cæcum is delivered and isolated by a pack. A purse-string suture is inserted. A small puncture is made with a narrow-bladed scalpel, and a quarter-inch (6-mm.) drainage tube or a rubber catheter with a lumen of the same diameter is pushed into the cæcum. Having anchored the tube to the cæcal wall with a catgut stitch the purse-string is tied. This is followed by two further invaginating purse-string sutures, preferably of unabsorbable material.

When available, the greater omentum is utilized to advantage as shown in *Fig.* 273. The free ends of the purse-string stitches are brought out through the greater omentum in the same way as shown in *Fig.* 727, p. 525. When the omentum cannot be found easily the peritoneum must be stitched accurately to the cæcal wall close to the tube, using interrupted sutures. The muscles and skin are approximated about the tube.

Fig. 273.—Cæcostomy as a subsidiary therapeutic measure in peritonitis.

After-treatment is as important as the operation itself. When possible, arrange for a special nurse to take charge of the case. As soon as the pulse permits, the patient is placed in Fowler's position (*Fig.* 274).

Gastric aspiration is continued as long as bile or intestinal contents are withdrawn; alternatively, a balloon-ended intestinal tube can be passed. With the tube in place, the patient is allowed to drink a small quantity (1 oz.) of water occasionally, provided the fluid is aspirated promptly. If, after the tube has been withdrawn, vomiting recommences or the patient hiccups, the tube must be re-inserted. Throughout treatment frequent mouth-washes are given.

Dextrose-saline is administered at the rate of 40 drops a minute. In severe cases associated with paralytic ileus when the intravenous route is the only one by which the patient can receive nourishment for several days, the addition of a preparation of amino-acids is valuable for maintaining the patient's strength. As mentioned already, blood transfusion is often required.

Charts.—A two-hourly pulse chart is recorded graphically. The temperature is recorded every four hours. No less important is a fluid intake and output chart, which must be kept for as long as the patient is receiving fluids intravenously. An antibiotic chart is also required.

Sedative Drugs.—Morphine $\frac{1}{4}$ gr. (16 mg.) or omnopon $\frac{1}{3}$ gr. (20 mg.) is given subcutaneously, and repeated in six hours if required.

Electrolytic Balance.—When the patient is being sustained by parenteral fluids only, careful watch must be kept for (*a*) sodium depletion (*see* p. 33) which is apt to occur as a result of the initial vomiting or subsequent gastro-intestinal aspiration; (*b*) potassium deficiency (*see* p. 34).

Vitamins, especially B complex and C, should be given parenterally at first, and later by mouth. Antibiotics produce vitamin deficiency, notably of the B complex.

Bowels.—Unless they have been opened naturally, a glycerine suppository followed by a low-pressure enema can be given on the fourth day. If, however, additional cæcostomy has been performed, one is spared the worry of failure of the bowels to act during the first six post-operative days of severe peritonitis.

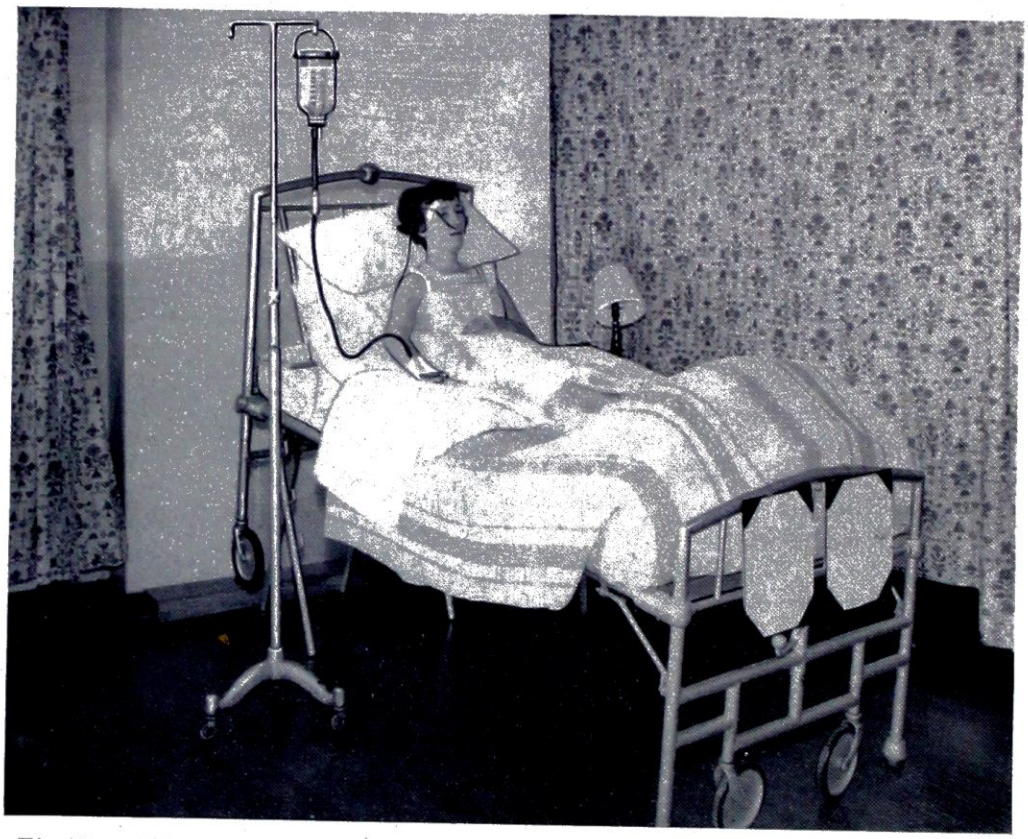

Fig. 274.—The bulwarks of treatment of peritonitis are shown in the illustration. The patient is undergoing treatment after an operation for gangrenous appendicitis with diffuse peritonitis, but the same principles can be invoked in grave peritonitis before operation. Attention should be focused upon : (1) Correct Fowler's position. (2) Transnasal gastric aspiration. (3) Continuous intravenous dextrose-saline. (4) Charts : (*a*) Two-hourly pulse and temperature. (*b*) Fluid intake and output, which is reviewed critically at the end of each 24 hours. The keeping of these charts and the skilful nursing that necessarily accompanies such scientific recordings are the mainstays that may preserve the thread of life.

GONOCOCCAL PERITONITIS

Examples of diffuse peritonitis which appear to arise from gonococcal salpingitis are encountered from time to time. In a number of cases belonging to this category aspirating and/or mopping up the pus, followed by closing the abdomen without drainage, and antibiotic therapy, has resulted in recovery. In several of these the pus was sent for culture and was reported to be sterile. This is probably due to the fact that the gonococcus, when removed from its habitat, is a frail organism. (*See also* Chapter XXIII.)

PERITONITIS DUE TO SUPPURATING MESENTERIC LYMPH-NODES

Examples of suppurating mesenteric lymph-nodes giving rise to diffuse peritonitis are not exceedingly rare. A correct pre-operative diagnosis is impossible.

T. W., aged 20, was admitted and gave the following history : while lying down he was seized with violent abdominal pain. There was no vomiting. The pain continued unabated and was all over the abdomen. The pulse was 120 and the temperature 102° F. (39° C.). Rigidity was almost general, but the right upper quadrant was relaxed moderately. The maximum tenderness was in the right iliac fossa. The diagnosis of perforated duodenal ulcer was considered, but it appeared that the temperature of 102° F. (39° C.) made this diagnosis unlikely.

The abdomen was opened by a gridiron incision, and the appendix examined. The organ was removed and slit up. Its mucous membrane was found to be normal. As there was much

turbid fluid in the general peritoneal cavity it was thought that after all the patient had a perforated duodenal ulcer. The gridiron incision was closed and the upper abdomen opened. There was no perforation, but a mass of suppurating lymph-nodes in the jejunal mesentery. Suprapubic drainage. Recovery.

In two other similar cases the same treatment was adopted, and both patients recovered; they were males, 27 and 30 years of age respectively.

ACUTE CHYLE PERITONITIS

J. C. Walker's Case.—

A forester, aged 27, was admitted with severe abdominal pain of eight hours' duration, which commenced suddenly after breakfast. The physical signs simulated those of perforated duodenal ulcer with extravasation along the right paracolic gutter. It was decided that immediate laparotomy was necessary. On opening the peritoneum the wound became flooded with chyle, of which about 12 oz. (360 ml.) was aspirated. The cæcum was completely white, and the ascending colon patchily so, as if milk had been injected beneath the serous coat. The mesentery of the ileum, the mesocolon, the pancreas, and several small areas on the posterior abdominal wall were affected similarly. A lump was felt behind the stomach. On opening the lesser sac an irregular mass overlying the second and third lumbar vertebræ presented, and from the middle of it there issued a trickle of chyle. A small piece of the mass, which consisted of enlarged lymph-nodes, was excised for histological examination. Closure of the leak was effected with difficulty by sewing a piece of detached omentum over the mouth of the opening, and a large Penrose drain was inserted into the lesser sac through the gastrocolic omentum. The wound was closed around the drain.

The pathological report was tuberculous lymphadenitis. It would appear that the mass of tuberculous lymph-nodes caused obstruction to the cisterna chyli. Leakage was due to erosion of a large lumbar lymphatic trunk, or the cisterna chyli itself. The distended lacteals evidently gained a communication with the thoracic duct by collateral channels opening up, for the patient made an uninterrupted recovery, and remained well.

In a collective review on chyle peritonitis Hoffman found that in nearly half the recorded cases the cause of the extravasation of chyle remained obscure. The next most common group occurred in cases of trauma, and this was usually produced by a tear at the base of the mesentery, presumably involving the cisterna chyli. Other causes were as in the case quoted above, or rupture of a chylous cyst. All cases operated upon within 12 hours, recovered. In some, drainage was carried out; in others, after the chyle had been aspirated the abdomen was closed without drainage.

PERITONITIS DUE TO PERFORATION OF THE SMALL INTESTINE

Perforation of the small intestine is comparatively rare, and it is improbable that the correct diagnosis will be made, except in trauma and in some cases of typhoid fever. However, the presence of free gas in the peritoneal cavity does make it certain that there is a perforation in some part of the alimentary tract. Without positive radiological evidence, most probably the abdomen will be opened on the diagnosis of perforated appendicitis. If a perforation of the small intestine is found, we should bear in mind:—

1. Regional ileitis.
2. Perforation by an ingested foreign body.
3. Typhoid perforation.
4. Perforated Meckel's diverticulum (*see* p. 264).
5. Perforated primary jejunal ulcer (*see* p. 277).
6. Perforated carcinoma of the small intestine.

Acute Perforation of the Intestine in Regional Ileitis.[1]—Laparotomy reveals diffuse peritonitis and turbid free fluid with large flakes of fibrin. The perforation is found in the thickened terminal ileum; it is usually near the mesenteric border, and is transversely linear. Owing to œdema and friability of the intestinal wall, mattress sutures are the least liable to cut out. The suture line should always be reinforced by a free omental graft. If the condition of the patient permits, a defunctioning ileotransverse colostomy should be carried out, thereby short-circuiting the diseased terminal ileum. Too often, in a matter of days simple suture has been followed by a second perforation. (*See also* p. 250.)

Peritonitis due to a Perforating Foreign Body.—It is not a great rarity to encounter diffuse peritonitis without a definite primary focus. Probably a proportion of these cases

[1] On no account should a piece of the wall of the intestine be removed for biopsy; the intestine is liable to perforate at this point.

is due to perforation of some part of the intestinal tract by an ingested foreign body, such as a bristle, which never comes to light. Sometimes the foreign body is large enough and the patient well enough, for the lesion to be discovered by a systematic search. In others we may have the good fortune to blunder across the offending object.

J. H., a stout man of 56, was admitted with what appeared to be a typical attack of acute appendicitis with diffuse peritonitis.

A gridiron incision was made, and thin pus welled up into the wound. The fingers were inserted into the wound for the purpose of withdrawing the cæcum. This manœuvre was hardly begun when I hastily withdrew my hand, for something had pricked my finger. Further investigation showed that the last coil of ileum had a spiked object sticking through its walls. This was extracted, the perforation closed, and the peritoneal cavity drained. Recovery.

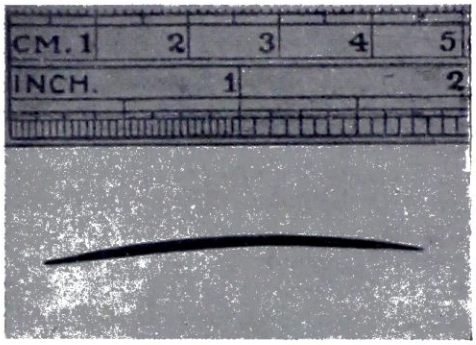

Fig. 275.—A foreign body made of celluloid found perforating the lower ileum in a case of general peritonitis.

The foreign body is shown in *Fig.* 275 ; it is composed of celluloid. The patient could throw no light on its origin.

Peritonitis from Perforated Typhoid or Paratyphoid Ulcer.—If it is known that the patient is suffering from typhoid the diagnosis is not particularly difficult. I have, however, seen 2 cases in which perforation occurred in a patient with ambulatory typhoid. Perforation occurs most frequently during the second and third weeks of typhoid or paratyphoid fever, and operation should be undertaken at the earliest possible moment.

Without operation, within 12 to 18 hours of perforation, the prognosis is practically hopeless. On opening the abdomen, in addition to obvious signs of peritonitis, the distal 3 ft. (90 cm.) of ileum are deeply congested. The perforation is usually found within two feet of the ileocæcal valve, and there may be more than one perforation. Occasionally the perforation is not situated in the lower ileum, but in the appendix, the cæcum, or any part of the colon, including the sigmoid flexure. In rare instances the peritoneal cavity is found to be full of bile, and the perforation is discovered in the gall-bladder (*see* TYPHOID CHOLECYSTITIS, p. 314). Exceptionally the peritonitis arises from organisms penetrating the wall of the intestine without perforation (Banks). After closing the perforation or perforations, if such be present, and draining the peritoneal cavity suprapubically the abdomen is closed as expeditiously as possible.

If a course of chloramphenicol has not been started already, its administration should be commenced as soon as possible. Chloramphenicol is the antibiotic of choice in the treatment of typhoid. The mortality of perforated typhoid ulcer is very high—over 80 per cent.

Michael Oldfield's Case.—

Perforation occurred on the twelfth day, without previous diarrhœa or distension, and was not diagnosed as such until eleven hours after the event, when peritonitis was established. The single perforation 1 ft. (30 cm.) from the ileocæcal valve was closed and the pelvis drained. The post-operative course was punctuated by bloodstained pleural effusion, pelvic abscess, obstruction by bands, myocarditis, a mild heat-stroke, and a ventral hernia ; but the patient recovered.

Primary Perforated Jejunal Ulcer is a rare cause of diffuse peritonitis. Chew Smith collected 35 cases from the literature (*see* p. 283). More rare still is a perforated jejunal diverticulum.

Peritonitis due to a Perforated Carcinoma of the Small Intestine.—I have encountered 3 cases of perforated carcinoma of the small intestine, all of which ended fatally. It is probably a mistake to resect in the presence of gross peritonitis. If possible, the perforation should be closed by suture and reinforced with omentum, and resection carried out later if the patient survives.

Peritonitis due to Intestinal Perforation complicating Carcinoma of the Colon.—Perforation occurs in 4 per cent of cases of carcinoma of the colon ; of these, 85 per cent occur at the site of the neoplasm, while in 15 per cent the cæcum is the site of the perforation, due to overdistension from obstruction by the growth.

When the cæcum is perforated it is best exposed by a gridiron incision, if that incision has not been employed in the first instance. If the cæcum can be exteriorized readily, this course should be chosen.

If the cæcum is bound down, the perforation should be closed by liberal plication reinforced with omentum. This is followed by transverse colostomy. In either event, suprapubic peritoneal drainage is essential.

When perforation occurs at the site of the lesion the treatment is similar to that of perforated diverticulitis (*see* p. 254), a condition which is sometimes difficult to distinguish from a neoplasm. However, there is one fundamental point of difference: neoplasm is always associated with some degree of intestinal obstruction. Whatever course is adopted to stop the leak, the operation should be concluded by performing colostomy well proximal[1] to the lesion. Even with early operation aided by antibiotic therapy, the mortality is not less than 80 per cent.

Peritonitis due to a Perforated Ulcer occurring as a Complication of Ulcerative Colitis.—Perforation of an ulcer into the general peritoneal cavity occurs occasionally in ulcerative colitis, especially in cases belonging to the fulminating type. If the perforated segment is mobile, it is best cared for by exteriorization. Otherwise, closure of the perforation,[2] together with suprapubic drainage and a Penrose drain down to the site of the perforation is the best course. If the patient's general condition will permit a more prolonged operation ileostomy (*see* p. 523) should be carried out, more particularly because without it the incidence of re-perforation is high.

ACUTE TUBERCULOUS PERITONITIS

Cases of acute tuberculous peritonitis usually come to operation on account of an error in diagnosis. In some instances it is almost impossible to make a correct pre-operative diagnosis.

Especially in the case of a child with diffuse peritonitis, a leucocyte count of under 10,000 favours acute tuberculous peritonitis. When there is any real doubt as to the differential diagnosis it is safer to operate.

If a patient with acute tuberculous peritonitis has a good anæsthetic, no harm is done by opening the abdomen; indeed, good seems to accrue from removal of the ascitic fluid which accompanies the disease.

On opening the peritoneum a varying amount of free fluid, usually clear and straw-coloured, escapes. Tubercles are seen scattered over the peritoneum and the greater omentum. Tubercles may be confused with fat necroses. The latter are more yellow, and are often associated with a blood-stained peritoneal exudate. Nevertheless, I have seen a case in which it was most difficult to decide between fat necroses and tubercles until the swollen, purple pancreas was displayed, and left no doubt that it was a case of acute pancreatitis. Again, peritoneal carcinomatosis may on occasions easily be confused with tuberculosis. The tiny multiple deposits of carcinoma feel hard when rolled between the finger and thumb, making their recognition tolerably simple.

On opening the abdomen and finding acute tuberculous peritonitis, a piece of omentum should be removed for histological examination. The abdomen is then closed without drainage.

A troublesome, but rare, complication is the development of tuberculous ulceration in the wound. For this reason, as well as to enable the patient to overcome the tuberculous infection, streptomycin, with its allies isoniazid and para-amino-salicylic acid in correct alternating combinations, is administered as in other forms of tuberculosis.

Other Aspects of Tuberculous Peritonitis in Relation to Acute Abdominal Surgery.—

M. K., aged 21, was admitted with hypogastric pain extending over six days. The pain commenced abruptly, and she vomited twice.

On examination the pulse was 108 and the temperature 100·8° F. (38·2 C.). There was a fullness in the lower abdomen, dull to percussion, which persisted after the passage of a catheter. A rectal examination was negative. A leucocyte count showed leucopenia. A diagnosis of (?) twisted ovarian cyst was made.

Laparotomy showed tuberculous peritonitis, with a loculus containing a pint of clear fluid which was aspirated, and the resulting cavity was mopped dry. The abdomen was closed without drainage. Recovery.

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[1] Some authorities advise that the colostomy be placed immediately above an operable neoplasm, so that later the neoplasm and the colostomy can be excised together.

[2] If, as is sometimes the case, the neighbourhood of the perforation is so friable that it will not hold sutures, partial colectomy with closure of the cut ends, followed by ileostomy, is the best course.

E. H., aged 6, gave a history extending over three days of attacks of colic lasting about three minutes and recurring every twenty minutes. Her mother stated that the child's bowels had not been open, but that a quantity of mucus had been evacuated.

On examination the pulse and temperature were normal, and the child did not appear very ill. There was a lump in the hypogastrium which also could be felt per rectum. An enema yielded a small fæcal result and a considerable amount of mucus. The diagnosis was doubtful. An appendix abscess was suggested, also an anomalous intussusception.

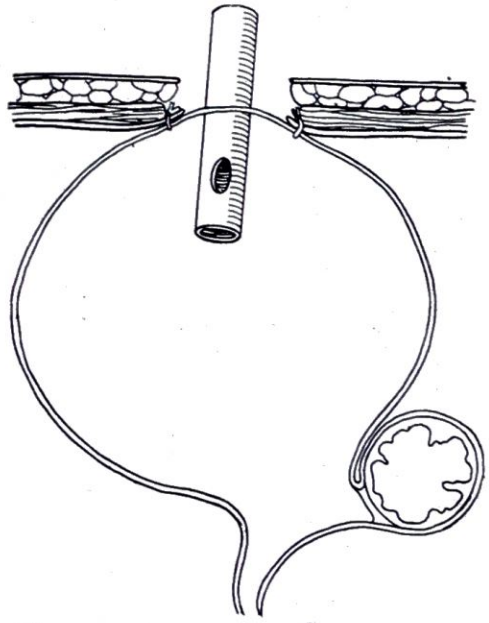

Fig. 276.—Marsupialization of a large tuberculous abscess of the mesentery.

Laparotomy showed a large tuberculous abscess in the mesentery of the lower third of the ileum. The peritoneum was sewn around the wall of the abscess so as to marsupialize it (*Fig.* 276). The abscess was then drained, a large amount of tuberculous pus being evacuated.

Recovery. When seen two years later she was perfectly well, but there was some keloid formation in the scar.

F. J., aged 19, was admitted in a very grave condition with an indefinite history of abdominal pain extending over five weeks. She had vomited once on the day of admission. The pulse was 120 and the temperature 100° F. (37·8° C.). The abdomen was greatly distended.

On opening the abdomen there was plastic tuberculous peritonitis. Behind the umbilicus there was a cystic mass composed of loops of ballooned small intestine adherent to one another. It was impossible to find even one loop of small intestine which was not diseased. Therefore nothing was attempted, and the abdomen was closed, with the resolve to re-open the abdomen should urgent obstruction develop. Unexpectedly she improved after the operation. The bowels moved regularly. She was discharged a month later.

When written to two years later, her mother replied that F. J. was in a sanatorium, and was progressing "quite well".

DIFFUSE PERITONITIS FOLLOWING PARTURITION OR ABORTION

When streptococcal peritonitis follows puerperal infection, it is a notifiable disease. It is more common after first deliveries. Rigidity is seldom much in evidence; this, at any rate in part, is due to the stretched condition of the abdominal musculature. The lochia may be offensive, but not necessarily so. Diarrhœa is common.

When the infection is limited strictly to the pelvis, the Ochsner-Sherren régime (p. 232), followed when necessary by posterior colpotomy (p. 563), is eminently successful. We are considering here a more extensive peritoneal involvement. It is the considered opinion of those who have had much experience of these cases that operation should be carried out as soon as possible, even though the patient be very ill. After resuscitative measures and antibiotic therapy have been instituted, the abdomen is opened by a right paramedian incision. When there is an abscess in the wall of the uterus or in the broad ligament, after packing off the area, the abscess is opened with sinus forceps, and a drainage tube is introduced into the abscess cavity, should this be large enough to admit one. In any case the peritoneal cavity is drained by *two* drainage tubes passed into the pelvis, one in front of the uterus and the other into the pouch of Douglas.

In the pre-antibiotic era the mortality of general peritonitis following parturition or abortion was at least 50 per cent; with antibiotic therapy the mortality has fallen to less than 10 per cent. (Brews.)

IDIOPATHIC STREPTOCOCCAL PERITONITIS IN ADULTS

In nearly every instance primary streptococcal peritonitis is a local manifestation of septicæmia, and the infection is carried to the peritoneum by the blood-stream. However, it is possible that in a few cases the infection reaches the peritoneum via the Fallopian tubes. Whereas in secondary peritonitis the peritonitis commences as a localized lesion and becomes generalized, the primary variety begins as a diffuse inflammation and (if the patient lives long enough) becomes localized (Cokkinis). Prior to the antibiotic era,

primary streptococcal peritonitis was nearly always fatal, and the mortality is still very high. Probably appendicitis with peritonitis will be diagnosed. The appendix is found inflamed on the *outside*, but not perforated. The peritoneal exudate is odourless, thin, contains small flecks of fibrin, and is sometimes blood-stained. Meteorism may be extreme, causing the condition to be confused with intestinal obstruction. In this connexion the following case is of some interest :

I was asked to see a woman aged 37 years, who had been admitted to the medical wards as (?) typhoid. She was gravely ill, and the abdomen was greatly distended. There had been no result from an enema, and she vomited small amounts repeatedly.

Examination showed a small right femoral hernia. Operation was advised on the diagnosis of a strangulated Richter's hernia.

On opening the sac pus was found within, also a small piece of omentum which was reduced readily into the peritoneal cavity. She was too ill to warrant anything but drainage, so I passed my finger up the femoral canal and cut down upon it in the suprapubic region. In so doing I pricked my finger. In spite of the usual precautions I had a rigor five hours later. The pus from the peritoneum grew a streptococcus. The woman died, and at the necropsy general peritonitis was found, but without any demonstrable primary focus. I consider myself fortunate to have escaped with the loss of my left index finger. This, of course, occurred in the pre-antibiotic era.

Having decided that the peritonitis is idiopathic, as much as possible of the pus is removed by suction. After inserting a suprapubic drainage tube the abdomen is closed, and measures detailed in the general treatment of peritonitis are carried out.

PRIMARY PERITONITIS IN INFANCY AND CHILDHOOD

(*Pneumococcal and Streptococcal Peritonitis*)

By primary peritonitis is meant there is no focus of infection within the abdomen. In nearly all cases the organism responsible is a pneumococcus or a hæmolytic streptococcus, the latter being slightly more frequent than the former. Seventy-five per cent of the juvenile patients are under the age of 5 years.

Diagnosis.—The onset is sudden, and the earliest symptom is pain localized to the lower half of the abdomen. The temperature rises to 102° F. (39·8° C.) or more, and there is usually frequent vomiting. Should an inguinal hernia be present, it is likely to be distended, but the contents can be reduced readily. After 24–48 hours, profuse diarrhœa, occasionally blood-stained, is characteristic. There is usually increased frequency of micturition. The last two symptoms are due to the severe pelvic peritonitis. Herpes near a nostril or on a lip is often present. In acute forms of the disease, even in cases where there is no involvement of the lung, there is often a tinge of cyanosis of the lips and cheeks, and movement of the alæ nasi is often discernible. On examination rigidity and tenderness are usually bilateral, but are less marked than that due to appendicitis. When facilities exist, and the patient is a female, a vaginal smear should be examined for the presence of pneumococci. Positive findings strongly support a diagnosis of pneumococcal peritonitis.

Primary peritonitis is prone to occur in patients with nephrosis, in which case the infecting organism is nearly always a pneumococcus. Primary peritonitis of childhood is seen less frequently than formerly ; perhaps this is due to the greater cleanliness and higher standards of living of the poorer classes. The condition tends to be epidemic ; by this is meant that several cases are encountered within a short space of time.

Differential Diagnosis.—A leucocytosis of 30,000 or more with approximately 90 per cent of polymorphonuclear leucocytes favours pneumococcal peritonitis rather than appendicitis. The condition which is extremely difficult to differentiate from primary peritonitis in its early stages is pneumonia. An unduly high respiratory rate, and the absence of rigidity, are the most important signs supporting the diagnosis of pneumonia, which is usually clarified by a radiograph of the thorax. One must, however, be mindful of the fact that pneumococcal peritonitis can occur as a complication of pneumonia. Of 8 consecutive cases of pneumococcal peritonitis under my care, 3 occurred in children who were being treated for pneumonia in the medical wards.

Treatment.—The best plan for the management of a case of primary peritonitis in early life is as follows :—

1. A period of preparation for operation, usually a matter of hours. This includes the administration of parenteral dextrose-saline solution, gastric aspiration, the commencement of penicillin therapy, and performing compatibility tests prior to blood transfusion.

2. A limited operation is conducted under local anæsthesia in the following manner: after a suitable dose of nepenthe, 1 per cent procaine solution is injected over the lower right rectus muscle. An incision 1 in. (2·5 cm.) in length is made (*Fig.* 277), and after injecting more local anæsthetic into the rectus muscle this is split. With blunt hooks holding aside the wound edges, the peritoneum is exposed, and is opened for about half an inch (12 mm.). With a fountain-pen filler, a specimen of the peritoneal exudate is obtained. A hint as to the nature of the infection can be gathered from the appearance of the exudate :—

Fig. 277.—Under local anæsthesia an incision 1 in. in length is made over the right rectus muscle, the fibres of which are split.

In pneumococcal peritonitis it is odourless, fibrinous, and soapy.

In streptococcal peritonitis it is odourless, thin, contains small flecks of fibrin, and may be blood-stained.

If, on opening the peritoneum, the findings indicate that the infection has originated from a perforated appendix, e.g., there is odour, after a little general anæsthetic has been given, if required, the incision is enlarged and appendicectomy is carried out. In other circumstances manipulation is reduced to a minimum. On no account should the appendix be removed because its peritoneal coat, in common with the rest of the intestine, is inflamed. Appendicectomy in primary peritonitis increases the mortality. Excess of purulent fluid is aspirated with a mechanical sucker, after which a Penrose drain that just fits the incision (*Fig.* 278) is insinuated down into the pelvis. This cigarette drain should be large enough to fill the wound, suture of which is then unnecessary (*Fig.* 279). The patient is returned to bed.

After-treatment follows in many respects that detailed for adults. The patient is placed in high Fowler's position, gastric aspiration is continued, usually for four or five days, during which time the patient receives intravenous fluid therapy. Blood transfusion is beneficial. For the first 36 hours appropriate doses of nepenthe four-hourly give necessary rest. An oxygen tent is particularly valuable in patients with respiratory distress and/or those (the majority) with abdominal distension. Unless the bacteriological sensitivity tests dictate otherwise, penicillin is continued until there is evidence that the infection has been overcome, and thereafter it is given in reduced doses for four or five days.

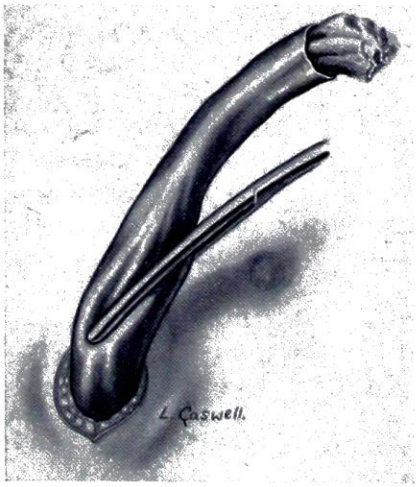

Fig. 278.—A cigarette drain is inserted through the wound into the pelvis.

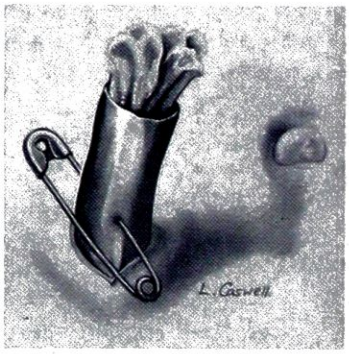

Fig. 279.—The soft cigarette drain fills the wound and no sutures are necessary. The excess of tubing distal to the safety-pin is cut off. (Ladd's technique.)

OTHER CAUSES OF PERITONITIS IN THE NEWBORN

Bacterial peritonitis can be due to :—

1. A blood-stream infection by streptococci, gonococci, or pneumococci.
2. An extension of omphalitis (*see* p. 179).
3. Perforated peptic ulcer, which is not a great rarity in the neonatal period, whereas
4. Acute appendicitis is extremely infrequent at this time of life.
5. Perforation of a Meckel's diverticulum (*see* Chapter XXVI).

MECONIUM PERITONITIS

Meconium peritonitis is a non-bacterial chemical or foreign-body peritonitis, usually occurring during late intra-uterine life, but it may occur at or soon after birth. It is due to a perforation, usually in the terminal ileum. In 50 per cent of cases the cause of the perforation is unknown ; in 50 per cent it occurs in association with neonatal intestinal obstruction

(meconium ileus, atresia of the ileum, volvulus neonatorum). In a number of instances the perforation becomes sealed during intra-uterine life, when dense adhesions are the aftermath. When the perforation remains patent, many of the infants are born dead, or die soon after birth. In those that survive birth the originally sterile peritonitis soon becomes infected, when, strictly speaking, it is no longer meconium peritonitis.

Diagnosis.—The presenting signs are very like those of intestinal obstruction of the newborn, which indeed is present in half the cases. As a rule the signs develop shortly after birth, but when the perforation is secondary to a congenital stricture of the intestine, or to bands, the symptoms do not come on for a few days, or even for over a week. When the perforation is recent, shock is pronounced. There is also cyanosis, rapid grunting respirations, abdominal distension, bile-stained vomit, œdema of the flanks and scrotum, and occasionally, in the absence of obstruction, the passage of blood and mucus per rectum. Not all these symptoms are encountered in the same patient, but some of them are always present. Radiography may reveal free gas in the peritoneal cavity. In meconium peritonitis, meconium extruded into the peritoneal cavity frequently calcifies, giving rise to a characteristic X-ray appearance (*see Fig.* 648, p. 475). On the other hand, less frequently, calcification is so slight that it cannot be demonstrated radiologically. Free fluid in the peritoneal cavity is often sufficient to give a fluid thrill. Franklin and Hosford found that on diagnostic aspiration the fluid withdrawn was bile-stained.

Operative Treatment.—Without operation, the condition is hopeless. As soon as fluid therapy and gastric aspiration have improved the general condition sufficiently, laparotomy is performed. In order to expose the lesion usually the surgeon is faced with dissection of a number of dense adhesions. Should the case prove to be one of a perforation only, this is closed with sutures, and suprapubic drainage of the peritoneal cavity carried out. In cases of perforation secondary to intestinal obstruction, the obstruction must, of course, be remedied as set out in Chapter XLI. The mortality in those patients submitted to laparotomy is about 40 per cent.

POST-OPERATIVE PERITONITIS

The incidence of post-operative peritonitis due to infection of the peritoneum at the time of operation is now infinitesimal. Nevertheless, because of post-operative intra-peritoneal leakage of intestinal contents, bile, pancreatic secretion, or urine, post-operative peritonitis is not infrequent. According to Maingot, 20 per cent of cases of peritonitis arise after abdominal operations not performed for peritonitis.

The diagnosis is difficult. Abdominal rigidity, one of the mainstays of the recognition of other forms of peritonitis, is frequently in abeyance. Tenderness, though present, is likely to be attributed to the recent incision. Moreover, the patient in the early post-operative days is permitted, almost as a routine, to have a narcotic for pain ; consequently he may not register tenderness, or do so in an unconvincing manner. The abdominal distension (which in fulminating cases is slight), the diminished or absent bowel-sounds, and the continued aspiration of bile-stained or even fæculent material from the stomach, will most certainly be attributed to paralytic ileus ; indeed, probably many cases of paralytic ileus *are* due to peritonitis, which may or may not be overcome by antibiotic therapy. However, no antibiotic can succeed in staying the onslaught of bacterial peritonitis from massive necrosis of the bowel, or leakage from a suture line.

The operation which the patient has undergone should serve as a pointer to the possibility of ' paralytic ileus ' being due to post-operative peritonitis. Leakage from the duodenal stump after gastric resection, leakage from the line of anastomosis after partial colectomy, leakage following resection and anastomosis (particularly end-to-end anastomosis) of small intestine, leakage of bile from a cut accessory duct or from a ' blow off ' of a ligature on the cystic duct in the presence of obstruction to the common bile-duct, urine in the peritoneal cavity following leakage from a uretero-intestinal anastomosis or an injury to the ureter or bladder during a difficult hysterectomy, are all possible causes of post-operative peritonitis, and unless drainage has been provided, or occurs spontaneously through the wound, peritonitis will become diffuse, and soon prove fatal.

The diagnosis can only be made after repeated clinical examinations. Antibiotic therapy is likely to control the temperature, and at this time, when every scrap of evidence is so important, it tends to mask other signs of peritonitis. However the most valuable of all signs, abdominal tenderness, is not so affected, and will surely be present if the

narcotic has been suspended. Peritoneal puncture (*see* p. 1118) sometimes clinches the diagnosis.

Treatment.—In the early stages of post-operative peritonitis drainage to the site of the suspected leak will probably save the life of the patient. If the leak is beneath the incision, removal of stitches and the provision of an opening into the peritoneum, if performed early, may suffice. In other circumstances, drainage by the most direct route, as well as suprapubic peritoneal drainage, must be instituted as soon as possible.

POST-OPERATIVE BILE PERITONITIS

Extravasation of bile into the peritoneal cavity following an operation on the bile-passages occurs in one of the following ways :—

1. Seepage through the suture line after exploration of the common bile-duct without drainage of that duct. Leakage through the site of puncture for operative cholangiography has been reported (McKenzie).
2. Blockage or accidental dislodgement of a drainage tube placed in the common bile-duct.
3. Slipped ligature on the cystic duct.
4. Leakage from an accessory duct.
5. Operative damage to the common hepatic duct or common bile-duct.

As far as can be ascertained (1) is the most common ; it is often impossible to determine the site of leakage when the abdomen is reopened, particularly as the surgeon is anxious to drain the collection and resuture the abdomen as quickly as possible.

McKenzie draws attention to the fact that a stab drainage tube leading to Rutherford Morison's pouch sometimes fails to permit escape of bile due to (*a*) compression of the tube by too small a stab incision, (*b*) the tube becoming blocked with blood-clot or a plug of omentum, (*c*) the tube on occasions becoming kinked when the patient is placed in a sitting position if the stab incision is placed near the costal margin, even if it is well clear of the ribs in the recumbent position.

The lesson to be learned is that in draining Rutherford Morison's pouch by a stab incision, the incision must be of adequate size and placed three fingers' breadth below the costal margin.

Post-operative bile peritonitis is often most difficult to diagnose. It should be known that there are two distinct clinical varieties :—

a. **Sudden Collapse** within 48 hours of operation. In this type peripheral circulatory collapse overshadows all other clinical features. Internal hæmorrhage or extravasation of bile suggests itself as the cause of the catastrophe. If the condition of the patient improves with intravenous dextran, plasma, or, preferably, blood, it is likely that some physical signs will be elicited in the abdomen. In only 2 of 7 cases reported by McKenzie did the patient's condition improve sufficiently to permit re-opening the laparotomy wound. These patients recovered with drainage ; in the remainder death occurred within 24 hours of the onset of symptoms. In a case of bile peritonitis following cholecystectomy, Ivor Lewis reopened the abdomen within 24 hours and inserted a drainage tube. Rapid improvement after the second operation was almost as striking as the rapid deterioration after the first.

b. **Insidious Onset.**—Shock is absent. In some cases the symptoms are so mild and the signs so indefinite that there is a considerable delay in establishing the diagnosis. Otherwise unexplained tachycardia with vomiting and abdominal distension coming on several days after an operation on the bile-passages should call to mind the possibility of bile peritonitis. In nearly all cases there are recurrent attacks of abdominal pain. In about half the cases there is some degree of abdominal distension. In only a quarter of the cases is there tenderness, and rigidity is most exceptional. In a quarter of the cases mild jaundice[1] is present. Signs at the base of the right lung, and X-ray evidence of raising of the diaphragm, suggest a sub-diaphragmatic collection of bile. When considering the diagnosis of post-operative bile peritonitis the total absence of drainage from a tube, if such be present, or a copious drainage of bile that ceases abruptly, is most suggestive. Of 13 cases belonging to this group, there were 2 deaths, in neither of which was secondary drainage established.

Summarizing.—If there are reasonable grounds for suspecting intraperitoneal extravasation of bile, there should be no hesitation in reopening the abdomen, and if free bile is present, establishing local and, if necessary, suprapubic peritoneal drainage.

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[1] Greenish discoloration around the umbilicus is a helpful sign, when present.

RESIDUAL ABSCESS

A residual abscess (*Fig.* 280) may occur after successful treatment of diffuse peritonitis by non-operative means. More often such an abscess arises as a complication after an operation for peritonitis. When a localized intraperitoneal collection of pus is suspected, excluding subdiaphragmatic abscess, operation should be delayed. When palpable, the limitation of an intraperitoneal inflammatory mass should be marked out on the skin, and examined carefully each day.

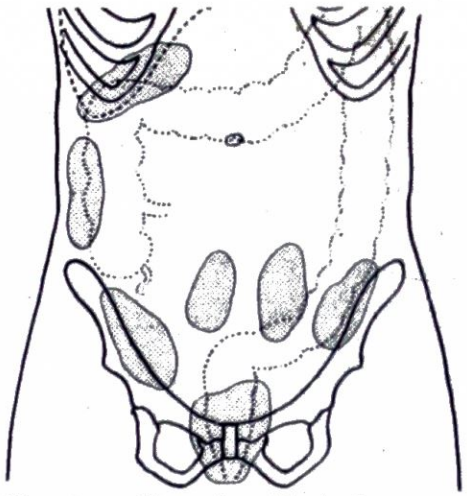

Fig. 280.—Sites of residual abscesses. (*After Cutler.*)

In a number of instances, with the aid of antibiotic treatment, the mass becomes smaller and smaller, and is finally impalpable. In other cases, if one waits, the limitations of the abscess become discrete, and in many situations the abscess becomes adherent to the abdominal wall, so that it can be drained without opening the general peritoneal cavity.

In the case of a laterally-placed abscess, the incision is made on the lateral side of the swelling. The layers of the abdominal wall are divided until the peritoneum is reached. With the finger, the extraperitoneal tissues are separated from the peritoneum until the abscess is opened. A drainage tube is inserted ; if the path is tortuous, a Penrose drain is best.

Appendix Abscess.—*See* p. 234.
Pelvic Abscess.—*See* p. 239.
Abscess connected with Diverticulitis.—*See* p. 252.
Subdiaphragmatic Abscess.—*See* p. 342.

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CHAPTER XXI

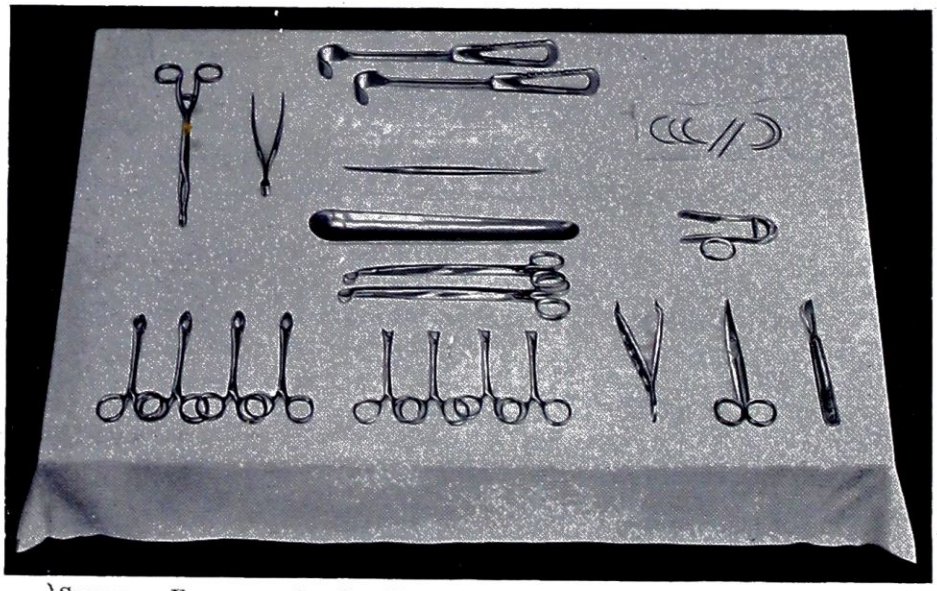
ACUTE APPENDICITIS

The earlier the operation, the lower the mortality. (J. B. Murphy.)

WHEN a patient is seen during the first 48 or 50 hours of an attack of acute appendicitis no question arises as to the best treatment; it is agreed universally that the appendix should be removed without delay. In these circumstances appendicectomy is the most satisfactory operation of abdominal surgery.

APPENDICECTOMY DURING THE FIRST FORTY-EIGHT HOURS OF AN ATTACK OF APPENDICITIS

Instrumentarium.—The instruments required for the operation about to be described are shown in *Fig.* 281. To reduce the number of instruments to the minimum compatible with efficiency makes for an orderly technique.



Sponge-holding forceps
Forceps for inverting the stump
Morrant Baker's forceps
London Hospital retractors
Watson Cheyne dissector
Sargent's depressor
Moynihan's tetraclips
Towel-holding clips
Needles
Author's modification of Printy's needle-holder
Jean's dissecting forceps
Mayo's scissors
Bard-Parker knife

Fig. 281.—Instruments for appendicectomy with the exception of hæmostats, which are on a separate table.

The Incision.—*The gridiron incision* (p. 159) made over McBurney's point is the best one for the removal of an acutely inflamed appendix. If the method that has been described for enlarging the incision in necessary cases is followed, the sole objection to the gridiron incision—namely, limitation of space—fades into insignificance. It is well established that the gridiron incision is associated with the lowest mortality (Abel and Allen).

The paramedian incision: For the designed removal of an acutely inflamed appendix, a paramedian incision is far less suitable than the foregoing. The appendix is often comparatively inaccessible from this approach. By employing an incision so near the middle line it is possible to contaminate the medial portion of the peritoneum in cases where the infection was strictly localized. Coils of intestine cannot be packed off so readily as in the gridiron incision.

However, the paramedian incision is valuable when the diagnosis is in doubt, particularly in a female when disease of the adnexa[1] cannot be excluded.

Technique.—We will assume that the abdomen has been opened by the gridiron incision. Place a retractor under the medial side of the peritoneal incision and lift up the abdominal wall (*Fig.* 282). This allows one to peer into the peritoneal cavity and to see the state of affairs before anything is disturbed. It is often possible to see the cæcum, and occasionally the appendix also.

Fig. 282.—Appendicectomy. Before attempting any intraperitoneal manipulation a retractor is placed under the medial side of the wound, and the abdominal wall is lifted up. The surgeon then peers inside before anything has been disturbed.

Obtaining a Specimen of Peritoneal Exudate.—Whenever possible, a specimen of purulent peritoneal fluid should be collected for culture and sensitivity of the organisms present to antibiotics. To send a swab that has been in contact with the fluid to the bacteriologist for this purpose is not a fraction of the value of a fluid specimen in a stoppered test-tube. From the point of view of the surgeon, who would wish to examine more closely the character of the fluid, as well as that of the bacteriologist, it should be looked upon as a necessity to have a sterile teat-ended fountain-pen filler in readiness at every urgent laparotomy.

If pus or purulent fluid wells up and a mechanical sucker is available, it is used freely at this stage, and whenever purulent fluid enters the field. Pack a portion of a roll of gauze under the medial side of the peritoneum and reapply the retractor over this before attempting to deliver the cæcum. It should be needless to emphasize that nothing must enter the peritoneal cavity without having a hæmostat attached. Pick up the cæcum between finger and thumb and draw it outwards and upwards. When the cæcum is difficult to

Fig. 283.—Appendicectomy. The cæcum is held by an assistant. Morrant Baker's forceps have encircled the appendix, and the meso-appendix is displayed.

[1]A pelvic examination under the anæsthetic often helps to elucidate this problem.

grasp, Denis Browne's forceps, used with a very light touch, without engaging the ratchet, are sometimes of distinct value, but the fingers are the best, and if the beginner cannot get a hold of the cæcum it usually means that either the patient is straining under the anæsthetic or the incision is too small. Once a portion of the cæcum has been drawn out of the wound, it should be grasped between the finger and the thumb holding a moistened abdominal pack. Using the pack, the cæcum is withdrawn fully, and usually the appendix comes into view. The right index finger may be inserted into the wound to aid the gentle delivery of the appendix under vision, but only under vision. Once the appendix has been delivered the cæcum is given to the assistant to hold. He should be instructed to take a good grip and hold the slippery structure with an abdominal pack (*Fig.* 283).

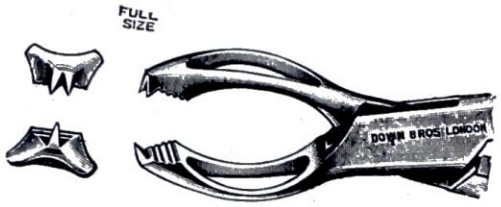


Fig. 284.—Morrant Baker's forceps.

Morrant Baker's forceps (*Fig.* 284) are applied around the appendix in such a way as to encircle the organ and yet not damage it (*Fig.* 285). Clipping then cutting, section by section the meso-appendix is severed, until the base of the organ is reached. A long hæmostat is applied to the base of the appendix. It is released, and applied again a few millimetres more distally. Around the crushed portion a ligature is applied, tied, and its ends cut short. A purse-string suture is inserted to encircle the caput cæci about half an inch (12 mm.) from the appendix. This stitch passes through the muscular coat,

Fig. 285. — Appendicectomy. All is in readiness for the insertion of the purse-string suture, after which the appendix is removed by cutting across its base between the ligature and the hæmostat.

Inset shows Morrant Baker's forceps in use grasping the appendix without crushing it. Lane's forceps with one tooth cannot be employed satisfactorily for this purpose: when traction is applied the meso-appendix is torn by the single tooth.

particularly at the longitudinal bands. The purse-string having been inserted, it is momentarily left untied while the appendix is severed between the hæmostat and the ligature (*Fig.* 283); to employ a diathermy needle for this purpose renders the cut surfaces virtually sterile. The appendix, hæmostat, and Morrant Baker forceps are now free in the left hand, and if it has been employed, the scalpel is in the right. All these are cast into a special dish because they are contaminated. The free ends of the purse-string are held moderately taut while the stump is invaginated with small non-toothed dissecting forceps (*Fig.* 286). The purse-string having been tied, the cut ends are left long and

grasped in a hæmostat. Attention is directed to the ligaturing of the meso-appendix. For this purpose always use transfixion sutures (*Fig.* 287), which are safer than a simple ligature. I have seen at necropsy a hæmoperitoneum resulting from a slipped ligature on the meso-appendix. The transfixed ligature cannot slip. Finally, in selected instances the long ends of the ligature which has been applied to the meso-appendix and the ends of the purse-string may be knotted (*Fig.* 288), thus obliterating any cut edge of peritoneum. This step is only attempted when there is absolutely no tension between the structures involved.

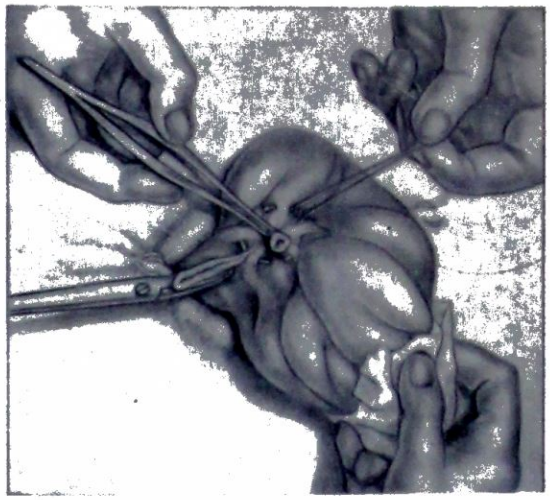


Fig. 286.—Appendicectomy. Inverting the stump of the appendix.

On 'Hooking out' the Appendix.—An experienced surgeon can, and does, sometimes put in a finger and hook out the appendix. This is all very well for one who, from experience, can estimate the mobility of the organ in relation to the length of the incision. With much practice it is possible at a glance and a touch to recognize the flexibility or friability of a particular appendix. To the beginner, hooking out the organ is fraught with danger. The most dangerous appendix to attempt to hook out is one situated in the pelvis. Sir Frederick Treves in his well-known sketch, "The Idol with the Hands of Clay", depicts graphically the fatal termination of an operation for appendicectomy by a sudden hæmorrhage. It is possible that the external iliac artery was hooked up, for this artery may feel very like the continuation of a pelvic appendix (*Fig.* 289). The safest method of delivering the organ is by gentle traction of the cæcum. The finger may be used to ease the appendix through the abdominal wall, but this is not what is understood by hooking. If the appendix does not come out kindly it means that more room is required.

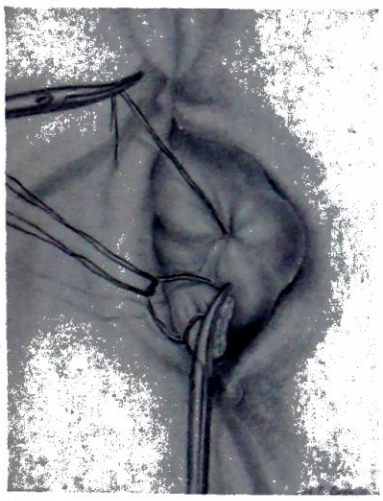


Fig. 287.—Appendicectomy. Ligaturing the meso-appendix. Often several hæmostats are applied in dividing this structure.

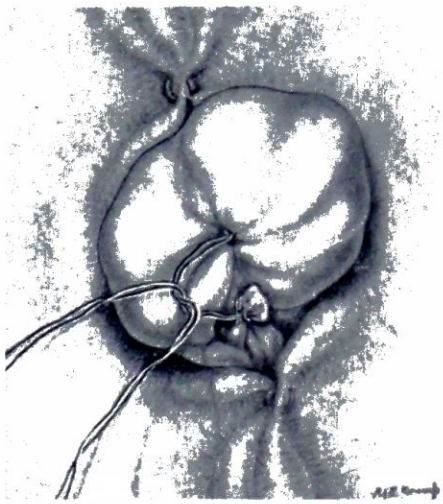


Fig. 288.—Appendicectomy. Knotting together the ligature which has been applied to the meso-appendix and the long ends of the purse-string. This is only done in exceptional cases where there is no tension between the two points.

It is far better to abstain from 'hooking' altogether. To enlarge the incision to see exactly what one is doing, to dissect gently and pack away extraneous viscera, apply Morrant Baker's forceps in the manner described, and by these means to strive to lift the appendix intact on to the surface, renders 'hooking' unnecessary.

Overcoming some Difficulties.—

The Cæcum cannot be Found.—This means that either the cæcum has not descended fully or that malrotation of the intestine (*see* p. 471) is present. An extension of the incision in an upward direction is required.

The Appendix cannot be Found.—Make certain that it is the cæcum that has been delivered. The transverse colon is recognized at once because of the attachment of the greater omentum. Having made sure that it is the cæcum, trace one of the tæniæ coli

Fig. 289.—An inflamed appendix lying over the brim of the pelvis is often in intimate contact with the common iliac vessels.

downwards; this must lead to the base of the appendix. Another help is to retract the terminal ileal fat-pad[1] (P. Thorek). This pad, as its name implies, is a flap rather like a large appendix epiploica attached to the anterior surface of the last half-inch or so of the ileum (*Fig.* 290). If this pad is seized (preferably with a Babcock's forceps) and retracted by the assistant to the left, the inferior ileocæcal recess is displayed, and often therein lies the base of the appendix. If still in trouble enlarge the wound, and after locating the ileocæcal valve (the appendix must be near this structure) palpate the back or under-surface of the cæcum, for the appendix may be buried in the cæcal wall. If the patient has not had a previous abdominal operation, the only remaining possibility is that the organ has become inverted or intussuscepted (*see* p. 487). The umbilicated extremity of the cæcum should make this rare occurrence obvious.

The Appendix has Sloughed off.—Except on occasions so rare that they are unlikely to be encountered more than once in a surgical lifetime, the meso-appendix anchors the organ in the field of operation. Once only, I found that the bulk of the appendix was missing. After dealing with the appendix stump the incision was enlarged, and a free appendix was retrieved from the pelvis without much difficulty.

Has all the Appendix been Removed?—The distal end of the appendix is dome-like, and rarely, if ever, is there a perforation exactly on the convexity of the dome. If the tip of the organ has not been removed with the rest of the appendix, a probe passed along the lumen of the excised portion will demonstrate if a part is missing. Never leave behind

[1] Called by H. A. Kelly, in his monumental work 'Appendicitis', the jejunal-cæcal fold.

a piece of detached appendix : the blood-supply has been cut off, and consequently gangrene and liquefaction of the infected fragment is almost certain to follow. The proximal end of the appendix, when buried in the cæcal wall, has been overlooked many times (*Fig.* 291).

The Appendix lies buried Retrocœcally.—In order to gain an unobstructed view of the peritoneal cul-de-sac to the right of the cæcum it is often necessary to enlarge the wound. Instruct the assistant to retract the cæcum to the left. Once the reflection of the peritoneum on the lateral aspect of the cæcum is in view, make the hockey-stick-shaped incision in the

Fig. 290.—A well-developed terminal ileal fat-pad (x) in an obese subject. (*After Howard A. Kelly.*)

Fig. 291.—Showing how the proximal end of the appendix may be buried in the cæcal wall, and the cuff method of ensuring total appendicectomy. (*After A. Edmunds.*)

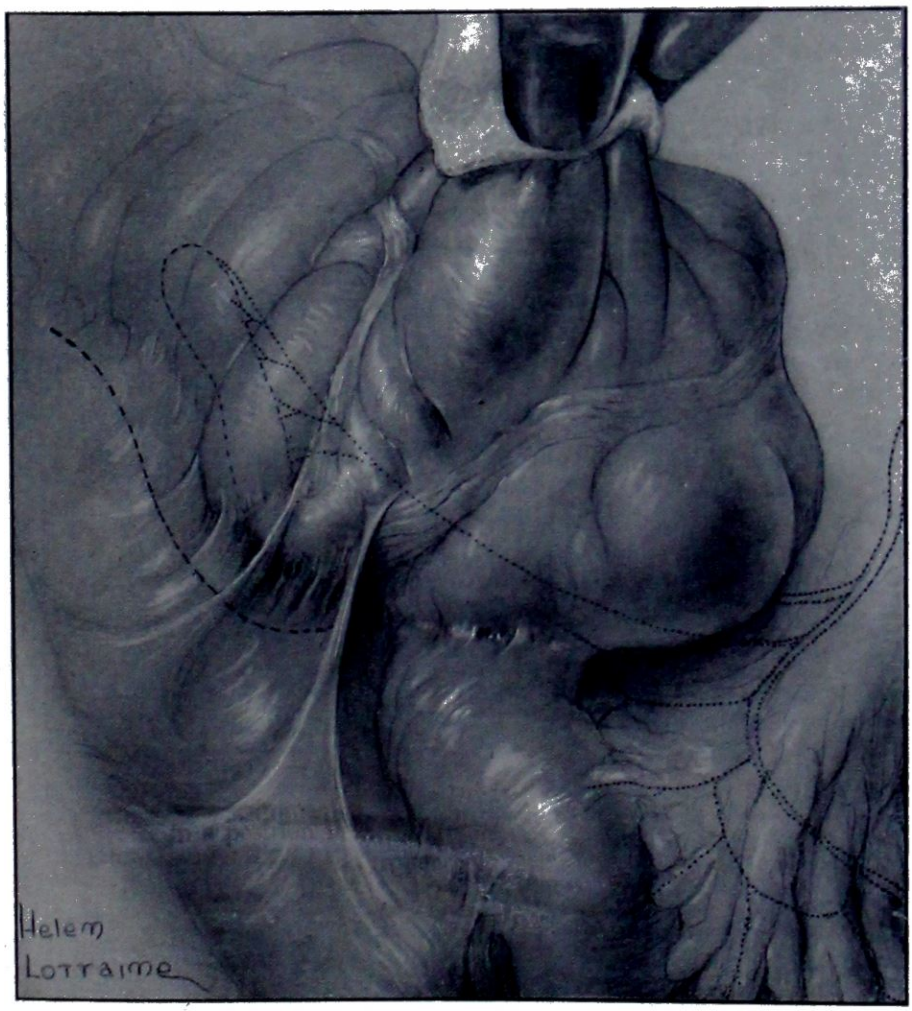


Fig. 292.—Incision in the posterior layer of the peritoneum to display a buried retrocæcal appendix. The usual distribution of the appendicular artery is also depicted. (*After G. N. Morris.*)

parietal peritoneum shown in *Fig.* 292. After a little blunt dissection in the retroperitoneal space the cæcum can be retracted still further to the left, rendered far more mobile and rotated, the combined effect of which results in bringing the greater portion of a previously hidden appendix into full view.

Fig. 293.—Colour photograph of an actual case where slitting up the appendix was of inestimable assistance. A concretion (broken in removal. and situated on the right of the swab) occupied the yellow area on the left, which is the base of the appendix. The inflamed mucosa is contrasted with the uninflamed mucosa. When inspected from without, the organ appeared perfectly normal.

Is the Appendix sufficiently Diseased to have Caused the Symptoms?—Having removed the appendix, pass the organ, wrapped in a swab, to some competent person in the theatre. Often the anæsthetist will undertake the examination of the specimen. The organ should be slit up from end to end with scissors; no other method is efficient. If the appendix was the cause of the symptoms, assuredly it will be more inflamed on the inside than on the outside (*Fig.* 293). When on macroscopical examination the mucous membrane proves to be normal and the occasion warrants it, search elsewhere for an intraperitoneal lesion.

The Appendix is clothed with Adherent Greater Omentum (*Fig.* 294).—Make every effort not to disturb adherent omentum performing its constabulary duties, for so often within lies a gangrenous or even a perforated appendix. Usually the greater omentum should be divided between hæmostats at a convenient distance from the appendix, and then appendicectomy conducted as atraumatically as possible. To excise an inflamed appendix replete in an omental overcoat is an occasion for congratulation.

The Appendix is Gangrenous near its Junction with the Cæcum.—Above all things be alive to the possibility of a sudden gush of liquid fæces from the cæcum. Should this calamity occur—and it has often done so—the patient's life is endangered, although provided the peritoneal cavity has been well packed off on the medial side and a mechanical sucker is available, with antibiotic therapy the prognosis is less gloomy than formerly. There is no golden rule for its prevention, but a surgeon aware of the possibility is far more likely to avoid it than one who is not. In exceptional cases, when the cæcum is ballooned, it is good judgement to deflate the cæcum in the manner described on p. 444 before proceeding with the appendicectomy.

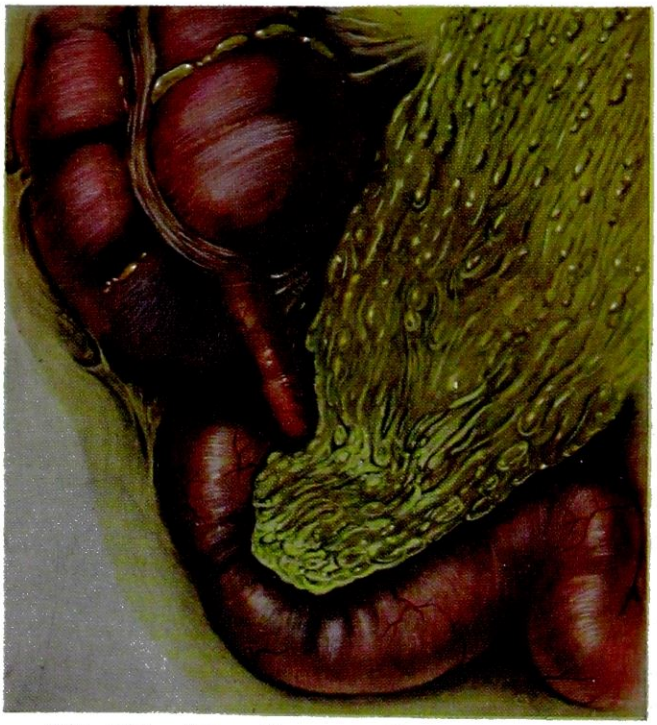


Fig. 294.—After the appendix, together with an appropriate portion of omentum, had been excised, without detaching the latter, the specimen revealed that the distal half-inch of the appendix was completely gangrenous.

The insertion of a preliminary (i.e., before appendicectomy is attempted) mattress suture into indubitably healthy cæcal wall at an appropriate distance from the junction of the appendix with the cæcum, traversing, if necessary, the base of the meso-appendix, is a certain method of being forearmed (Lahey). This does not necessarily imply that the mattress suture is to be employed for purposes of invagination when the appendix has been removed and its stump has been closed satisfactorily. When the appendix is gangrenous right up to its junction with the cæcum, the only reliable method of closing

the stump is by two sutures transfixing the cæcal wall. These must be inserted before the appendix is amputated (*Fig.* 295).

The Caput Cæci is Infiltrated and Œdematous.—In such circumstances it is unwise to attempt to insert a purse-string suture. It should be realized that invagination of the appendix stump is not essential. Indeed, a few surgeons state that it should never be

Fig. 295.—Gangrene of the cæco-appendicular junction. Methods of guarding against a fæcal deluge (*see text*).

employed.[1] When it is considered desirable to embed the appendicular stump in the presence of cæcal œdema, a good alternative to the purse-string suture is shown in *Fig.* 296.

The Meso-appendix is Gangrenous and cuts out.—This is not uncommon, and is a trying complication, especially in the obese. If a ligature will not hold, a stitch applied directly beneath a spurting vessel may stop the bleeding. On the other hand the artery is liable to retract and become hidden from view; in which case the ileal fat-pad should be raised and the bleeding artery sought behind the ileum. The artery to the appendix takes a retrocæcal course, as also does the accessory appendicular artery (*Fig.* 297).

Persistent Oozing.—A swab moistened with a little snake-venom and left in situ for about thirty seconds at a time will often stop considerable oozing. A thin layer of oxycel will quell most oozing. Recourse may have to be made to packing the area for forty-eight hours. The necessity for this step is a great rarity, and it should not be resorted to unless the circumstances are most exceptional.

The Appendix is lying against the General Mesentery, and the Inflammatory Process has implicated the Latter.—Usually the appendix can be dissected uneventfully from the mesentery. It is highly important to observe the ileum in the immediate neighbourhood of the affected portion of mesentery. If the intestine is discoloured from interference with the blood-supply, it is usually wise to resect the affected segment, as the following experience testifies.

[1] It is alleged that a 'pus pocket' occurs under the tightened purse-string, and this is responsible for numerous complications, including that extremely rare condition, hæmorrhage into the bowel following appendicectomy. In view of the hundreds of thousands of appendix stumps which have been invaginated, it is obvious that this hypothesis does not warrant serious consideration.

In one case (of forty-eight hours' duration) I found that, after the appendix had been separated, the mesentery of the last inch of ileum was bleeding seriously. Attempts to stop the hæmorrhage by ligature were only successful after several ligatures had cut out. When the bleeding was quelled finally, it was noticed that the last two inches (5 cm.) of ileum were blue; the blood-supply had been interfered with seriously. This segment was therefore resected and ileocæcostomy performed. Recovery followed.

Fig. 296.—An alternative method to the purse-string suture. Three or four interrupted sutures are placed as shown. All are inserted before they are tied. The middle ones are the last to be tied.

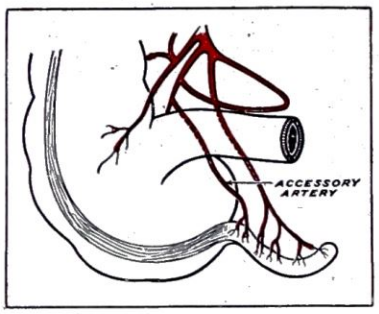


Fig. 297.—In nearly 50 per cent of cases there is an accessory appendicular artery, a branch of the posterior cæcal. (*After Seshachalam.*)

In a second example that occurred some years later there was no hæmorrhage, but two inches of ileum were œdematous and somewhat blue, evidently from thrombosis of the mesenteric veins in the neighbourhood. After hesitation, I decided not to resect. Ten days later the condition of the patient became critical rather suddenly; fæces poured from the wound. The small intestine had necrosed in this area, and he died in a few hours. I regretted that I had taken the conservative course.

Retrograde Appendicectomy.—

Indication.—When the base of the appendix is more accessible than the distal part of the organ. Retrograde appendicectomy is useful particularly in retrocæcal appendicitis when the extremity of the appendix is embedded in the cæcal wall or attached to retroperitoneal structures, yet the base of the organ is comparatively free (*Fig.* 298).

Technique.—The base of the appendix is inspected, and a Morrant Baker's forceps is applied a little distance from the cæco-appendicular junction in such a way that the appendix lies within its lumen. A little blunt dissection may have to be done before this step is possible. Gentle traction is then applied to Baker's forceps, and the interval between the appendix and the cæcal wall becomes apparent. The probe end of a Watson Cheyne's dissector is passed (through the meso-appendix) under the appendix, and two hæmostats are applied to the appendix close to one another (*Fig.* 299). The appendix is divided between them; if a scalpel (as opposed to diathermy) is used for this purpose, it is discarded, for it is infected.

As far as the cæcum and the severed base of the appendix are concerned, the procedure is straightforward. With the hæmostat still grasping the appendicular stump a purse-string suture is inserted in the usual manner. Only after this has been done is the appendicular stump ligated; the hæmostat grasping the stump is then removed and discarded. After cutting off the fragment of crushed tissue that was held in the jaws of the forceps, the base of the appendix is buried by the purse-string suture.

The appendix is now excised in the following manner: by gentle traction on the hæmostat that grasps the freed base of the organ, aided by blunt dissection, the ill-defined meso-appendix becomes sufficiently demonstrable to clip and cut (*Fig.* 300), clip and cut, until the whole appendix is removed.

Ligatures having been applied, the bed in which the appendix lay may be obliterated by a running suture. It is in this type of case that the last step is often particularly satisfactory.

In selected cases retrograde appendicectomy is an excellent measure; it renders easy what otherwise might prove an extremely difficult operation. But it must not be abused. *It is necessary to have the whole course of the appendix under vision before the operation is commenced*, otherwise the terminal portion of a gangrenous organ is in danger of being overlooked.

Drainage.—Drainage of the peritoneal cavity is absolutely necessary when an appreciable amount of frankly purulent fluid is present. In other instances, particularly when the fluid is in the immediate vicinity of the cæcum, this is mopped, or, better still, extracted with a suction apparatus, and layers of the wound are closed with the exception of a corrugated rubber drain in the subcutaneous space. In very early cases only, when the infection is limited to within the appendix and the hæmostasis is all that can be desired, is subcutaneous drainage omitted.

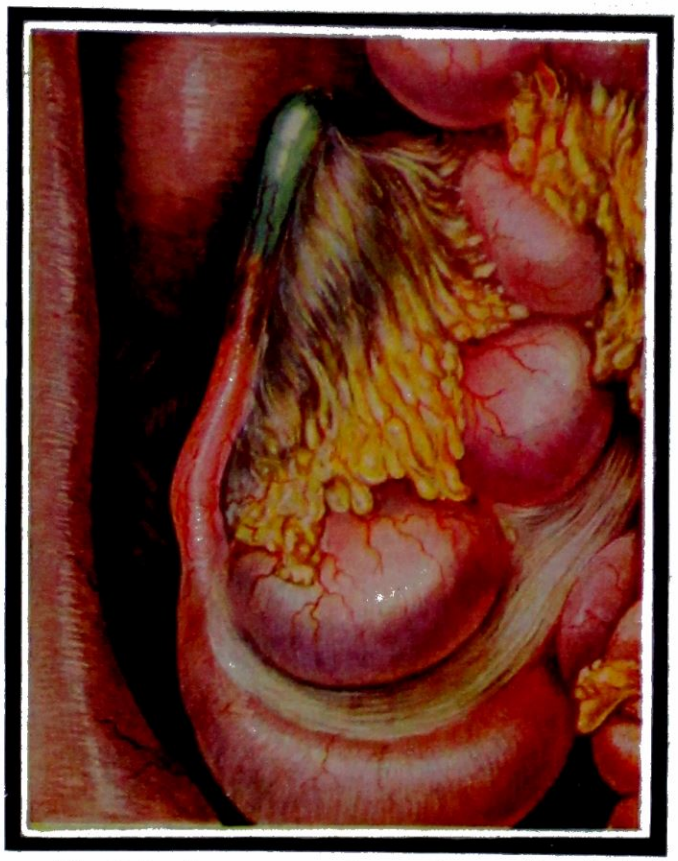


Fig. 298.—Gangrenous retrocæcal appendix attached to the lower pole of the kidney. An indication for retrograde appendicectomy.

Intraperitoneal drainage is *not* usually necessary :—

1. In unperforated appendicitis, however evil the organ may look; cases where there is a considerable purulent peritoneal exudate are excepted.

2. In cases where the appendix breaks or bursts during removal.

3. In recent perforation with a local serous or sero-purulent exudate. (By recent perforation is meant that there was no pre-operative distension or considerable acceleration in the pulse-rate.)

Is there an Appreciable Amount of Pus or Purulent Fluid in the Pelvis?—This is, perhaps, the major problem before closing without intraperitoneal drainage. With experience the question seldom arises, for it is answered soon after the abdomen has been opened. The amount and the nature of the fluid that escapes when the peritoneum has been incised, the appearance of the interior when one peers into the peritoneal cavity before disturbing the viscera, the position of the appendix, the pre-operative rectal examination, and the pulse-rate are all factors which are taken into consideration.

In cases of real doubt a small swab on a holder is passed down into the pelvis through the incision, withdrawn, and examined by sight and smell. This diagnostic swab will tell if a suprapubic drain is needed. The method should not be employed promiscuously. There is a danger of spreading infection from the right iliac fossa into the pelvis. The need for the diagnostic swab is only likely to arise when the appendix is pelvic, or purulent fluid is seen to well up from the pelvis. Provided it is employed only when there is a definite need, and not ' to be quite certain ', the method is more than justified.

Where to Insert the Drainage Tube.—A suprapubic drainage tube through a special stab incision above the pubes is a life-saving measure in diffuse and pelvic peritonitis.

It is never necessary to put a drainage *tube* through the original appendix incision, except when deliberately draining an appendix abscess. The most pernicious practice of all is to pass a long tube through the original incision into the pelvis. In this instance the tube takes a very oblique course, that is in itself enough to condemn the method; but in addition pressure necrosis of the external iliac artery by the tube is a possible complication, by no means unknown when this method was practised extensively.

When the retrocæcal space needs draining, it is best to avoid a stab drain in the flank, for the thick muscular layers of the abdominal wall in this situation are rather prone to cellulitis. Drainage by means of a Penrose wick drain (*see Fig.* 243, p. 190) is particularly valuable in this instance.

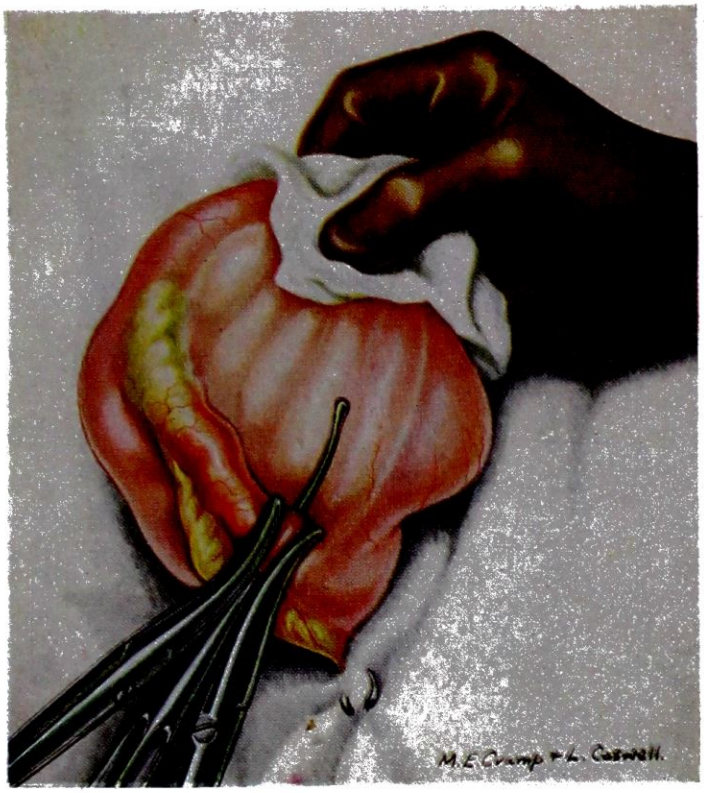


Fig. 299.—Retrograde appendicectomy. The base of the appendix has been isolated with the probe end of a Watson Cheyne's dissector. Two hæmostats are applied in the manner shown, and the appendix is divided between them on to the dissector which can also be seen.

Leaving the Wound unsutured.—Referring to the gridiron incision. If, as is frequently unavoidable, the layers of the incision become contaminated during the operation, there is much to be gained by leaving muscular layers unsutured. Some surgeons leave the skin completely unsutured as well. By using this method infection and cellulitis of the abdominal wall occur but rarely (Deaver).

Drainage v. No Drainage.—In reviewing fatalities in cases of *unperforated* gangrenous appendicitis treated by appendicectomy without drainage, Fowler and Bollinger found that it was unfortunate that drainage had not been employed in five instances. In four of these death was due to peritonitis, and one to intestinal obstruction secondary to the local inflammatory process. In the case of *perforated* appendicitis these authors found that, in spite of full antibiotic therapy, the incidence of post-operative complications following appendicectomy without peritoneal drainage was 38·6 per cent, compared with 13·9 per cent in those drained. Seeing that drainage is undertaken in the more seriously contaminated cases, it must be admitted that supplementary peritoneal drainage is most rewarding.

WHERE THE DIAGNOSIS OF APPENDICITIS IS IN ERROR

It is not intended here to dwell upon the various conditions that may be, and have been, mistaken for appendicitis, but to indicate briefly how to proceed when the abdomen has been opened by a gridiron incision and an intraperitoneal lesion other than appendicitis is found.

Peritonitis is manifest, but the appendix, though obviously inflamed, is not perforated. Remove the appendix and detail someone in the theatre to slit up the organ. If the appendix is the cause of the peritonitis, its mucosa will assuredly be more inflamed than its peritoneal surface.

From the quantity and the quality of the fluid which escapes when the peritoneum is opened perforated duodenal ulcer is probable. If considered necessary, guided by two fingers within

Fig. 300.—Retrograde appendicectomy. The base of the appendix has been divided and the appendicular stump invaginated. The appendix is in the course of being removed from the base to the tip.

the abdomen, insert a suprapubic drain (which incidentally will enable you to get a good sample of the fluid for your inspection and for culture). Close the appendix incision and open the upper abdomen.

Perforated diverticulitis is probable. After having examined the last two feet of ileum for a Meckel's diverticulum (this step can be omitted if there is a lead to the site of the diverticulitis), close the incision and reopen the abdomen on the left side. (*See* COLONIC DIVERTICULITIS, p. 251.)

Also refer to table of peritoneal exudates (p. 166), which in the contingency under consideration is of definite assistance.

Intussusception of the appendix (*see* p. 487).

POST-OPERATIVE TREATMENT IN ACUTE APPENDICITIS

Antibiotic Therapy.—Full details are given on p. 202.

General After-treatment.—Omnopon, $\frac{1}{3}$ gr., is given and repeated six-hourly for three doses, if required.

In cases with peritonitis, gastric aspiration is employed for at least 24 hours, or until flatus is passed. For a like period continuous intravenous dextrose-saline is given. In the presence of meteorism these measures of ensuring gastro-intestinal rest should be continued until the bowels have opened. In exceptional cases, when a low hæmoglobin justifies it, blood transfusion is given.

Bowels.—The management of the bowels is of more than ordinary importance. Purgatives and peristaltic stimulants are banned absolutely. Enemata should only be given (and not before the fourth day) if ordered in writing. Liquid paraffin is the only laxative allowed, and that should not be commenced until at least the fifth post-operative day; again it must not be given as a 'routine'. The only methods permitted without special order are the passage of a flatus tube and the insertion of a glycerol suppository. If an enema becomes necessary, it must be stated that it is to be a low-pressure enema given under the sister's or charge-nurse's supervision.

COMPLICATIONS FOLLOWING APPENDICECTOMY FOR ACUTE APPENDICITIS

Internal Fæcal Fistula.—This should be suspected when the patient suddenly develops signs of diffuse peritonitis between the fourth and seventh days after appendicectomy. A large enema or a purgation is frequently the determining cause, and the appendicular stump bursts open. Once the condition has developed the only possible treatment is immediate operation and conversion of the internal fistula into an external one. The sheet anchors are then antibiotic treatment and supportive fluid therapy. This complication, which is not as rare as may be thought, is of course extremely serious, but with prompt operative treatment and antibiotic therapy is not hopeless.

Wound Infection occurs frequently, especially in cases where the appendix was perforated. The administration of antibiotics does not appear to offer any protection against this complication (Wolff and Hindman). As emphasized already, non-closure of the grid-iron incision (peritoneum excepted) at least prevents spreading cellulitis of the abdominal wall.

Residual Abscess.—In about 5 per cent of cases of suppurative appendicitis treated by operation, a further operation for a residual abscess is required (Cutler). Except in the case of a pelvic abscess or a subdiaphragmatic abscess, when such a localized intra-peritoneal collection of pus is suspected, operation should be delayed until a mass can be palpated, until it is discrete, and, if possible, until it is so adherent to the abdominal wall that it can be approached without opening the general peritoneal cavity. In a few instances residual abscesses resolve. In all cases it is advised to mark the extent of the abscess on the skin and to make frequent clinical examinations. When necessary, drainage should be carried out by the most direct route possible. Usually it is unwise to prise open the original incision.

Acute Intestinal Obstruction.—Appendicectomy for perforated appendicitis is the commonest cause of post-operative intestinal obstruction (*see* p. 413). Other complications that occur from time to time are:—

1. Paralytic ileus (*see* p. 462).
2. External fæcal fistula (*see* p. 529).
3. Subdiaphragmatic abscess (*see* p. 342).

4. Pylephlebitis (*see* p. 349).
5. Femoral and iliac phlebothrombosis (*see* p. 925).
6. Pulmonary embolus (*see* p. 930 and Chapter XCIII).
7. Post-operative pulmonary complications (*see* p. 144).
8. Melæna after appendicectomy (*see* p. 293).

APPENDICITIS IN PREGNANCY

Ignore the pregnancy. Appendicitis is a serious lesion, and as such should be treated on its merits. (Cuthbert Lockyer.)

Since both pregnancy and appendicitis are more common during early adult life, the finding of a higher incidence of appendicitis in primagravida and secundipara who are less than 30 years of age is consistent. Pregnancy, with its shift of the vermiform appendix from the pelvis to an abdominal organ, favours peritonitis ; the nearer to term, the greater the danger, even in cases of appendicitis without perforation. As a consequence the overall mortality, in spite of antibiotic therapy, is in the neighbourhood of 20 per cent. The unwillingness to perform early operation because of doubt in diagnosis is the main reason for having still to categorize appendicitis as a very grave complication of pregnancy.

A fact which must be continually before the surgeon is that acute appendicitis is a supremely important complication of pregnancy, and if only the diagnosis can be established within forty-eight hours from the onset appendicectomy can be undertaken safely. The difficulty is to establish the diagnosis. As pregnancy advances the pain becomes higher, and more lateral. Pyelonephritis of pregnancy, which is usually right-sided, is the condition most frequently confounded with appendicitis. When it is of paramount importance to exclude pyelonephritis, excretory urography and the microscopical examination of specimens of urine obtained from the right ureter by cystoscopy and catheterization will sometimes help to settle a very important and urgent question, especially in early pregnancy, but it should be known that pyuria and appendicitis can coexist (*see* p. 575).

The symptoms of right-sided ectopic gestation, twisted ovarian cyst, salpingitis, and necrobiosis of a uterine fibroid are often similar to those of appendicitis. In doubtful cases it is best to perform early laparotomy.

Operation.—When the intra-abdominal manipulations can be reduced to a minimum the pregnancy is not necessarily interfered with. When operation has to be undertaken during the first three months of pregnancy, abortion occurs in about 20 per cent of cases. After the third month the liability to abort becomes increasingly less. If peritonitis has set in, abortion or premature delivery is the rule even in advanced pregnancy. Once I removed a gangrenous perforated appendix at the twenty-fourth hour in a woman six months pregnant, and she miscarried shortly afterwards, but recovered.

The fact that the patient is pregnant makes no difference in selecting suitable cases for the Ochsner-Sherren treatment (*see* p. 232). A pertinent example is as follows :—

The patient was a woman of 28, four months pregnant, with a large peri-appendicular phlegmon. She was first seen on the seventh day of the attack of appendicitis, and the pulse was 112. On the next day the pulse was 104, and after that it remained between 75 and 80. Slowly the mass resolved completely. Appendicectomy was performed two months after delivery.

When acute appendicitis complicates pregnancy near term, and the patient has reduced pelvic measurements, the lives of the mother and the unborn child are at stake. The correct course is first to undertake the Cæsarean section, and then to proceed with appendicectomy, preferably through a gridiron incision. With antibiotic therapy the prognosis after this dual operation has greatly improved.

ACUTE APPENDICITIS IN INFANTS AND YOUNG CHILDREN

The mortality of acute appendicitis in children under 5 is still higher than that of the general mortality. One of the reasons for this is that perforation occurs early and often, and the greater omentum, being comparatively short and poorly developed, is unable to perform its customary constabulary duties. Nevertheless, the chief reason for this high mortality is difficulty in diagnosis. The four earliest signs of acute appendicitis in infancy are pyrexia, abdominal pain, vomiting, and local tenderness. Any of these may predominate, any may be absent, and any may be associated with another symptom which is uncommon in older patients, to wit, diarrhœa (Bunton).

Temperature and Pulse.—In a baby very little constitutional upset is sufficient to produce a considerable rise in temperature. In over 50 per cent of cases the temperature is more than 101° F. (33·3° C.). A steady rise in the pulse-rate is of great diagnostic significance. The administration of antibiotics tends to mask these signs.

Pain usually comes in attacks, causing screaming or crying with the knees drawn up. It is highly important to make repeated examinations as necessary, for it is useless to palpate the abdomen when the child is crying. Stealthy abdominal palpation with the hand under the bed-clothes is usually the best.

'Thoracic' respiration comes on early, and must be looked for carefully.

Vomiting.—In many cases the axiom "pain precedes vomiting" is reversed. Occasionally both are absent.

Diarrhœa occurs frequently, and when present is a cardinal sign. The stools are very loose and often contain mucus. This is due to the proximity of an inflamed pelvic appendix to the upper rectum. How easy it is to attribute the diarrhœa to enteritis, and even send the child to a fever hospital! Rectal examination is particularly valuable in childhood.

Auscultation reveals a nearly normal amount of peristalsis, whereas in enteritis it amounts to a hubbub.

Treatment.—Fifty years ago Dr. Ochsner, of Chicago (of the Ochsner-Sherren régime), insisted that the delayed treatment should not be employed in children. This does not imply that adequate time should not be taken in correcting dehydration and rendering the patient in the best condition possible for the operation. Ladd, whose experience in this field is unrivalled, conforms with this view.

In relatively small peri-appendicular phlegmons occurring in older children, the delayed method can be safely employed, but one certainly should be particularly on the alert for danger signals.

Full general anæsthesia with gas, oxygen, and ether is the most satisfactory when operating upon children. In cases where the appendix is probably unperforated the gridiron incision can be employed with perfect satisfaction. In the very young, when complications are anticipated, an incision over the middle of the right rectus, splitting its fibres, will be found efficient. Moreover, if drainage is required, the lower end of this incision is an admirable avenue for the exit of a drainage tube.

Antibiotic Therapy.—Patients under 5 years of age are given 500 mg. of aureomycin initially, and then 250 mg. every four hours, until improvement sets in, after which 250 mg. is given every six hours until the temperature is normal and the patient appears clinically well for five days. Older children are given the same dosage, except that 1 G. is given initially. If the patient can take fluids by mouth, the drug is given in syrup. If gastric aspiration is being employed, the aureomycin is injected down the tube and suction stopped for an hour (Blackburn and Drake).

ACUTE APPENDICITIS IN THE AGED

Gangrene and perforation (*Fig.* 301) occur much more frequently in elderly patients, probably because vascular occlusion occurs more readily on account of arteriosclerosis. In the evening of life, patients not infrequently harbour a gangrenous appendix within the abdomen with such paucity of symptoms and signs that the true diagnosis or its severity is not appreciated until too late. Rigors occur relatively frequently in acute appendicitis in the aged (20·5 per cent as opposed to 8·4 per cent in controls). They are of ominous import, usually signifying the presence of spreading peritonitis. As Lewin emphasizes, by the time surgical opinion is sought, abdominal distension is present, and often intestinal obstruction is considered to be the most probable cause of the symptoms. Such cases require early laparotomy.

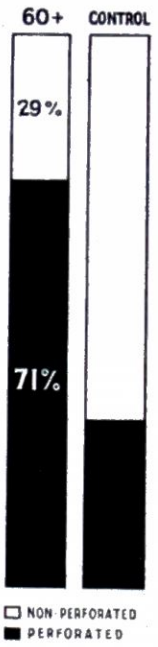


Fig. 301.—The frequency of perforation in patients over 60 years of age. (*Wolff and Hindman's statistics.*)

The post-operative complication rate in the older age group is three times that in the control group. Among the less obvious reasons for this is that a high proportion of cases, owing to uncertainty of diagnosis, are submitted to paramedian laparotomy and are denied the undoubted benefit of a gridiron incision.

It is commonly stated that the Ochsner-Sherren delayed treatment should not be employed in elderly subjects. I have found no objection to employing this treatment in this age group in cases where there is a localized palpable mass. Resolution occurs somewhat less frequently, but the burden of years does not appear materially to affect the issue.

LEFT-SIDED APPENDICITIS

More than 100 cases of appendicitis occurring in patients with transposition of the viscera have been reported. The main interest in these cases lies in the fact that, despite the position of the appendix on the left, in a proportion of cases the pain is situated on the right side. The explanation of this paradoxical phenomenon is unknown. A likely reason for the appendix being on the left side is non-rotation of the mid-gut (*see* p. 471).

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CHAPTER XXII

LATE ACUTE APPENDICITIS

ACUTE APPENDICITIS WITH GRAVE DIFFUSE PERITONITIS

Meditation before operating is no less important than proper operative technique. (H. J. Kohlmann.)

WHETHER the delayed method is going to be employed or not, there is not a shadow of a doubt that in order to get the patient into the best possible condition it is better to delay the operation for several hours (*see* p. 202). Usually, as a result of fluid therapy, gastric aspiration, and antibiotics, indications of some improvement become manifest. We are now faced with a problem requiring a high degree of surgical judgement.

It will be recalled that Ochsner first framed this method for cases of diffuse (spreading) peritonitis. There is plenty of evidence that some cases of this type respond favourably to the Ochsner-Sherren treatment. In this instance such treatment aims at aiding nature to transform the diffuse peritonitis into a localized infra-umbilical or pelvic collection of pus that can be treated safely by simple drainage.

Experience teaches us that simple drainage without removal of the appendix *before localization of the peritonitis has occurred* rarely saves the patient's life. Indeed, in many instances it appears to hasten the end. On the other hand, in most cases the *expeditious* removal of the appendix, together with suprapubic drainage and possibly cæcostomy (*Fig.* 302), is, I believe, the best method of treating diffuse peritonitis due to a perforated appendix, but the operation must be expeditious and the anæsthesia as perfect as possible. Should the operation prove to be difficult, necessitating considerable intra-abdominal manipulations, or if the attempt to remove the appendix has to be abandoned in favour of simple drainage, death usually follows. In such circumstances one must be prepared to admit that the patient might have been saved by the delayed method.

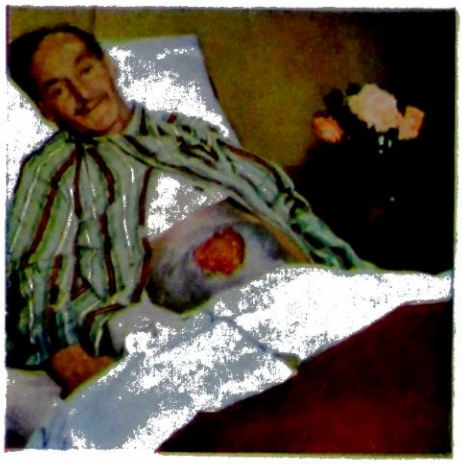

Fig. 302.—This patient was admitted in a moribund condition with diffuse peritonitis. Under local anæsthesia supplemented by a very small dose of thiopentone, appendicectomy was performed, together with suprapubic drainage and cæcostomy. Photograph taken on the fourteenth day. Aluminium paint is protecting the skin from excoriation. The fæcal fistula healed spontaneously.

In the light of the above remarks, before advising immediate operation, at least it is necessary for the surgeon to pause and ask himself a question. Is it likely that this appendix can be delivered without undue difficulty?

No one can answer this question with assurance, but one can say this much :—*When the disease has been present for more than sixty hours, it is practically certain that the appendix will be matted to neighbouring structures.*

Especially when the data before us signify that matting is present, we should meditate : even before the advent of the antibiotic era many contemporary, and recently deceased, master surgeons renowned for their manual dexterity, subscribed to the teaching of Albert Ochsner in the United States and James Sherren in the United Kingdom. Years of experience, doubtless bitter experience, taught them that perseverance with the delayed method in the hope of localization of the infection offers the patient his best chance. There are two notable exceptions to this rule :—

1. *In childhood and early adolescence.* Early in life, localization of a diffuse peritoneal infection does not occur often enough to warrant a trial of the delayed method[1] unless the circumstances are extenuating.

[1] This does not imply that operation-on-diagnosis is indicated. Several hours of treatment designed to correct dehydration and to relieve gastric and intestinal distension is of cardinal importance.

2. *If there is good reason to believe that the diffuse peritonitis is due to the recent bursting of an appendix abscess.* Here simple drainage is a life-saving measure.

An endeavour has been made to show that there must be adequate reasons for adopting a particular method. If those reasons dictate delay in operating, then the surgeon must be courageous, for in this instance it requires more courage *not* to operate.

THE OCHSNER-SHERREN OR DELAYED TREATMENT OF APPENDICITIS

Indications.—The Ochsner-Sherren treatment can be recommended in many cases of acute appendicitis of over fifty-hours' duration.

The following exceptions are made, and early (in most cases immediate) operation is advised :—

1. In the presence of hyperæsthesia. (Other things being equal, the presence of hyperæsthesia indicates that the appendix is still unperforated.)
2. When there is uncertainty in diagnosis.
3. When there is obviously considerable peritonitis (*see* p. 231).
4. When a purgative has been ingested recently.
5. In children, especially those under the age of 8 years.

In order to practise the delayed treatment successfully, the surgeon must be a reliable diagnostician. If intraperitoneal lesions normally requiring immediate operation cannot be excluded definitely, it is wiser to operate.

Technique.—The delayed treatment of appendicitis *must* be carried out on the threshold of the operating theatre by the surgeon himself, for at any moment operation may become imperative. The responsibility for delaying operation rests entirely with the operating surgeon, and no other. It is he who is going to perform the operation, and he is at liberty to choose the time that he will do it. In a highly civilized country it should be absolutely forbidden to attempt this treatment outside a surgical hospital or a correspondingly equipped nursing home, preferably with a staff acquainted with the principles of the method. On the other hand, one can picture extenuating circumstances where, by reason of these circumstances, the risk of attempting this treatment would be less than attempting operation—for instance, in a small ship at sea.

Clinical Notes.—A careful history is recorded, together with a diagram of the physical signs at the time of the first examination. Every effort is made not only to diagnose appendicitis irrefutably, but also to diagnose the *position* of the appendix, whether it is retrocæcal, in the right iliac fossa, or pelvic. The patient is then placed in true Fowler's position (*see* p. 191 et seq.).

Charts.—As a routine the pulse-rate is recorded every two hours in graphic form on a special chart. In cases where anxiety is felt as to the advisability of continuing the treatment, an hourly chart is employed. On several occasions, when the peritonitis has been widespread, I have had a half-hourly chart prepared through the night. The temperature is relatively unimportant ; it is recorded every four hours. A special antibiotic chart and a fluid intake and output chart are strongly recommended.

Gastric Aspiration (intermittent or continuous) is carried out in all cases when vomiting has occurred, or the patient feels nauseated.

Diet—For the first 48 hours nothing at all is given by the mouth. Continuous intravenous dextrose-saline is administered. At the end of 48 hours sips of water are allowed. As the intake by mouth is increased, so the intake intravenously is decreased, and, as a general rule, by the evening of the third day the intravenous fluid is discontinued altogether. It is most desirable to explain to the patient that he is going to be starved—" in order to try to prevent the appendix bursting " is a phrase that can be understood by the patient and his relatives. On the fifth day, if the pulse and temperature are satisfactory and the patient feels hungry, feeding is commenced. Small feeds of proprietary milk preparations (e.g., Benger's food), alternating with a cup of meat extract, are given. On the sixth day custard and jelly are allowed. After that the diet is increased gradually.

Drugs.—It should be noted particularly that morphine or its derivatives are not allowed.

Antibiotic therapy : Penicillin 500,000 units and streptomycin 0·5 G. are given intramuscularly 12-hourly.

Bowels.—The bowels are left confined if they are not opened naturally. On the fourth day a small glycerol enema is given. No purgatives of any kind are administered until resolution is complete ; that is, until the pulse and temperature have been normal for a week and pain and physical signs are absent. Then liquid paraffin 2 oz. (60 ml.) thrice daily is prescribed.

Pain, as opposed to *tenderness*, is complained of very seldom after the first night of the treatment. A hot-water bottle may be given to the patient to apply to the abdomen ; but it is well to repeat, that as long as the inflamed appendix remains in situ, drugs are forbidden, for they may mask those all-important signs which foretell that the delayed treatment is not likely to succeed. Instructions are given for the nurse in charge to watch the patient carefully and report immediately : (1) A rising pulse-rate ; (2) Vomiting (or copious dark gastric aspirate) ; (3) Pain ; (4) Diarrhœa or the passage of mucus in the stools (pelvic abscess).

A *rising pulse-rate* in the early stages is the most reliable *single* sign that it is dangerous to proceed with the delayed method. If the pulse-rate has increased even ten points in the first four hours, operation is often indicated. One should not feel alarmed at a moderate rise in temperature. It quite often indicates that the patient is exhibiting a good reaction to the inflammatory process ; it does not necessarily mean that a local abscess is developing, though this, of course, may be the case, and will be revealed by the physical examination. A moderate rise of temperature with a pulse-rate in the eighties or nineties does not necessarily foretell failure of the delayed treatment.

Vomiting after the first few hours should always be regarded seriously, and this by itself may be a sufficient indication to abandon delayed treatment. This statement refers to those comparatively favourable cases where there was no indication that gastric aspiration was necessary at the primary clinical examination.

Indications for abandoning Conservative Treatment.—A patient undergoing delayed treatment should not complain of *pain*, as opposed to tenderness, after the first six hours of treatment. If he does there is usually something wrong, and this is a strong indication for operation. In the few cases in which pain has been the determining factor in advising operation a large thick-walled unperforated appendix had been found. The patient was experiencing appendicular colic.

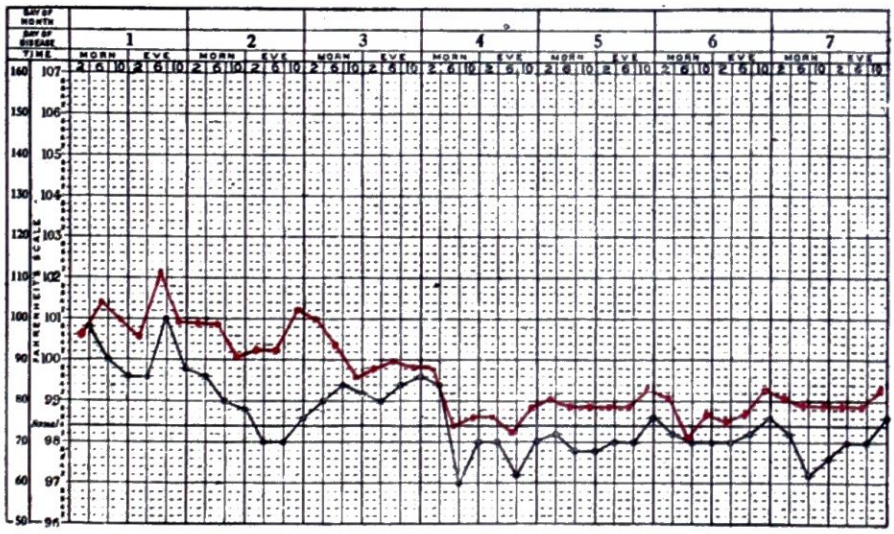

Fig. 303.—Chart, showing resolution of a case of appendicitis under Ochsner-Sherren treatment.

After a large experience of the Ochsner-Sherren treatment I have nothing but praise for it. Several hundred cases have resolved uneventfully (*Fig.* 303). As in surgical practice one always seems to get ill fortune in batches, it sometimes happens that several cases in a short period of time fail to resolve.

If the delayed treatment fails, and the patient has been starved for some days, the urine should be examined for acetone before giving the anæsthetic, but if the patient has been receiving dextrose-saline, acetonuria is most unlikely.

In order that there should be no slackness in its application the dangers of this treatment have been emphasized—perhaps even over-emphasized. The method in itself is life-saving ; the chief danger lies in its abuse. Surely this is true of most good things.

In order to strengthen the confidence of those who have not had the advantage of a thorough training in the method it can be stated with assurance :—

1. Subdiaphragmatic abscess is almost unknown.

2. Pylephlebitis does not occur. I have had a number of cases of pylephlebitis associated with acute appendicitis, but not once has it developed in a patient undergoing delayed treatment (*see* PYLEPHLEBITIS, p. 349).

3. Intestinal obstruction is very much rarer than after immediate operation.

4. The treatment is not a hardship to the patient.

5. In the long-run there is very little wastage of hospital beds. But what is this in the matter of saving a useful life ?

In some quarters the Ochsner-Sherren treatment is frowned upon, and especially in the face of criticism, it often requires more skill and courage to undertake this treatment than to operate. As McNeill Love says, " psychological reasons are a great deterrent to the adoption of expectant treatment. If a case treated on delayed lines ends fatally it is usually regarded as a tragedy, and all concerned may have lingering doubts in their minds as to whether immediate operation would have saved the patient. On the other hand, if the appendix is immediately removed and the patient succumbs, the general impression is that because immediate operation was performed everything possible was done, and the fatality is accepted philosophically."

Eventual Appendicectomy.—One of the most important duties in a case where the delayed treatment has proved successful is to ensure that the patient has his appendix removed in due course. Experience shows that in an average case an interval of two months is necessary for the products of inflammation to resolve completely. Appendicectomy soon after clinical resolution is often a very difficult operation, and the patient, by reason of the starvation, is ill prepared to stand it. If an interval of two months elapses between the time he is fit to be discharged and the operation, it will be found that the patient's general condition will have improved, and the local œdema, friability, and increased vascularity, so much in evidence soon after clinical resolution, are absent ; consequently the operation proves comparatively easy. It is remarkable how few adhesions are found.

Unfortunately a very real danger creeps in. The patient may fail to appear for his operation. I found that more than 5 per cent of those who had successfully undergone the Ochsner-Sherren treatment failed to return. They were written to, and a proportion replied, with varying excuses, the principal being that they had not understood. The following is a good plan. As soon as it is evident that resolution can be expected confidently, the patient is handed two cards to sign. On each is printed the following words :—

> I realize that I have just been tided over an attack of appendicitis. The surgeon considered that in my case it was safer to defer operation. I fully understand the danger of leaving the appendix, and I agree : (1) To come into hospital on
> (2) To report at the hospital immediately if I have any symptoms before that date.
> *Signed*

One card the patient takes away. The other is indexed and serves to remind the staff of the appointment, which, except in special cases, is made for a date two months after leaving. This method has worked admirably, and frees the surgeon of the responsibility of inadvertently omitting to explain the necessity for eventual operation.

PERI-APPENDICULAR PHLEGMON

(syn. *The ' Appendix Mass '*)

Well-founded criticism has been levelled at the term appendix ' abscess ' when it is used to denote a lump associated with an inflamed appendix during the comparatively early stages (three to five days) of the onset of an attack. It must be conceded that at this time the lump consists mainly of œdematous cæcum plastered with greater omentum and probably coils of œdematous small intestine ; true, there may be a small quantity of pus around the appendix in the midst of this conglomerate medley, but it is confusing and inaccurate to designate such a swelling as an abscess. Although favoured by many, the term ' appendix mass ' is less descriptive than peri-appendicular phlegmon, which conjures up a picture of the true underlying pathology—a state of cellulitis rather than a collection of laudable pus—and it will help to segregate those cases of acute appendicitis above all others that are in dire need of the surgeon's clinical acumen and repeated watchful attention, rather than his immediate operative skill.

On the other hand, when the time factor and non-resolution make it almost certain that the lump in question is composed largely of pus, there should be no reluctance in designating the swelling as an appendix abscess.

The type of case *par excellence* for delayed treatment is when the patient gives a typical history of acute appendicitis of three or more days' duration; when the pulse-rate is not above 90; and when a localized mass can be palpated in the right iliac fossa.

Mapping out the Lump.—If it is to be a scientific gauge more attention than might be imagined must be given to the procedure. Secure an ordinary indelible pencil and take with you a glass containing a little water. After moistening the tip of the pencil in the

Fig. 304.—Marking out the periphery of the lump. This must be done accurately, using deep index-finger pressure.

Fig. 305.—Patient undergoing the Ochsner-Sherren treatment for appendix abscess. The extent of the lump has been marked on the skin.

water, try marking your own wrist. Ensure that the skin of the abdomen is not greasy, for it may be that antiphlogistine, or some other substance, has been applied. Palpate the lump, with special reference to its periphery, before starting the marking. The best method of ascertaining the periphery is by deep index finger-tip pressure (*Fig.* 304). Little by little, pressing then marking, the periphery is outlined (*Fig.* 305). Explain to the patient the importance of the procedure, and should the lump be tender, ask him to

bear the pain and, if possible, not to contract his abdominal muscles. In all cases where there is a second practitioner in attendance (e.g., a house surgeon), ask him to confirm the accuracy of the outline, and not to be afraid to differ. Once the mark has been agreed upon, pencil on the date. Request the nursing staff to see that the marking is not washed off, and prescribe, if necessary, not hot fomentations, but an electric heating pad (a hot-water bottle, because of its weight and the possibility of bursting or leakage, is less desirable).

When overlying rigidity makes the exact outlining uncertain, and assuredly this will occur quite often, on no account should one lull oneself into completing a hypothetical periphery; the uncertain zone is left uncompleted. This is *the* occasion for repeated examinations, and the diligent clinician may even find an opportunity to complete his handiwork while the patient sleeps.

Delayed Treatment.—The Ochsner-Sherren treatment is carried out in exactly the same way as has just been described. Each day the outline on the skin is compared with the underlying lump. A rectal examination must be performed at least every third day, or more often if the mass has invaded the pelvis. Pelvic abscess is considered later in the chapter.

It must again be emphasized that the delayed treatment must be carried out by the surgeon himself on the threshold of the operating theatre.

G. P., aged 11, whilst undergoing the Ochsner-Sherren treatment for appendix abscess, appeared to be going on well, although the size of the abscess was not decreasing. On the fifth day he suddenly collapsed and showed signs of general peritonitis. Within fifteen minutes gas and oxygen was administered and drainage instituted both suprapubically and locally. His condition was critical for several days, but he recovered, and six months later appendicectomy was performed uneventfully.

This is a most exceptional complication; it is indeed the only example of its kind that I have encountered, but it illustrates forcibly that the Ochsner-Sherren treatment must be carried out on the threshold of the operating theatre.

Difficulties in Diagnosis.—Twice I have mistaken a ballooned cæcum, following on large-gut obstruction for an appendix abscess. In each case, because of vomiting, the patient was submitted to operation after twenty-four hours of delayed treatment, and no harm resulted. Twice, twisted ovarian cysts were mistaken, and again pain and vomiting brought the cases to operation on the second day, with recovery. At least once I have not been able to make up my mind between an abscess connected with perforated colonic diverticulitis and appendix abscess, and I have waited, with fatal results. If perforated diverticulitis enters the clinical picture this is sufficient indication for early exploration.

In a number of instances where the lump has not decreased in size Crohn's disease (*see* p. 250), carcinoma of the cæcum, or actinomycosis has proved to be the underlying cause, but this is not an error or a disadvantage; indeed, it has everything to recommend it, for one has been enabled to become thoroughly familiar with the lump and to suspect one of the above conditions before embarking upon a difficult operation. Moreover, the delay permits the oral administration of neomycin or sulphasuccidine in order to sterilize the contents of the bowel in preparation for possible resection.

The Case is responding Favourably.—Purposely the snares have been emphasized before dealing with the more usual course to be expected. The majority of these cases do exceptionally well under the delayed treatment. With starvation, rest, and antibiotic therapy the lump gradually gets smaller and smaller and finally disappears. When the time comes for the appendix to be removed one often marvels at the freedom from adhesions; perhaps there are a few dried-up pieces of leathery substance stuck upon the appendix or the juxta-appendicular structures, but this is all that remains of what was once a peri-appendicular phlegmon giving rise to a lump, say, the size of a cricket ball. To those familiar with the delayed treatment such a phenomenon is commonplace.

In a few most exceptional instances the surgeon has been astonished to find that the appendix has disappeared. The most satisfying explanation is that an intussusception of the appendix was present, and that the inverted appendix, bereft of its blood-supply, sloughed.

Abscess Formation.—If delayed treatment has been instituted, those masses in the right iliac fossa that do require evacuation of pus will be frank abscesses, and the technique can be reduced to one of simplicity, for the question of removing the appendix at the time of the evacuation of the pus never arises. This, no doubt, helps to account for the very small mortality in cases of appendix abscess treated on the above lines. We are spared the possibility of turning a localized infection into fatal spreading peritonitis,

a tragedy that I have witnessed more than once when I was attached to a surgeon who believed in early operation for all cases.

I have collected the notes of 90 consecutive cases of acute appendicitis with a localized mass treated by myself by the Ochsner-Sherren method. In 69 instances the palpable mass slowly disappeared. In 21 cases the abscess did not resolve, and drainage was carried out. There was one death, and that was the fourth in the series. This occurred before I realized it was necessary to allow at least two months to elapse between resolution and appendicectomy.

The above findings conform with the published experience of others; with antibiotic therapy the proportion of localized swellings that resolve is somewhat higher.

Indications that the Abscess must be drained.—

1. The lump is not getting smaller after the fifth day, or, alternatively, is getting larger before this time.

2. The temperature is swinging above 100° F. (37·7° C.) on several successive days. A moderate intermittent rise in temperature is not a contra-indication to delayed treatment.

3. Œdema of the subcutis—a rare occurrence which indicates that the abscess has already been left undrained too long.

DRAINING AN APPENDIX ABSCESS SITUATED IN THE RIGHT ILIAC FOSSA

Technique.—The swelling is palpated under the anæsthetic. A point is chosen about the centre of the swelling, but rather nearer the lateral (*Fig.* 306) than the medial aspect. A small incision is made; small, because it is naturally very prone to become infected, and there will be less of it to break down.

Having traversed the subcutaneous tissues and displayed the external oblique, the lump is again palpated by a finger in the wound, and an area well lateral to the centre of the swelling is chosen. The external oblique is divided in the direction of its fibres. The internal oblique is divided *across* its fibres. Two advantages are claimed for departing from our usual practice of splitting the muscle. First, an incision of 1½ in. (3·8 cm.) will be found to be adequate if the internal oblique is divided instead of being split; secondly, drainage is direct. There is no valve-like action of the criss-cross to interfere with the exit of pus and the re-insertion of a shorter tube.

Fig. 306.—Incision suitable for draining an abscess in the right iliac fossa.

Retractors are inserted under the muscles; and the peritoneum, which is often greatly thickened, is sought. The aim should be to open the abscess extraperitoneally. "Cut through the abdominal muscles layer by layer. You will find them very œdematous. If you can distinguish the peritoneum, strip it (laterally) with the finger." (Marmaduke Sheild.)

The index finger is passed into the wound, and very, very gently burrows laterally and posteriorly (*Fig.* 307). In the case of a large abscess it is hardly a moment before the finger is felt to enter a cavity. The finger is still kept in situ and acts as a bung to the flow of stinking pus until a tube can be passed into the abscess cavity. The tube is fixed to the skin by a single stitch, which is often the only one necessary to approximate the wound about the tube. Pus now flows through the tube and may be collected in a receptacle. As the abscess cavity collapses, the flow becomes more and more blood-stained. This is not a cause for alarm. The abscess cavity is lined by granulation tissue which oozes freely.

If, inadvertently or by design, the peritoneal cavity is opened, every care should be taken to avoid breaking adhesions unnecessarily, especially on the medial side. The extremity of a length of gauze is packed gently into the *medial* part of the wound. "The effectiveness of gauze in protecting the general peritoneal cavity has often filled me with astonishment when I have seen foul, stinking pus pour from a large appendix abscess and beating against the barrier of gauze which I have placed to prevent it flowing into the peritoneum." (Barnard.) It should be noted that no matter whether the abscess

is approached extraperitoneally or intraperitoneally it is the finger, and not an instrument, that is used to penetrate the wall of the abscess.

After the patient has been returned to bed and has regained consciousness, he is again placed in the sitting position and a pillow placed under his left loin in order to keep him on his right side and thus invoke the aid of gravity. After the first forty-eight hours the tube is turned and shortened only. Usually it is omitted altogether on the sixth day. There are seldom any complications if a frank abscess has been drained.

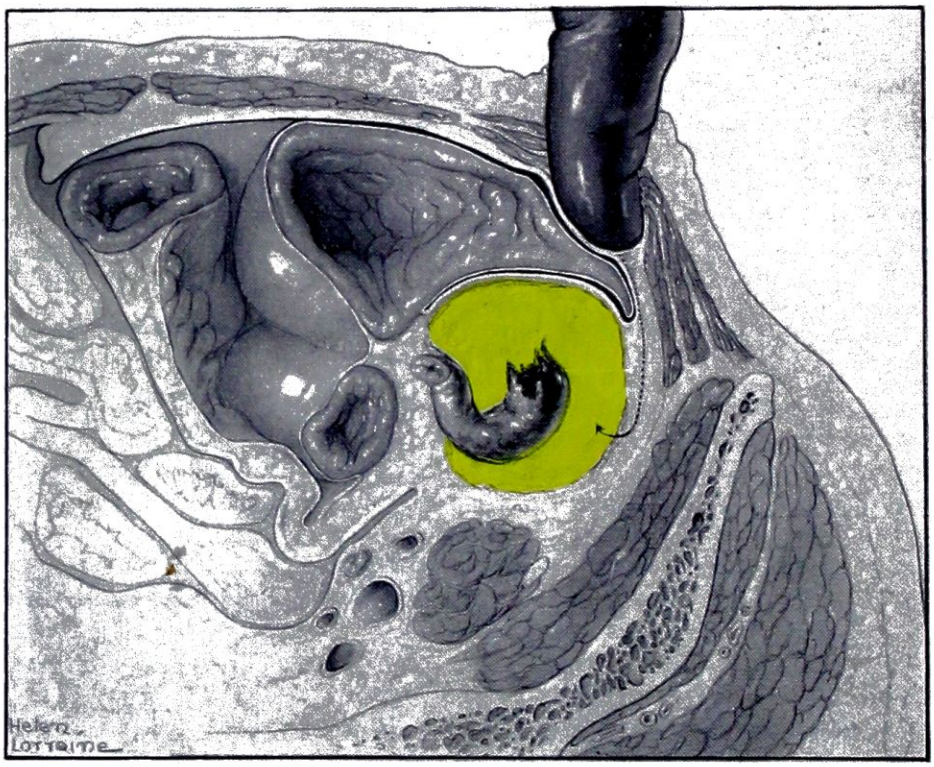

Fig. 307.—Opening an appendix abscess extraperitoneally.
(*After A. Ochsner.*)

The patient should be given a card to sign bearing the agreement to return for appendicectomy (*see* p. 234). He should be examined at monthly intervals. It is most inadvisable to attempt the second operation (appendicectomy) until at least *four* months later, which may be extended to six months, unless of course symptoms develop in the meantime.

Dangers and Difficulties.—

1. One may have to burrow for some little distance before a retrocæcal abscess is opened. This burrowing must be done very gently. In certain cases it may be advisable to place a tube through a counter-incision in the flank, in which case the original incision is closed about a corrugated rubber drain.

2. Owing to some mischance, such as fatness of the abdominal wall masking physical signs, or undue anxiety on the part of the surgeon, cases occasionally come to operation where the abscess is resolving.[1] In such cases, on opening the peritoneum a mass as hard as a rock may be felt. If this lump has been present for some time and carcinoma is suspected, the incision must be enlarged, otherwise my advice in the case of a hard, fixed, rock-like mass is to leave it alone, sew up the abdominal wall with the least possible intra-abdominal disturbance, and return to masterly inactivity. In six instances where this has been done resolution has proceeded evenly, in spite of the untimely incision. In three of these cases the abdomen was closed without drainage. In each of the six cases appendicectomy was undertaken successfully in six months' time. On no account tear through the indurated tissues with the finger in an endeavour to find central pus. One is almost certain to prise open the cæcum and an external fæcal fistula is but one of the grave complications that will ensue.

[1] In a few instances when the abdomen has been palpated under the anæsthetic a hard mass, hitherto unsuspected, has been found. Instead of opening the abdomen the patient has been returned to bed and treated by the Ochsner-Sherren method.

DRAINAGE OF A PELVIC ABSCESS PER RECTUM

Nature has taught us to drain these abscesses into the rectum. (F. T. Paul.)

The pelvic abscess now under consideration is one that is seen in surgical, as opposed to gynæcological, practice, and usually, but not necessarily, arises as a complication of acute appendicitis. As is well known, pus can accumulate in the pelvis without serious constitutional disturbance (*Fig.* 308); it is therefore not surprising that these abscesses sometimes attain large proportions before being recognized. The most characteristic symptoms to which they give rise are diarrhœa and the passage of mucus. The latter is of cardinal diagnostic importance; it is no exaggeration to say that the passage of mucus occurring for the first time in a patient who has, or has recently had, an attack of acute appendicitis is pathognomonic of pelvic abscess. Rectal examination reveals a bulging of the anterior rectal wall, which, when the abscess is 'ripe', becomes softly cystic. It is inaccurate to say that it fluctuates, unless fluctuation can be elicited between it and the anterior abdominal wall. Fluctuation cannot be tested with one finger.

Fig. 308.—Symptoms referred to the bladder—usually increased frequency, sometimes retention, of urine—are to be expected in cases of pelvic abscess.

Left to nature, a few of these abscesses burst into the rectum, after which the patient nearly always recovers. Deliberate opening into the rectum should be contemplated only when the swelling is quite soft. When the patient is considered to be *developing* a pelvic abscess, provided he is kept in Fowler's position and frequent (at least daily) rectal examinations are carried out, and the only disturbing feature is a hectic temperature, it is good judgement to wait until the swelling is quite soft, when opening the abscess into the rectum should be contemplated. In such circumstances the operation proves one of the most satisfactory in surgery.

Fig. 309.—A pelvic abscess about to point into the rectum.

Summarizing, blind rectal drainage should be reserved for those cases where the history, the free discharge of mucus, the cystic swelling, centrally placed, and complete absence of abdominal rigidity make the diagnosis of a localized abscess pointing in the rectum (*Fig.* 309) absolutely certain.

Doubtful Cases.—If there is the slightest doubt in the mind of the surgeon as to whether the swelling in question is an undeniable abscess—and it is sometimes difficult, particularly in post-operative cases, to be quite certain—the patient should be placed on the Ochsner-Sherren régime (*see* p. 232), and antibiotics administered. In a number of cases the pyrexia and diarrhœa will abate, and no further treatment is required. Others will go on to undoubted pelvic abscess formation, and drainage becomes necessary.

Technique.—The bladder must be completely empty, therefore a catheter is passed on the operating table. This step should never be omitted. The patient is placed in an exaggerated lithotomy position. The anal sphincter is dilated, and the small end of a Sims' vaginal speculum, which answers the purpose admirably, is introduced into the rectum (*Fig.* 310). The passage of some mucus when the speculum has been inserted is very characteristic,

and strengthens the diagnosis of a ripe pelvic abscess considerably. Should the operator feel in doubt as to whether pus lies beneath the rectal wall he can introduce a large lumbar-puncture needle, guiding the point with the left fore-finger. If necessary, an aspirating syringe can be attached after the stilette has been removed (*Fig.* 311), but this is seldom necessary, for the pus flows down the needle when the fore-finger presses the swelling. A long hæmostat is the best instrument with which to penetrate the rectal wall. This is done, not by a sudden jab, but by even pressure. As soon as the abscess is entered, pus streams down the speculum. A suitable rubber drainage tube is inserted into the abscess cavity.

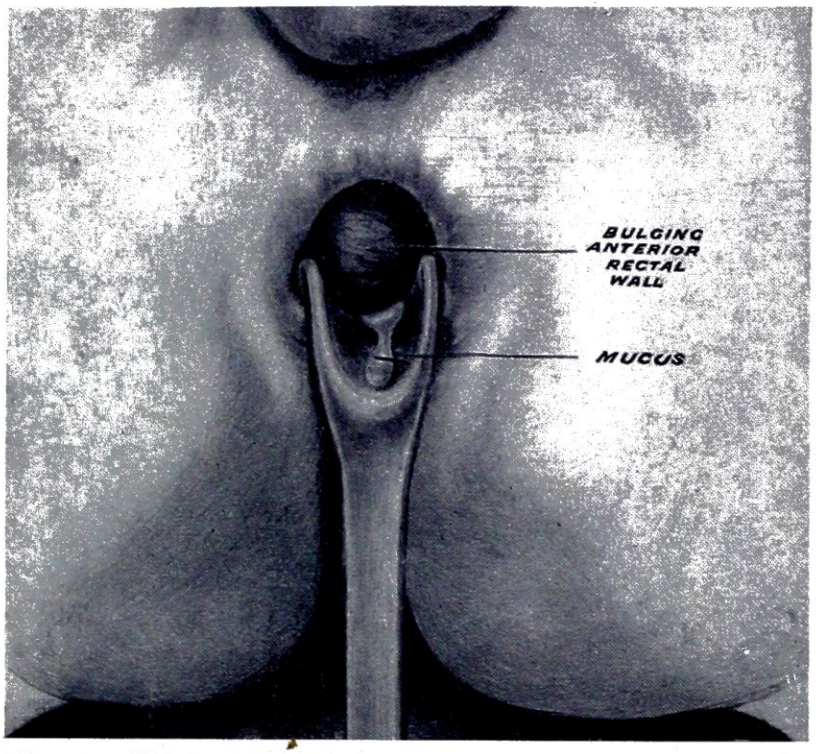

Fig. 310.—All is in readiness for opening a pelvic abscess into the rectum.

Lee McGregor is most insistent that the tube should not be anchored to the perianal skin, as he has seen serious cellulitis follow this usual practice. It may, therefore, be a better practice to endeavour to keep the tube in place with flexible adhesive plaster, or to cut the tube short enough to rest intrarectally on the upper surface of the internal sphincter, as advised by Barnard. After 3 or 4 days the tube can be removed.

Diarrhœa, which is usually present prior to operation, ceases once the abscess is opened. If possible, the bowels should remain confined until the tube is removed. The patient is nursed in Fowler's position for a week. *Fig.* 312 shows the temperature chart of a case treated in this way. I have used this method in a large number of cases, and never with regret.

In the case of an adult female, particularly a married woman, posterior colpotomy (Chapter XLIX) is a good alternative, perhaps even a better method than rectal drainage.

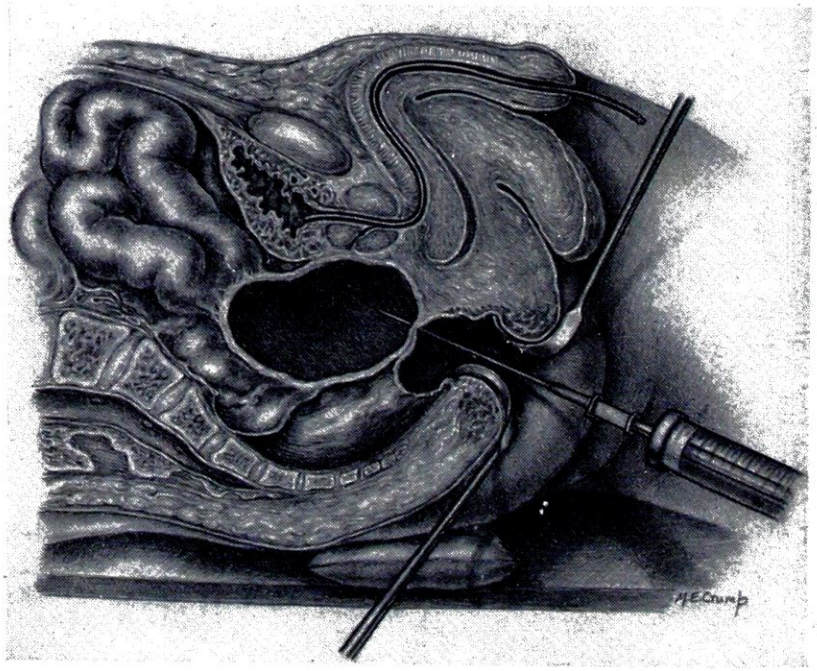

Fig. 311.—When the operator is in any doubt as to whether pus lies immediately beneath the rectal wall, aspiration will confirm or dispel that doubt.

As is exemplified in the case that follows, a collection of pus in the pelvis sometimes gives rise to symptoms of intestinal obstruction.[1] When he is convinced that there is a ripe

[1] After the abscess has been drained usually these symptoms abate promptly.

abscess in the rectovesical pouch, this feature should not deter the surgeon from carrying out *blind* rectal drainage. Of several relevant examples, the following is the most dramatic :—

I was called to the country to see a case of ' intestinal obstruction '. Beside the patient, who was a middle-aged, thin, hollow-eyed woman, there was a bowl of fæculent vomit, and she was adding to this with ' mouthful ' vomits. The pulse-rate was 120 and strong, and her abdomen was enormously distended. She said that she had been vomiting for four days, but had little pain. Her bowels had been open all the time ; indeed, she had some diarrhœa. A week before the onset of the vomiting she had had an attack of ' gastric influenza '. A gastric aspiration tube was passed and 2 pints of fæculent matter were withdrawn. Continuous intravenous administration of dextrose-saline was then commenced.

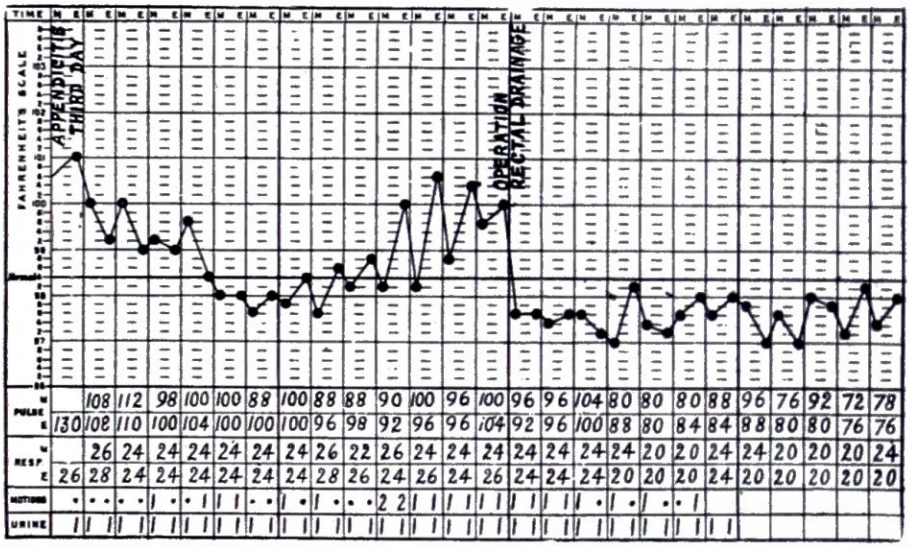

Fig. 312.—The temperature chart of a patient who developed a pelvic abscess which was drained per rectum.

The abdomen which, up to that time, had only been inspected, was palpated. The enormous distension had been much reduced and was now mainly confined to the lower abdomen, where a swelling could be felt in the hypogastrium. The patient said she had not passed urine all day. A sterile catheter was passed and a large bowlful of urine was withdrawn.

Re-examination of the abdomen, that by now was assuming a more normal contour, made it evident that there was still a swelling arising out of the pelvis.

With the patient in the lithotomy position, I inserted a finger into the rectum, there to find a tremendous bulging of the anterior rectal wall. In order to endeavour to elicit fluctuation, I exerted some pressure on the abdominal swelling with my left hand when to my astonishment the finger in the rectum passed through the mucosa and entered a cavern. As soon as I removed my finger, the bed became filled with stinking pus, and the patient, who had not complained of pain, said she felt faint. After she had received about half a pint of dextrose-saline intravenously, her condition improved. By that time the doctor had arrived ; she said she felt better, and her abdomen had assumed almost normal dimensions. Never before or since have I seen such a change in the shape of an ' acute abdomen ' in the matter of an hour.

She recovered, and four months later came to London for appendicectomy.

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CHAPTER XXIII

ACUTE SALPINGITIS

It is better to make the mistake of opening the abdomen in a case of doubtful early pelvic inflammation than to risk death from hæmorrhage with ectopic pregnancy. (W. O. Johnson.)

EMPHATICALLY, in cases of acute salpingitis, it is far better not to open the abdomen as an urgent measure. Equally emphatically, it is better to perform urgent laparotomy when one is not quite sure of the diagnosis. Throughout my career I have laboured the latter point, for I learnt my lesson early.

The beautiful daughter of a pharmaceutical chemist, whose shop was not far from the hospital, was sent in late at night as a case of acute appendicitis. It fell to her lot to be admitted under me—then a particularly raw and youthful house surgeon of one week's standing. In accordance with instructions, I summoned the Surgical Registrar to see the patient. He diagnosed acute salpingitis, and appropriate conservative treatment was instituted.

Although the charts showed that the patient's pulse and temperature were entirely satisfactory, and although no vomiting had occurred, she continued to complain of pain, and in my opinion the tenderness increased. Consequently, 48 hours later I telephoned my chief, who instructed me to ask the Surgical Registrar to re-examine her. The Registrar referred to had gone on a short well-deserved holiday, so it came about that his deputy (with less experience) examined the patient on this occasion. He reaffirmed the diagnosis of acute salpingitis and subscribed to the treatment that had been ordered.

I was most unhappy about the patient, for all the time I felt she had appendicitis. I should like to think that the reason for this uneasiness was clinical intuition, but a more probable explanation was that her father, who had many years of experience of prescribing over the counter, had on more than one occasion hinted that he was surprised to see that his daughter had not been operated upon. So passed the fourth, fifth, and sixth days. Her pulse remained steady in the 80's and she continued to complain of pain and I continued to harass the deputy Surgical Registrar concerning her.

In the late afternoon of the sixth day, after I had done a round of the wards and had satisfied myself that there was no change in this particular patient's condition, I left the hospital for two hours. On my return the Hall Porter told me that I was wanted urgently. I found the patient slightly cyanotic. Her pulse was thready and 140. Her skin was clammy, and I well remember that she told me her pain had gone and she felt better ; with all speed I summoned the Surgical Registrar (the original Registrar had returned that afternoon). He opened the abdomen within half an hour. Stinking pus poured out. The appendix was completely gangrenous. She died before daybreak.

Manifestly acute salpingitis is a condition in which all-important is the diagnosis. Indeed, there is not an acute abdominal catastrophe where the words of Howard Marsh : " Happy is he who has no serious consequences of his erroneous diagnosis to regret ", ring more true. To be responsible for the exodus of a young woman through arriving at the unproven assumption that she has contracted venereal disease—which is often what the position amounts to—is a heavy burden. The penalties of opening the abdomen on an erroneous diagnosis of early acute appendicitis or a ruptured ectopic gestation (more accurately, tubal abortion) and finding acute salpingitis are comparatively very light indeed ; there is always the redeeming feature that the vermiform appendix can be removed. Rightly, this is a source of satisfaction to all concerned.

The reader must not run away with the idea that a ' look-and-see ' policy is advocated as a routine ; on the contrary, the reader is urged to elaborate and perfect his pre-operative diagnostic régime—to spend time and trouble in examining and, if necessary, re-examining the patient and to open the abdomen only if he is still not sure that acute appendicitis can be excluded.

Diagnosis.—Acute salpingitis arises most frequently in the first week after abortion or delivery, or after menstruation, often in a patient with an already established intrauterine infection. Typical gonococcal salpingitis is now comparatively seldom encountered ; antibiotic therapy has lessened the incidence and has minimized the sequelæ. Probably the most common cause of salpingitis is attempting to procure abortion and violent douching by the patient, whether pregnant or not. Tubal infection is usually

bilateral in gonorrhœa and streptococcal infections, and unilateral in other infections. Streptococcal salpingitis leads to rapid onset of pelvic and frequently diffuse peritonitis.

The salient points in the diagnosis of acute salpingitis are as follows :—

1. The pain of acute salpingitis *commences* in the iliac fossa, not in the epigastrium or around the umbilicus.

2. The temperature is usually higher than that commonly found in acute appendicitis, but this should not bias the diagnostician unduly.

3. Dysuria is a frequent symptom. Scalding micturition with increased frequency is suggestive.

4. Usually there is some aberration in the recent menstrual history. Most commonly the last period was excessive.

5. Although there are exceptions, abdominal rigidity is not much in evidence.

6. Maximum tenderness is fairly constantly low down, i.e., just above the inguinal ligament. Frequently it is bilateral (*Fig.* 313).

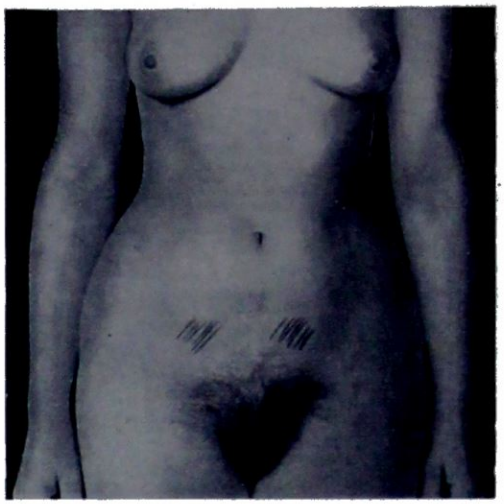

Fig. 313.—Areas of deep tenderness in acute salpingitis.

7. When it is thought necessary to do a bimanual examination in the patient's bed, always use a fresh glove for a rectal examination. The safest method is to perform the rectal examination first, then change the glove, and after wiping the vulva with Dettol solution, conduct the vaginal examination. By this technique the danger of carrying infection from one orifice to the other is avoided absolutely.

8. On bimanual examination, the cervix may be soft and the uterus slightly enlarged ; frequently it is tender. Seldom is there a unilateral or bilateral adnexal swelling in *early*

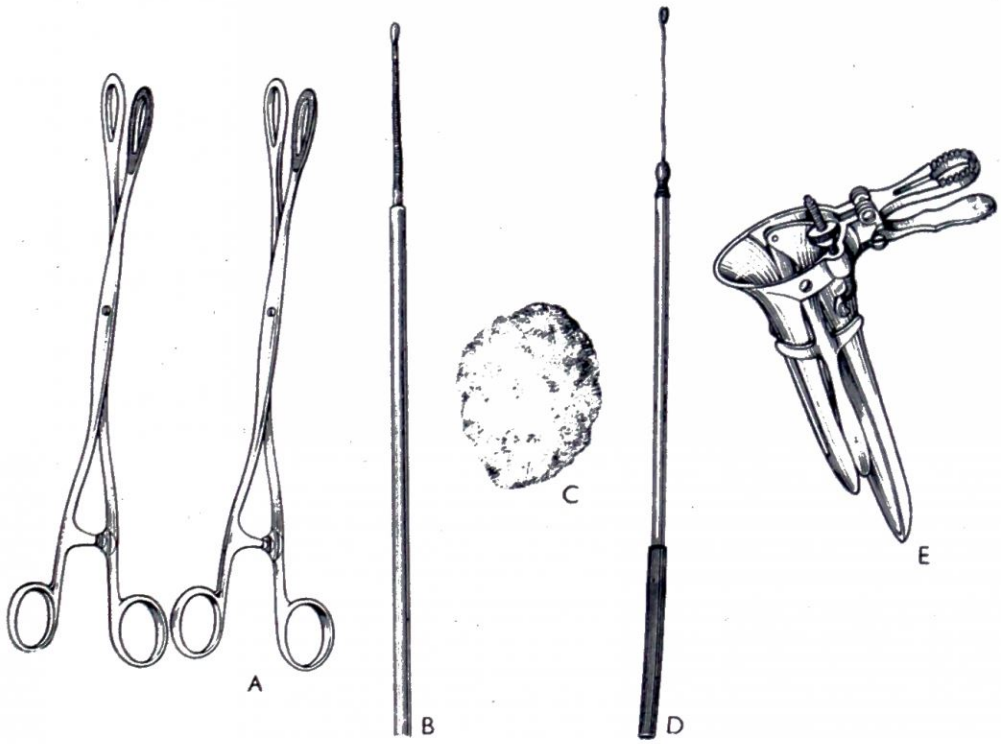

Fig. 314.—Apparatus necessary for conducting an examination of the female external genitalia for infection. A, Sponge-holding forceps ; B, Wool carrier ; C, Sterile cotton-wool ; D, Platinum loop ; E, Bi-valved vaginal speculum.

acute salpingitis. These signs, too often inconclusive, are the only ones which help to differentiate salpingitis from pelvic appendicitis.

9. If the surgeon is to feel justified that he has done his duty in endeavouring to make a correct pre-operative diagnosis, a vaginal discharge, whether admitted, or discovered at the clinical examination, needs special investigation, details of which will be given later in this chapter.

EXAMINATION OF THE FEMALE EXTERNAL GENITALIA FOR INFECTION

(*After Greenslade*)

Fig. 315.—The labia minora are separated by opening the jaws of sponge-holding forceps. The region of the urinary meatus is cleansed of secretion by means of a swab stick.

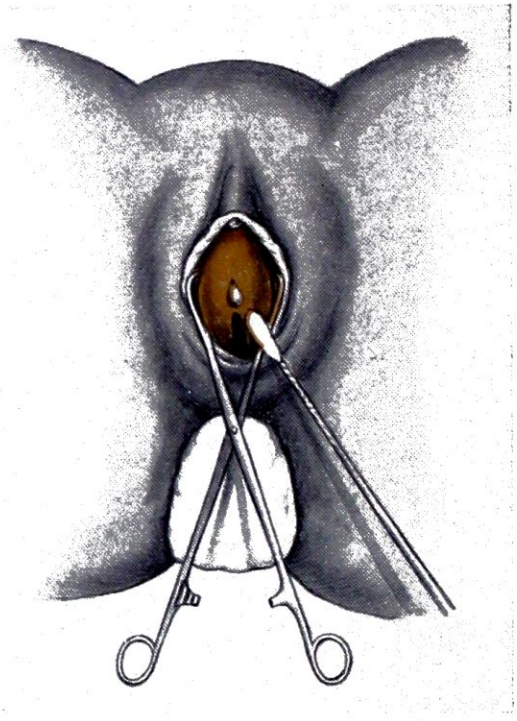

Fig. 316.—Using a second pair of (closed) sponge-holding forceps the floor of the urethra is milked. Should a bead of pus appear at the meatus the opportunity to obtain a specimen is seized.

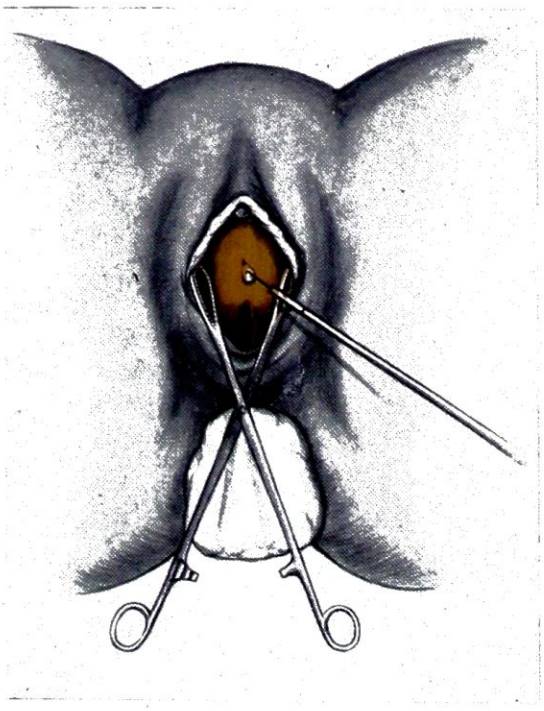

Fig. 317.—Pus from the urethra is transferred (*a*) to a glass slide, and (*b*) to an agar slope contained in a test-tube, each being labelled 'Urethra'.

Fig. 318.—Once again the mouth of the urethra is wiped with wool on a probe. The mouth of the urethra is compressed laterally with the second pair of sponge-holding forceps. Pus may be expressed from Skene's tubules by this manœuvre. If so, specimens are secured and labelled 'Skene's tubules'.

Fig. 319.—The orifices of Bartholin's ducts are displayed. Pressure from above downwards and inwards with the forceps compresses these glands. If pus appears a specimen is secured on the platinum loop. These specimens are labelled ' Bartholin's '. In any case the forceps are left in position while the speculum is passed.

Fig. 320.—A bi-valved speculum is inserted. The mouth of the cervix is cleansed of secretion with the probe wool carrier. The platinum loop is passed into the cervical canal to collect specimens which are labelled ' Cervix '.

In a few instances the diagnosis of acute salpingitis is difficult; in fewer still it is insuperably difficult. Most of the mistakes are due to a combination of three factors :—

a. Shyness on the part of the clinician.

b. Slip-shod methods in taking the history and examining the patient.

c. Sims' position.

The first factor presents a real obstacle, especially in private practice. With a relative in the room one cannot go into the matter as one would wish to do.

The following method of procedure is the outcome of considerable experience. When it is carried out conscientiously it reduces the margin of avoidable error to vanishing point.

IN THE PATIENT'S HOUSE

The question of the differential diagnosis between acute appendicitis and a lesion of the adnexa arises. As a general rule, refrain from performing a pelvic examination. Suggest that such an examination is most necessary, but as the patient must be transported to hospital for further observations and treatment, the internal examination is better postponed until after the journey. When the attending practitioner desires you to conduct a pelvic examination, perform a rectal examination, and unless something obvious is detected reserve judgment on the findings.

IN HOSPITAL

Go into the patient's menstrual and sexual history and the question of an intermenstrual discharge in more detail. If it seems desirable to speak with the patient alone, ask the nurse to fetch a second glove for the pelvic examination, or if that be present, to prepare a bowl of weak Dettol (chloroxylenol) solution.

If you are in doubt as to whether the patient has a vaginal discharge, when the nurse returns examine the patient in the lithotomy position in a good light and satisfy yourself whether or not a discharge is present. If there is no discharge, inquire whether the patient has douched the vagina recently.

As a result of these planned devices the diagnosis may become clarified. In other instances one is still in doubt. If in doubt, it may be justifiable to order the patient to

be placed in high Fowler's position and to be watched carefully for two hours, but this course is not advised unless the circumstances are extenuating.

Provided the patient is not menstruating, there is everything to be gained and nothing to be lost by making a thorough vaginal examination in the operating theatre. Give instructions for the patient to be shaved and otherwise prepared for laparotomy. In appropriate cases let this preparation include pre-operative medication for a general anæsthetic, but make it clearly understood by everyone concerned that an anæsthetic and an operation may not be required. The patient's eyes should be blindfolded before she is transported to the operating theatre.

In the Operating Theatre.—The patient is placed in the lithotomy position. The armamentarium required for the examination is shown in *Fig.* 314.

The correct method of procedure to ascertain if a gonococcal or other infection of the lower urogenital tract is present, is so clearly depicted in *Figs.* 315–320 as to render further description unnecessary. When the parts have been visualized thus, and the specimens have been obtained, a most thorough bimanual vaginal examination can be carried out—a far more efficient examination than can be hoped for with the patient in bed.

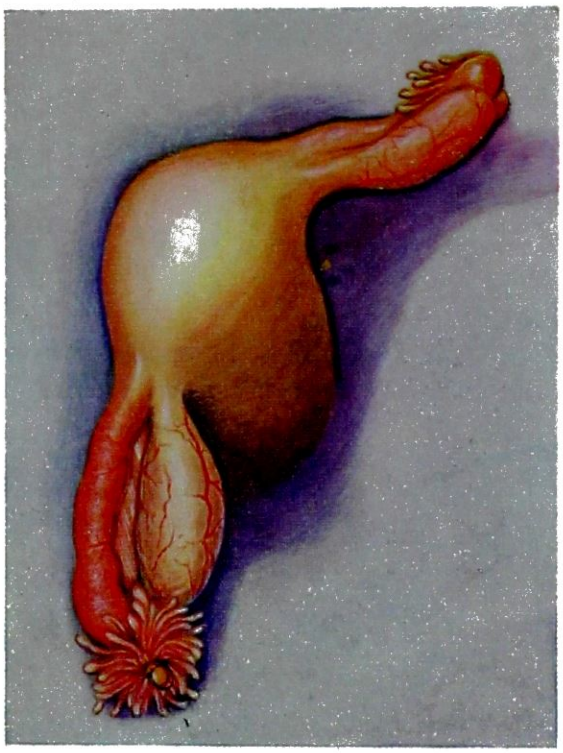

Fig. 321.—Acute purulent salpingitis, affecting mainly the right Fallopian tube.

As a result of the data obtained by the various expedients set forth the surgeon can now with a clear conscience make the important decision, whether (*a*) he will send the patient back to bed, or (*b*) he will open the abdomen forthwith.

Troublesome as it may be, it is only after an examination carried out in the above manner that it can be said that everything possible has been done to clarify the all-important differential diagnosis between acute pelvic appendicitis and acute salpingitis.

Is it :—

Acute Pyelonephritis ?—*See* p. 573.

Ruptured Ectopic Gestation ?—*See* p. 551.

Peritonitis following Abortion ?—*See* p. 210.

TREATMENT OF ACUTE SALPINGITIS

High Fowler's position and other details outlined for the Ochsner-Sherren treatment for appendicitis (p. 232) are instituted.

Gonococcal salpingitis in particular responds, usually within three days, to 500,000 units of penicillin bis die intramuscularly, or to aureomycin 1 G. t.d.s. orally. Excellent results have been obtained also with terramycin 1 G. daily.

THE ABDOMEN HAS BEEN OPENED AND ACUTE SALPINGITIS IS PRESENT

When the tubes are found to be inflamed and (often) pus is seen exuding from their ostia (*Fig.* 321), the reader is exhorted to leave them alone, aspirate any free pus in the peritoneal cavity, remove the appendix, and close the abdomen without drainage.

CLOSED PYOSALPINX

A closed pyosalpinx is found.[1] When a Fallopian tube is obviously distended as well as inflamed (occasionally both tubes are found in this condition) it is good surgery to remove it. After separating surrounding adhesions, the affected Fallopian tube can be displayed and removed satisfactorily by the following technique. The tube is grasped

[1] In pyosalpinx and tubo-ovarian abscess the confirmation of the diagnosis by culture of smears is not so conclusive as it is in acute primary salpingitis.

by two Morrant Baker's forceps in such a way that they do not crush or tear the friable appendage. By making a narrow 'melon-slice' incision into the uterus around the origin of the Fallopian tube, the tube can be detached from the uterus. The V-shaped wound

Fig. 322.—Excision of a pyosalpinx.

in the uterus is under-run by two or three sutures (*Fig.* 322) which control hæmorrhage and neatly approximate the edges of the wound. Clipping in hæmostats, then cutting, the attachment of the tube to the broad ligament is severed. This method permits the separation of the fimbriated end of the tube from the ovary to which it is often amalgamated by an extension of the inflammatory process. In this way the ovary or a considerable portion of it can be conserved. The stumps of the broad ligament held in the hæmostats are securely ligated with transfixion sutures. Before closing the abdomen the raw surfaces are covered as is shown in *Fig.* 323, and the greater omentum, if available, is drawn down and tucked about the operation area with a view to preventing coils of intestine becoming adherent to the inflamed ovary. Drainage is seldom necessary.

Fig. 323.—A method of covering the raw surfaces after salpingectomy or salpingo-oöphorectomy. The round ligament is drawn over the raw surfaces by two mattress sutures placed as shown. (*After Wilfred Shaw.*)

TUBO-OVARIAN ABSCESS

In spite of the fact that the use of antibiotics has resulted in a decrease in the incidence and the severity of pelvic inflammation, cases of tubo-ovarian abscess[1] still occur quite frequently. The condition, which is met with in women between the ages of 16 and 46 years, gives rise to a tender swelling in the pelvis, accompanied by pyrexia. In about 50 per cent of cases the condition is bilateral.

Treatment.—With conservative treatment similar to that of the Ochsner-Sherren treatment of appendicitis which, with certain reservations, is the treatment of choice, the abscess often resolves. It must, however, be emphasized that some patients respond poorly, if at all, to delayed treatment, while others become worse, and an appreciable percentage die if operation is deferred too long. Even if there is a favourable response to conservative treatment, a tubo-ovarian abscess often takes months of more or less continuous bed-rest to resolve, after which an operation to remove the infected focus is undertaken. Because of the danger of rupture of a tubo-ovarian abscess, as long as there is an inflammatory swelling present in the pelvis the patient should never be allowed to

[1] See footnote, p. 246.

pass from direct observation, even if the temperature has remained normal for a week or more.

Failure of Conservative Measures.—Operation should be undertaken :—

1. When the mass fails to become smaller, or alternatively is getting larger.
2. If pyrexia over 100° F. (37·7° C.) continues for more than six days.
3. Recurrent attacks of pain occurring in a patient with known pelvic inflammation should be an indication for immediate operation, with the object of forestalling intraperitoneal rupture of the abscess.

When an urgent operation is indicated, the essential step is to drain the abscess. When the patient is extremely ill, or the abscess is large, posterior colpotomy[1] is the operation of choice, provided the pus is accessible through the posterior fornix. In cases of doubt as to whether the abdomen should be opened or posterior colpotomy performed, diagnostic aspiration through the posterior fornix (*see* p. 563) gives valuable information.

When the patient is in good condition, usually it is best to approach the abscess through the abdomen. If the affected appendage is found to be accessible, salpingo-oöphorectomy can be undertaken. This step is desirable, for it gives better immediate, and long-term, results, whereas simple drainage is liable to be followed by a persistent sinus and/or incomplete resolution of the inflammatory mass, in which case, after a long convalescence, excision of the uterus and both adnexæ is the only means of curing the patient.

Bilateral Tubo-ovarian Abscesses.—When bilateral tubo-ovarian abscesses are present, and fail to resolve, there are two separate abscess cavities to be drained. These cavities often lie close beneath the abdominal wall, and are surrounded by adherent intestine and omentum. Both cavities must be opened and drained. There should be no hesitation in making two incisions in the abdominal wall, if it is considered that there will be less disturbance of the abdominal contents thereby.

RUPTURE OF A TUBO-OVARIAN ABSCESS

A. G. Miller states that although he still believes in conservative treatment of pelvic inflammation, his complacency in regard to possible rupture of inflammatory pelvic masses has been rudely shattered. Of 53 cases of rupture of a tubo-ovarian abscess collected by this author, the rupture took place as follows :—

Intraperitoneal	..	..	44	Cases
Intestinal	..	..	6	,,
Intravesical	..	..	3	,,

Intraperitoneal rupture is more likely to occur in a recent case, where the abscess wall is thin and adhesions are fragile or lacking, than in a long-standing case. Intraperitoneal rupture complicated 23 (3 per cent) of 751 cases of pelvic inflammation admitted to the Bellvue Hospital, New York (Lardaro). Of these, 17 were on the left side. The relative frequency with which rupture occurs on the left side has been remarked upon by other observers. Lardaro's explanation is that it is due to raising of the intracolic pressure as a result of ingestion of a purgative or the administration of an enema. In a little under one-third of the cases the patient was admitted mortally ill, with general peritonitis due to a ruptured tubo-ovarian abscess that had been unrecognized or misdiagnosed. In the remainder the rupture took place in hospital at various times from 1–25 days after admission. In an appreciable number of cases, rupture was precipitated by a bimanual examination.

Diagnosis.—When a tubo-ovarian abscess ruptures into the peritoneal cavity there is very severe pain in the lower abdomen, often followed by rigors, and less frequently by vomiting. The general condition of the patient deteriorates steadily, the degree of accompanying shock being proportional to the amount of pus liberated. In cases of rupture of a large abscess the pulse-rate may quickly reach 160 beats per minute ; the blood-pressure becomes increasingly low. In some cases the escape of pus through the rupture is comparatively slow, and the only signs are those of gradual deterioration of the patient's general condition. Therefore, in the absence of any systemic disease to account for the deterioration, rupture should be assumed and the patient operated upon without delay.

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[1] Posterior colpotomy will prevent rupture of the abscess into the abdominal cavity, but after convalescence further operative treatment will be required to prevent a recurrence.

Treatment.—Unless an urgent operation is performed, the patient's doom is sealed. In the absence of matched blood, dextran, followed by dextrose-saline, should be given as soon as possible, and the patient hurried to the operating theatre. When the blood-pressure does not quickly improve with intravenous fluid therapy, several good results have been reported from adding noradrenaline to the intravenous fluid (*see* p. 77). The essential operative procedure is to drain the peritoneal cavity suprapubically. It is seldom that anything more should be attempted, for as a rule these patients are desperately ill. If operation is performed within six hours of rupture, about 70 per cent of the patients recover.

The early administration of an antibiotic intravenously (*see* p. 202) is likely to improve these results.

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CHAPTER XXIV

ACUTE REGIONAL ILEITIS AND ACUTE COLONIC DIVERTICULITIS

ACUTE REGIONAL ILEITIS
(*Crohn's Disease*)

In the first stage of the disease the symptoms closely resemble those of acute or subacute appendicitis with one notable exception, viz., almost invariably diarrhœa precedes the acute attack. Because early acute appendicitis cannot be eliminated, rightly an emergency operation is performed. On opening the abdomen clear fluid escapes. The terminal

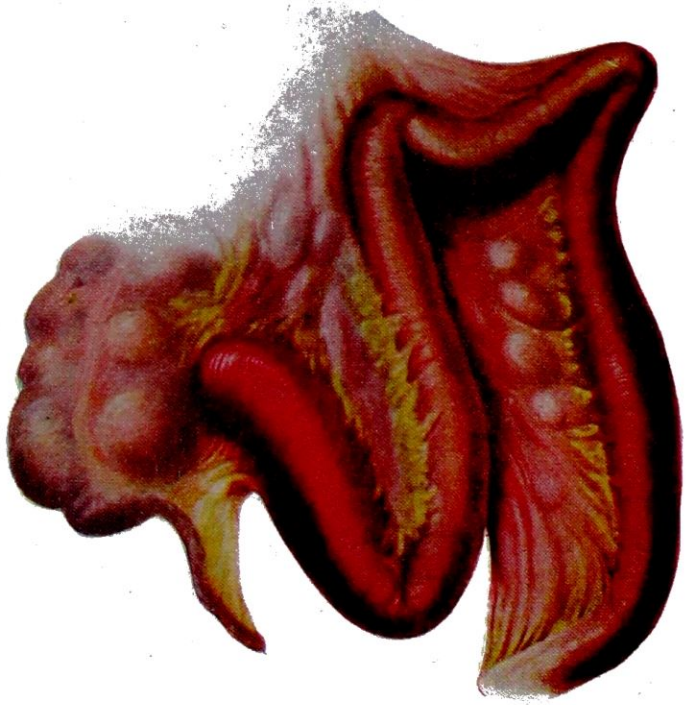

Fig. 324.—Terminal ileitis (Crohn's disease). Note the enlarged lymph-nodes. (*After A. S. Jackson.*)

ileum, if examined, is found to be inflamed and much thickened; the mesenteric lymph-nodes of the area are considerably enlarged and fleshy (*Fig.* 324). Usually these changes terminate abruptly at the ileocæcal valve; in a small percentage of cases the cæcum and the appendix itself take part in the granulomatous hypertrophy.

For practical purposes ileocæcal tuberculosis can be ruled out, because in the latter condition definite tubercles can be seen on the peritoneal surface of the intestine.

The one thing *not* to do in acute regional ileitis (and also in acute ileocæcal tuberculosis) is to perform appendicectomy, because so often in these conditions appendicectomy is followed by a fæcal fistula.[1]

If through some mischance, appendicectomy is commenced and then, on account of the comparative normality of the appendix, it is realized that the case is one of regional ileitis—a contingency which might reasonably arise—special precautions must be taken. The appendicular stump should be closed by a transfixion suture of well-tanned strong catgut. A purse-string suture should be omitted, for it will probably cut out. Indeed, it is best to avoid all attempts at invagination of the stump. A soft rubber drain should be inserted and retained for at least three days.

[1] For the same reason it is most unwise to excise a piece of the wall of the diseased intestine for biopsy.

On several occasions I have mistaken a mass in the right iliac fossa due to Crohn's disease for an appendix abscess or a carcinoma of the cæcum. Although termed a 'mistake', it is right that one of these relatively common conditions should receive diagnostic pride of place. The absence of pyrexia and a normal leucocyte count, greatly favours the diagnosis of a neoplasm, but the differential diagnosis between Crohn's disease and an appendix abscess may be insuperably difficult.

P. J. was a seedy-looking man of 27, who gave a history of three days' abdominal pain consistent with acute appendicitis. A tender mass could be palpated in the right iliac fossa, and his temperature was 99° F. None of those in attendance questioned the diagnosis of localized appendicitis. Two days later, as the signs and symptoms were not settling—the temperature was 100° and the pain had become more pronounced, and the lump was larger—operation was decided upon. There was massive induration of the cæcum and the appendix could not be found. After prising open the retrocæcal space without encountering pus, I wondered if I was dealing with a resolving appendix mass and committing the crime of breaking down Nature's barriers. Having regard to the clinical course of the disease, it was clear that resolution was not occurring. The complete normality of the small intestine seemed to rule out Crohn's disease ; actinomycosis could not be ruled out. It was decided that the best course was to proceed with resection. Removal of the right half of the colon with ileotransverse colostomy was carried out with recovery. Histological examination of the specimen revealed that this was a case of Crohn's disease of the cæcum.

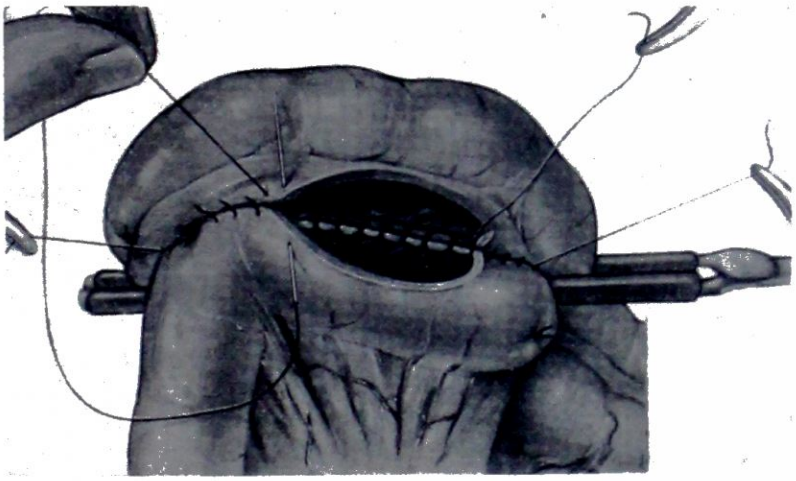

Fig. 325.—Ileotransverse colostomy in progress. Note that the ileum has been disconnected from the diseased area, both ends having been closed and invaginated.

Because recurrence follows in a high percentage of cases, resection of the affected segment is to be avoided in regional ileitis whenever possible. A much better course is to perform a disconnecting ileocolostomy between healthy ileum and the transverse colon (*Fig.* 325).

Acute Perforation of the Intestine in Regional Ileitis.—*See* p. 207.

ACUTE COLONIC DIVERTICULITIS

With the increasing span of life, colonic diverticulitis is becoming more frequent. Colonic diverticulosis is acquired. The diverticula, which possess only two coats—an outer serous and an inner mucous—are caused by herniation of the mucosa through the muscle wall, where it is pierced by an arteriole. Consequently, the diverticula occur between the mesenteric and the two antimesenteric tæniæ (*Fig.* 326).

As a rule the appendices epiploicæ of a diverticula-bearing pelvic colon are luxuriant and contain fat of a bright-yellow hue ; occasionally a diverticulum passes into an appendix epiploica. While diverticulosis is distributed equally between the sexes, acute diverticulitis of the pelvic colon is at least two and a half times more common in men than in women.

Ninety-five per cent of colonic diverticula giving rise to symptoms are situated in the pelvic colon. The pathogenesis of acute diverticulitis is as follows : many of the diverticula contain inspissated fæcal matter. Should the mouth of a diverticulum become blocked by a fæcolith, inflammation of the obstructed diverticulum ensues. As a rule inflammation is confined to one diverticulum at a time ; occasionally more than one become inflamed simultaneously.

The course of acute colonic diverticulitis can be summarized as follows :—

Acute Colonic Diverticulitis
- Resolution (sometimes with stenosis), often followed by chronicity and recurrent acute attacks.
- Subacute perforation with local abscess formation.
- Subacute perforation into a hollow viscus, notably the bladder.
- Free perforation into the general peritoneal cavity.
- Severe melæna.

Uncomplicated Acute Diverticulitis.—In typical cases the pain commences at the umbilicus and passes to the left iliac fossa, where the maximum tenderness is situated ; this makes the diagnosis from appendicitis simple. When the diagnosis can be made with assurance, conservative treatment similar to that of the delayed treatment of appendicitis should be employed ; nearly always resolution occurs. About a week after the patient is symptom-free it is safe to give a barium enema. Assuming that this demonstrates the presence of diverticulosis of the pelvic colon, in a dangerous condition such as this, one should not be content to let matters slide. Rather one should take the current when it serves, and about three weeks after resolution has occurred, advise an operation that will make the patient safe against future attacks and probable perforation, viz., resection of the affected portion of the intestine carried out after proper pre-operative preparation. On the other hand, for the poor-risk patient a watching policy, including a dietetic régime and the administration of antispasmodics and intestinal antiseptics, under the care of a physician, is advisable.

Acute diverticulitis presents itself in many guises, and examples, revealed only when the abdomen has been opened, are bound to occur from time to time. For instance, when the inflamed diverticulum is situated in a loop of colon lying in the pelvis, tenderness is elicited mainly by a pelvic examination, and the differentiation between acute pelvic appendicitis and acute diverticulitis is not apparent until laparotomy has been performed.

A taxi-driver stated that fourteen hours previously he had been seized with acute abdominal pain that had awakened him in the early morning. His temperature was 99° F. (37·2° C.) and his pulse normal. On abdominal examination the only physical sign was diffuse tenderness, most marked in the hypogastrium. Per rectum a hard lump could be felt in the rectovesical pouch. When I touched this the patient cried out in pain and said it felt like a red-hot dagger being thrust into his navel. On opening the abdomen through a right paramedian incision the pelvic colon, which was turgid and bright red, was found in the rectovesical pouch and the nature of the tender lump was clear. This portion of the colon could be readily delivered on to the surface through an incision in the left iliac fossa and a Paul-Mikulicz operation was performed with recovery.

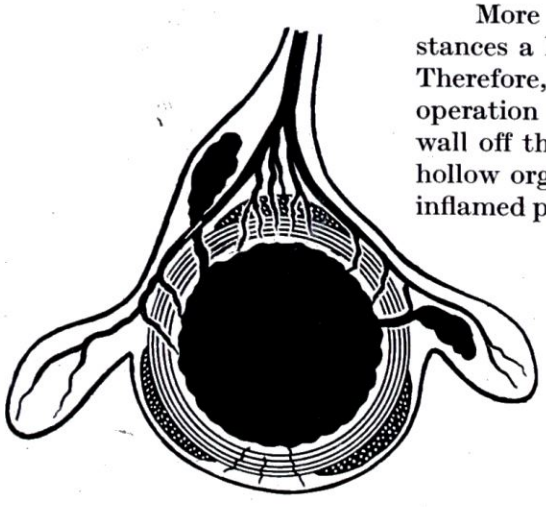

Fig. 326.—Usual sites of diverticulation of the colon. (*After Hamilton Drummond.*)

More usually the mesocolon is short ; in these circumstances a Paul-Mikulicz resection (*see* p. 396) is impossible. Therefore, as a rule, when acute diverticulitis is displayed at operation the correct procedure is as follows : in order to wall off the area and prevent fistula formation with other hollow organs, the greater omentum is wrapped around the inflamed pelvic colon, and the abdomen is closed. Antibiotic therapy and a low-residue diet is given.

Localized Peridiverticular Abscess is a common complication of acute diverticulitis. When an inflamed diverticulum situated within the mesocolon (*see Fig.* 326) bursts, the pus will be confined, at any rate for some time, between the layers of the mesocolon. In these circumstances the mesocolon becomes greatly thickened ; the bowel becomes angulated and the œdema resulting from pressure on the lymphatics and blood-vessels is liable to result in partial intestinal obstruction.

On the other hand, slow perforation of a diverticulum not thus confined gives rise to a peridiverticular abscess walled in by greater omentum and coils of small intestine. Sometimes a tender mass can be palpated in the left iliac fossa (*Fig.* 327) ; at others it is obscured by overlying rigidity.

Delayed Treatment.—For a localized peridiverticular abscess delayed treatment consisting of absolute rest to the bowel, parenteral feeding, continuous gastric suction, and antibiotic therapy can be recommended with every confidence, except in the following circumstances :—

1. If the patient has recently ingested a powerful purgative.
2. If on rectal or vaginal examination an indurated mass can be felt invading the rectovesical pouch as well as the left iliac fossa. It is difficult to estimate the size of such an abscess.

Fig. 327.—Abscess of the abdominal wall connected with a perforated diverticulum of the pelvic colon. A colocutaneous fæcal fistula followed incision of the abscess.

Just as in the case of the Ochsner-Sherren treatment of an appendix abscess, signs that foretell failure of the delayed treatment are :—

1. A rising pulse-rate or failure of an elevated pulse-rate to fall.
2. A hectic temperature.
3. Failure of the pain to abate, or recurrence of pain.
4. An increase in the size of the lump.

All the above are indications that operation should be undertaken without delay.

Operation for Peridiverticular Abscess.—The bladder must be emptied by a catheter on the operating table. Under the anæsthetic the periphery of the mass can be defined accurately. An oblique incision centred over the mass is made in the left iliac fossa, severing the fibres of the internal oblique instead of splitting them. This gives direct access. The abscess may be situated on the medial or the lateral aspect of the colon ; seldom is it on both sides. Therefore, before opening the peritoneum it is a good practice to peel the peritoneum off the muscles laterally. Should this open the abscess, all that is necessary is to insert a drainage tube and make a suitable stab incision to accommodate it. More often the peritoneum must be opened over the centre of the incision. Gentle separation of adhesions with the finger soon enters a stinking abscess, unless it is confined between the leaves of the mesocolon. In the latter instance, if fluctuation can be elicited, a closed hæmostat is thrust into the swelling and its jaws are opened. If fluctuation cannot be elicited and there is merely much thickening (and shortening) of the mesocolon, Lenhart and Flemming advise mobilizing the pelvic colon (which prevents intestinal obstruction by angulation) and placing a cofferdam drain (*see* Chapter XCIV) on the medial side.

For an abscess situated on the medial side of the colon invading the pelvis, Lenhart and Flemming also recommend cofferdam drainage.

A Colocutaneous Fistula is a usual sequel of drainage of a peridiverticular abscess (*Fig.* 327) ; such was the train of events in 24 out of 26 peridiverticular abscesses drained

by Mayo. It has long been the accepted practice in patients with a cutaneous or sigmoido-vesical fistula to perform transverse colostomy, to completely divide the colon, and then wait 6 or even 12 months before attempting to resect the sigmoid. Since the introduction of antibiotic agents there is abundant evidence that in the absence of signs of intestinal obstruction, resection can be undertaken without this preliminary colostomy after a somewhat longer convalescence than is recommended in the case of uncomplicated diverticulitis. In old and enfeebled patients, when resection is contra-indicated, a colo-cutaneous fistula is some guarantee against the development of further abscesses (Harold Edwards).

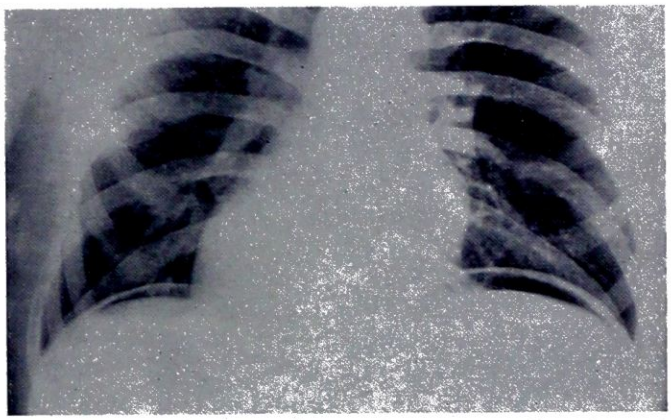

Fig. 328.—Pneumoperitoneum in a case of perforated diverticulum of the sigmoid. (*C. C. Guy and C. Y. Werelius.*)

Acute Free Perforation of an inflamed colonic diverticulum is not as rare as many seem to believe. Free perforation is responsible for the great majority of deaths in this disease, and one-quarter of the patients have no premonitory symptoms of diverticulitis. The radiological findings of pneumoperitoneum (*Fig.* 328) suggest a perforated peptic ulcer, although it should be recognized that gas beneath the diaphragm is to be expected in all free perforations of the large intestine.

While the operating theatre is being got in readiness, the patient is placed in Fowler's position, and continuous intravenous saline is administered. It is assumed that the diagnosis of diffuse peritonitis is evident, but, as is often the case, diverticulitis as the primary focus can only be suspected. Having suspected a perforated diverticulum of the pelvic colon as a cause of the peritonitis, it should be realized that spreading peritonitis following perforated colonic diverticulitis is one of the most lethal of the intra-abdominal catastrophes, consequently operation must be carried out with as little delay as possible.

There is a Palpable Lump.—Examination under the anæsthetic may reveal a lump in the left iliac fossa that could not be felt before because of muscular rigidity (*Fig.* 329). Should this be the case we are fortunate, for an appropriate incision over the mass will minimize intra-abdominal manipulations. In such circumstances I think it best to make a gridiron incision directly over the mass, and instead of splitting the fibres of the internal oblique, to sever them.

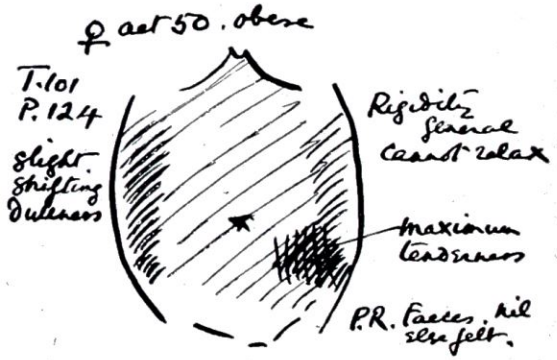

Fig. 329.—Physical signs recorded in the case of a woman of 50 with diffuse peritonitis. Under the anæsthetic a mass could be palpated in the left iliac fossa.

If, on an erroneous diagnosis of perforated peptic ulcer an upper abdominal incision has been made, foul-smelling gas escapes, and an indurated pelvic colon suggesting perforated diverticulitis is felt, the upper abdominal incision should be covered securely *pro tem* (transverse colostomy may have to be performed through it later) and the abdomen re-opened over the lesion by the incision recommended above.

Methods of dealing with a Perforated Colonic Diverticulum.—

1. If it is possible to exteriorize the lesion (*Fig.* 330), this is the safest of all measures. Failing this :—

2. When possible, the perforation should be closed and the defect reinforced by suturing an appendix epiploica over it.

3. In some cases the perforation is so large and the surrounding tissue so friable that suture is impossible. In these circumstances undoubtedly the course most likely to preserve the life of the patient is to resect the segment bearing the perforation, close the distal end of the colon, tie a Paul's tube into the proximal end, and bring it out of the upper part of the wound, keeping it above skin level by passing a spigot through its meso-colon. In favourable cases the restoration of continuity can be carried out at a later date.

4. Unfortunately, in a number of instances when the peritoneum is opened, the perforation cannot be found readily. There is a small quantity of stinking pus in a confusing mass of adhesions—proof that the peritonitis was secondary to bursting of a localized abscess. In some instances it is not possible to determine whether the indurated mass is the result of an inflammatory or a neoplastic process.

The best method of dealing with this perplexing situation is: (*a*) Perform suprapubic drainage; (*b*) Drain locally through the incision, which is closed about the drain; (*c*) After changing gloves perform transverse colostomy (*see* p. 447).

Suprapubic drainage of the rectovesical pouch must be carried out in all cases of perforated diverticulitis. If the upper abdomen was opened in error, it is closed as a last

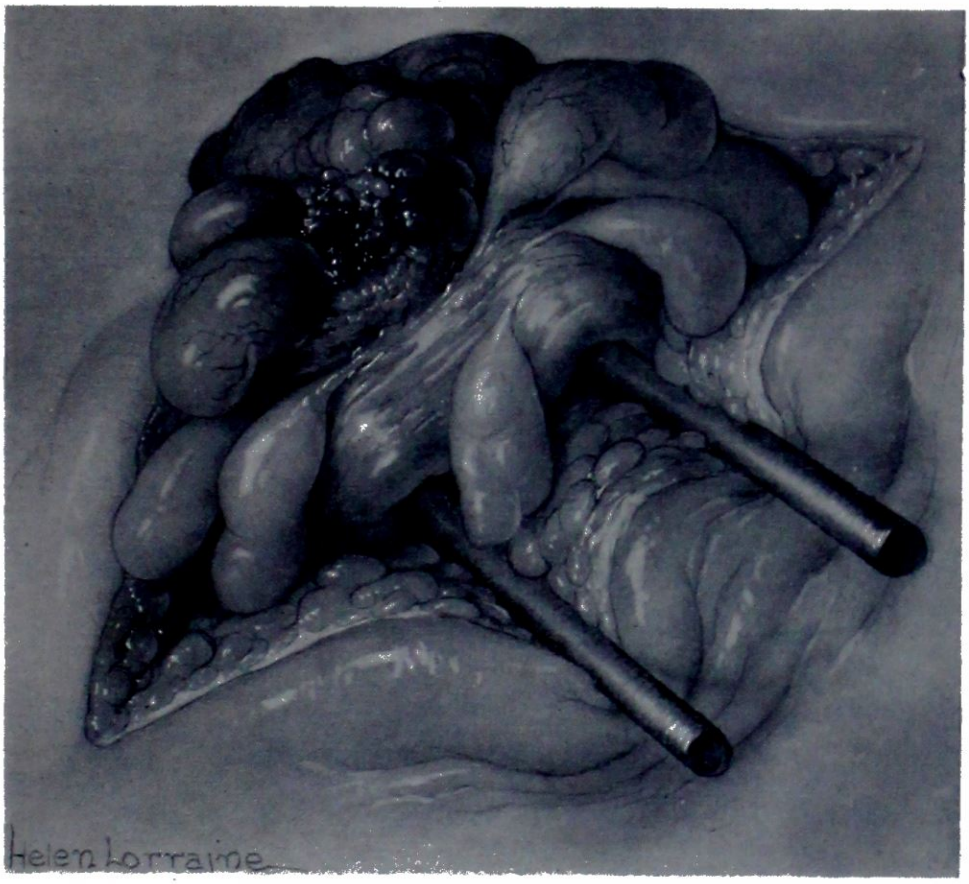

Fig. 330.—Exteriorization of the segment containing the perforation. Note that two spigots are employed.

step. Gloves are changed, and as far as possible instruments that were used for the lower abdominal incision are avoided.

Severe Melæna, or more usually the passage of bright-red blood, has only recently been recognized as one of the major complications of colonic diverticulitis. Profuse hæmorrhage is due to ulceration of a relatively large artery within the walls of the diverticulum (*see Fig.* 244). In the majority of cases the bleeding can be controlled by conservative measures, giving complete rest to the bowel, and by blood transfusion. In a few cases, partial colectomy must be undertaken as an emergency. Should this be necessary, the bowel is excised in the manner described in this chapter; it is most unwise to attempt to restore the continuity of an incompletely prepared colon of a patient in a parlous condition.

Acute Intestinal Obstruction complicating Chronic Diverticulitis.—*See* p. 252 and Chapter XXXIX.

Acute Diverticulitis of the Right Half of the Colon.—In 2 per cent of cases the inflamed diverticulum (it is often solitary) is situated in the cæcum or the ascending colon. Usually the first intimation of its presence is perforation into the general peritoneal cavity. Unlike diverticulitis of the pelvic colon, diverticulitis of the cæcum and ascending colon usually occurs in women under 40 years of age. The condition is impossible to differentiate from acute appendicitis with diffuse peritonitis, and it is on this diagnosis that the abdomen

is opened. The vermiform appendix being unperforated, a search elsewhere displays gas and fluid fæces issuing from the perforation. In some cases the perforation is situated on an easily recognized diverticulum, in which case the pouch is excised and its base is invaginated. More often the perforation is found in the midst of an indurated mass that cannot be differentiated from a carcinoma. Provided the condition of the patient is excellent, right colectomy with restoration of the continuity of the intestine by lateral ileotransverse colostomy (*see* p. 251) or by the Maylard-Sonnenberg technique (*see* p. 454) can be undertaken. If the peritonitis is advanced, resection should not be attempted. The right colon is mobilized as necessary (*see* p. 449), and that part of it containing the perforation is exteriorized, a spigot being passed through the mesocolon in order to keep the bowel above skin level. When the patient is fit to withstand it, resection is carried out.

In all cases suprapubic drainage of the peritoneal cavity is essential.

Acute diverticulitis occurring in any portion of the colon other than the pelvic colon is comparatively favourable as regards mobilization. For instance, in a case of perforation of the transverse colon associated with an abscess of the abdominal wall in the region of the umbilicus, I excised the walls of the abscess cavity without opening it, and delivered the attached transverse colon. The Paul-Mikulicz procedure was accomplished without difficulty, and the result was pleasing.

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CHAPTER XXV

SOME OTHER CONDITIONS SIMULATING ACUTE APPENDICITIS

RENAL COLIC

Woe betide a patient with gangrenous appendicitis who passes blood in the urine! Until it is better known that an inflamed appendix lying in juxtaposition to the ureter (*Fig.* 331) can give rise to ureteritis that causes hæmaturia, lives will be lost. When blood is found in the urine, almost invariably, the practitioner rules out appendicitis, and not

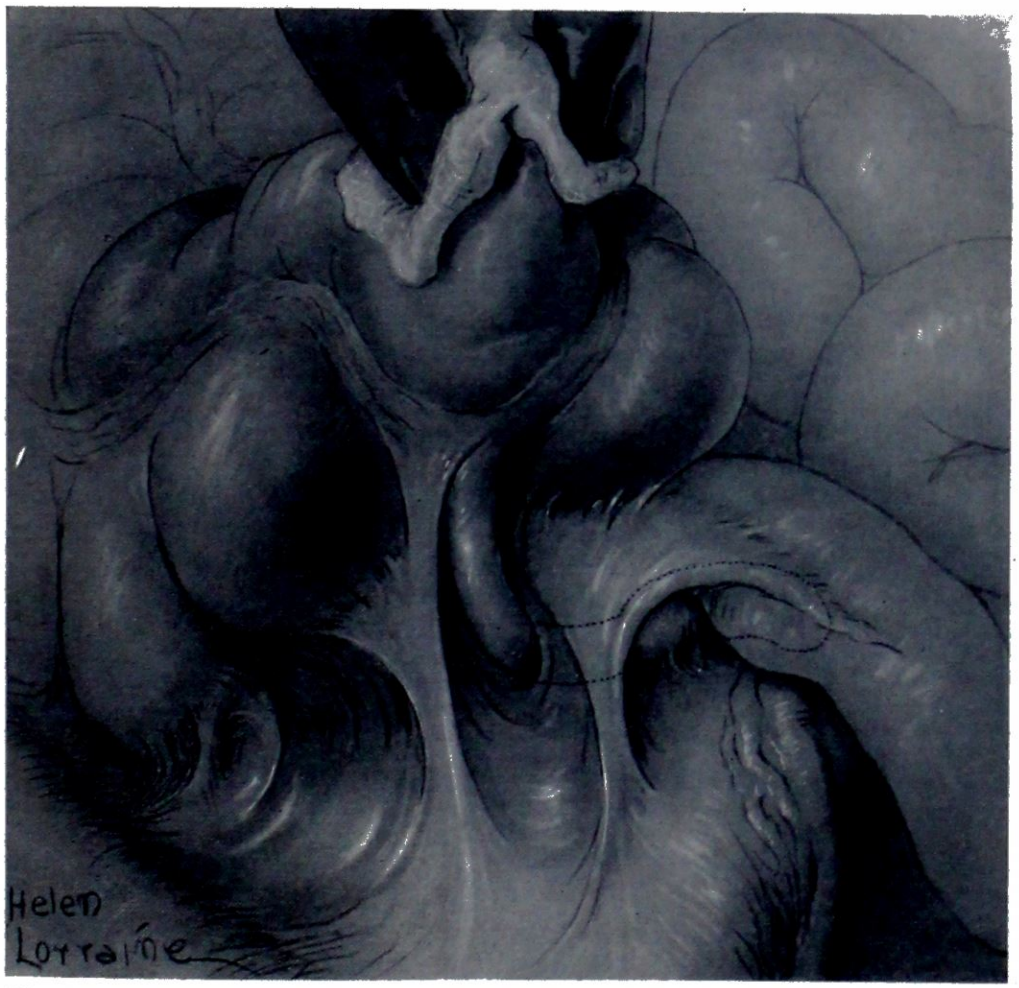

Fig. 331.—In cases of ureteritis secondary to appendicitis the appendix is nearly always retrocæcal. In this case the inflamed terminal portion of the appendix is adherent to the ureter.

infrequently the consultant aids and abets him in treating the patient for "pyelitis". In no less than 80 per cent of cases falling into this group, the inflamed appendix occupies a retrocæcal position.

Directly connected with this outstanding example of misleading symptomatology is the anatomical variation where an inflamed appendix is resting upon, or becomes attached to, the urinary bladder (*Fig.* 332). It will be readily appreciated that in such circumstances the symptoms produced are wont to be predominantly urinary, although in this instance hæmaturia is usually late and rare. So it comes about that numbers of unfortunate individuals suffering from acute appendicitis presenting symptoms which direct attention to the urinary organs are denied the benefits of early appendicectomy.

Paradoxically, because a stone in the ureter often fails to produce either hæmaturia or increased frequency, but only colic, numbers of patients harbouring a stone in the right ureter bear the scar of a recent appendicectomy, a branding that affords urologists an opportunity to point a finger of scorn at the general surgeon. Be that as it may, there is no gainsaying that it is better for nine appendices to be removed for stones in the ureter than for one patient with early gangrenous appendicitis to be treated as for renal colic. On the other hand, if radiological facilities are available it is not difficult to avoid most of these unnecessary appendicectomies.

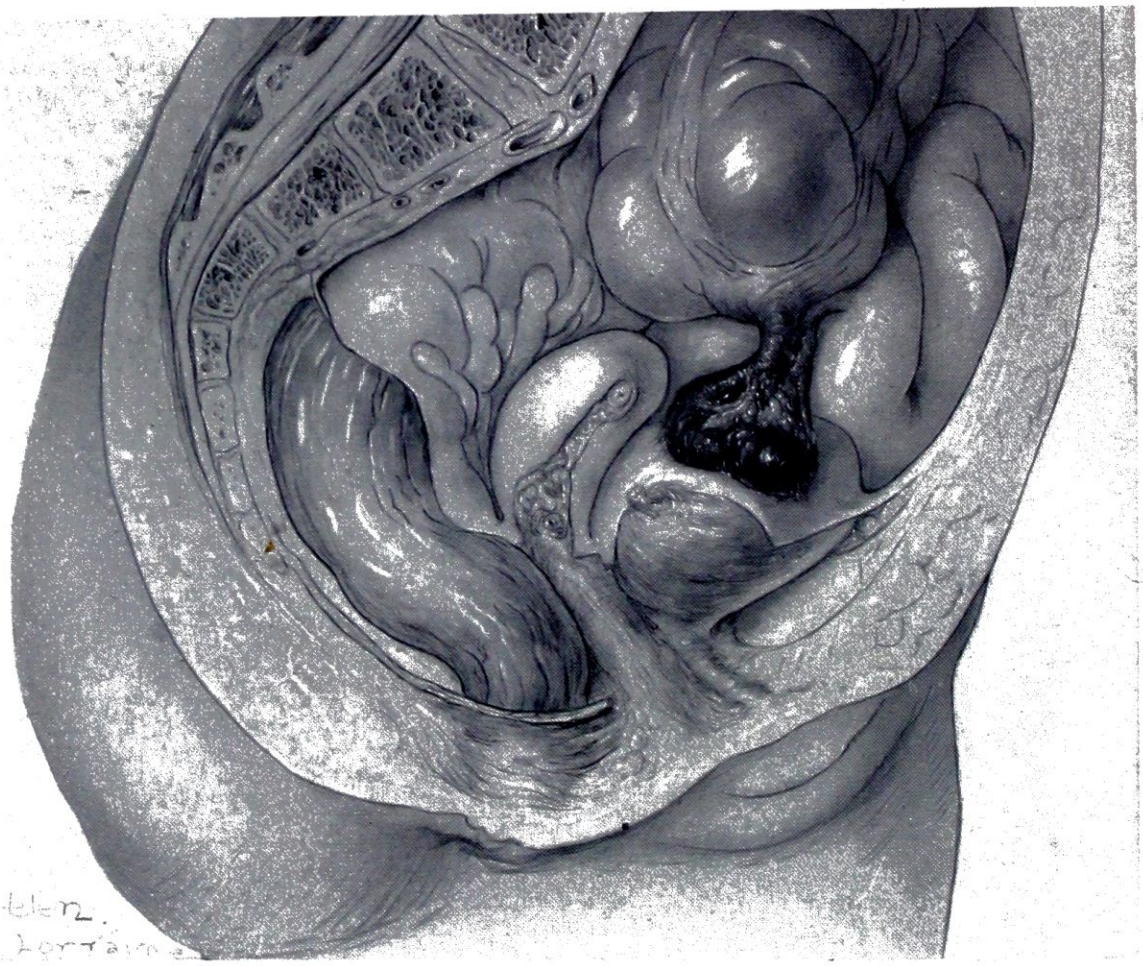

Fig. 332.—An inflamed appendix in contact with the bladder may produce symptoms predominantly urinary.

Urgent Excretory Pyelography.—Helge Wulff collected from the records of the surgical division of the University of Lund, Sweden, nearly 500 examples of acute right-sided abdominal pain where the symptoms were mainly urinary. Every patient in the series was subjected to urgent excretory pyelography. Those whose right kidney and ureter could be visualized normally were hurried to the operating theatre. No less than 59 of these patients were found at operation to have a gangrenous appendix lying near the right ureter. As a result of this study, Wulff comes to the following, most important practical conclusion :—*If the differentiation between early acute appendicitis and renal colic is at stake, urgent excretory pyelography should be undertaken. When the pyelogram shows a normal outline, appendicectomy should be performed forthwith.* To emphasize the value of this dictum, he quotes the following instructive case :—

A man, aged 60, seven years previously had had an attack of right-sided abdominal pain, which proved to be due to a ureteric calculus. A calculus the size of a hemp seed was passed. The present attack commenced at 10 p.m., and one hour later he was found to be rigid and tender on the right side of the abdomen. The pulse and temperature were normal. The urine was tinged red, and microscopical examination showed many red corpuscles. Excretory pyelography revealed that both kidneys and ureters were functioning normally. Urgent appendicectomy was undertaken. The appendix was completely gangrenous and unperforated.

In a number of instances where I could not make up my mind as to whether a patient was suffering from renal colic or early acute appendicitis, I have performed urgent cystoscopy and, when facilities existed, have invoked the aid of radiology as well. With a catheterizing cystoscope alone one can often prove that the patient is suffering from a lesion of the right ureter. On several occasions after a ureteric catheter has been passed up the right ureter, a brisk dripping of limpid urine through the lumen of the catheter has resulted in immediate amelioration of symptoms.

Management and Treatment of Renal Colic.—*See* Chapter LI.

TORSION OF AN APPENDIX EPIPLOICA

There are about 100 appendices epiploicæ in the average adult, and they are most conspicuous on the transverse and sigmoid segments of the colon. It is more than probable that some of those cases where the abdomen is opened and one is astounded to

Fig. 333.—Torsion of an appendix epiploica.

find no obvious lesion to account for the symptoms, are examples of torsion of an appendix epiploica (*Fig.* 333): if it were possible to scrutinize the whole of the large intestine the lesion would be revealed more often.

Clinical Features.—The condition can occur at any age, the maximum incidence being in the third and fourth decades. Without exception, an acute attack commences suddenly with severe, sometimes colicky pain. Although the pain is often experienced in the umbilical region, it varies with the site of the affected appendix epiploica (*Fig.* 334). Nausea and vomiting are unusual. Most cases are referred to the surgeon comparatively late, the average duration of the symptoms being 3·3 days (Murdie). Leucocytosis was present in 23 out of 32 cases where this investigation was carried out.

Treatment.—The twisted base is transfixed and ligated, and the appendix epiploica snipped off with scissors. Care should be taken to apply the ligature a little way from the colon, as a diverticulum is sometimes present in relation to the base of an appendix epiploica. After excision of the diverticulum the base should be invaginated by a purse-string suture.

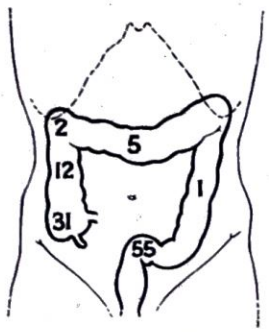

Fig. 334.—Sites of a twisted appendix epiploica from 106 cases collected from the literature. (*After W. Murdie.*)

Reflecting on this condition, it is certain that Nature would in all probability deal effectively with all cases. The gangrenous appendage (the gangrene is abacterial or virtually so) would drop off and form a small loose body in the peritoneal cavity. The insuperable difficulty is that we can never hope to diagnose this condition, even tentatively; we can only bear it in mind.

TORSION OF THE GREATER OMENTUM

In 80 per cent of cases the condition is mistaken for appendicitis with unusual symptoms; in women the alternative diagnosis is usually a twisted ovarian cyst. That the torsion usually presents in the right iliac fossa is explained by the fact that the right side of the greater omentum is larger and more mobile. The twisted omentum, depleted of its blood-supply, may become gangrenous (*Fig.* 335) and give rise to peritonitis.

F. W., aged 28, gave a history of five days' general abdominal pain. Twenty-four hours before admission he gave up work and went to bed. He had not vomited, and there was no history of a previous attack. The pulse and temperature were normal. On examination, he pointed to the right iliac fossa as the site of the most acute pain. There was considerable general abdominal tenderness, but no rigidity. An ill-defined lump could be palpated in the right iliac fossa. A diagnosis of unperforated appendicitis was made.

Under the anæsthetic the lump could be clearly demonstrated, and was movable. It was thought that it was probably an acute appendix wrapped in omentum. The abdomen was opened by a rectus-splitting incision and a small quantity of blood-stained fluid escaped. The lump was found to be a piece of greater omentum about the size of a tangerine orange, the neck of which was pedunculated and obviously twisted. On being excised the mass was found to be quite gangrenous. No other abnormality was found. The appendix was removed, and appeared quite normal. Recovery ensued.

Fig. 335.—Torsion of the great omentum. (*W. Etherington-Wilson, 'British Journal of Surgery'.*)

An important point to be remembered is that torsion of the greater omentum is one of the causes of blood-stained fluid in the peritoneal cavity. Untwisting may be attempted, but it is usually impossible. In any case, the base of the twisted mass should be ligated securely, and the mass excised.

PRIMARY IDIOPATHIC SEGMENTAL INFARCTION OF THE GREATER OMENTUM

The colour changes, viz., an intense red in early cases and blue-black in cases of some standing, are the same as those of torsion of the greater omentum, but there is no twisting to account for it. It should be noted, however, that infarction occurs in an area of the greater omentum where torsion is unlikely. The area affected is more or less wedge-shaped at the free edge of the greater omentum. As in torsion of the greater omentum, there is often blood-stained fluid in the peritoneal cavity. The affected area should be excised. Seeing that practically all cases of both torsion as well as infarction of the

greater omentum are diagnosed as acute appendicitis, when the appendix is found to be blameless and there is blood-stained fluid in the peritoneal cavity, in the absence of an obvious lesion the greater omentum should always be scrutinized.

ACUTE NON-SPECIFIC MESENTERIC LYMPHADENITIS

There is a distinctly higher incidence of acute mesenteric adenitis during the months in which infections of the upper respiratory tract are prevalent.

The patient is most often a male between the ages of 3 and 10 years, but the condition sometimes occurs in adolescents and adults. The attacks are usually recurrent. There are spasms of severe general abdominal colic with intervals of complete freedom—complete freedom from pain never occurs in appendicular colic. This should lead one

Fig. 336.—Acute non-specific mesenteric lymphadenitis. (*After A. P. Bell.*)

to suspect the condition. Nausea and sometimes vomiting accompany the attack. The temperature is raised, and there is a leucocytosis of 15,000 cu. mm. or more on the first day of the attack, but this falls on the second day. The initial reading is higher and falls more rapidly than in acute appendicitis. The point of maximum tenderness is higher and more medial than is usual in acute appendicitis. The most valuable differentiating sign is shifting tenderness. After lying the patient on the left side for a few minutes, the site of maximum tenderness referred to changes to the level of the umbilicus, or to the left of that point. Sometimes the condition is mildly epidemic, and is preceded by upper respiratory infection.

Many times I have removed the appendix to discover it was doubtfully diseased or healthy, and the mesenteric lymph-nodes were enlarged (*Fig.* 336). On a few occasions I have suspected non-specific mesenteric lymphadenitis, and have displayed an acutely inflamed appendix. The diagnosis of acute mesenteric lymphadenitis may be made before operation, but it is dangerous to be so sure of the diagnosis as to withhold operation (Postlethwait and Campbell).

Summarizing: Unless early acute appendicitis can be ruled out definitely, it is far better to operate.

See also SUPPURATING MESENTERIC LYMPH-NODES (p. 206).

ACUTE PHLEGMONOUS CÆCITIS AND COLITIS

Acute phlegmonous inflammation, well recognized in the case of the stomach (*see* p. 302), can also attack the duodenum, the small intestine, and the large intestine. When the large intestine is the seat of this rare condition it is the cæcum, or the ascending colon, that is usually affected. A normal appendix is found in all cases, except when the appendix has become inflamed by contiguity.

Acute phlegmonous cæcitis (or colitis) can be circumscribed (*Fig.* 337) or diffuse. The lesion commences as a cellulitis of the submucosa.

Diagnosis.—Most cases of acute phlegmonous cæcitis have been diagnosed as either acute appendicitis or as an appendix abscess. A mass appears in the right iliac fossa early, even during the first 48 hours.

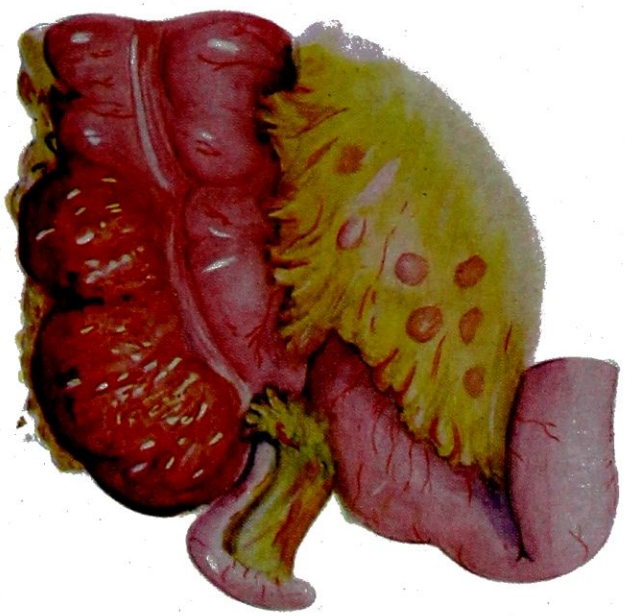

Fig. 337.—Acute circumscribed phlegmonous cæcitis (*R. E. B. Tagart*). (*By kind permission of the ' British Journal of Surgery '.*)

Treatment.—If circumscribed phlegmonous cæcitis or colitis without gangrene or perforation is found at laparotomy, removal of the lesion is unjustifiable. After suturing a free omental graft over the area of inflammation, closure of the abdomen with corrugated rubber drainage, followed by antibiotic therapy, is the correct treatment. In cases where perforation appears imminent, local excision, preferably by diathermy, and closure of the defect in layers, ileocolostomy or exteriorization of the affected portion can be undertaken as circumstances dictate. It goes without saying that full antibiotic therapy must be instituted.

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CHAPTER XXVI

EMERGENCIES CONNECTED WITH MECKEL'S AND OTHER DIVERTICULA OF THE SMALL INTESTINE

As is well known, Meckel's diverticulum is present in 2 per cent of the human race, it is situated upon the antimesenteric border of the small intestine 2 ft. (60 cm.) from the ileo-cæcal valve, and is usually 2 in. (5 cm.) long. What is not so well known is that the diverticulum, unlike acquired diverticula of the colon, is composed of the same three layers that make up the ileum, but in 20 per cent of cases the innermost layer contains heterotopic epithelium. This takes the form of gastric, duodenal, jejunal, or colonic epithelium, or pancreatic tissue. The most common variety of heterotopic tissue is gastric mucosa, and it occurs in 16·6 per cent of all cases; the presence of aberrant gastric glands capable of pouring forth acid and pepsin under the same hormonic control as the stomach is responsible for peptic ulceration in or adjacent to the diverticulum. When present, heterotopic tissue usually lines the greater part of the diverticulum, often involving the neck of the pouch and not infrequently extending into the nearby ileum, also. Peptic ulcers that give rise to hæmorrhage (and also those that perforate) are situated most frequently in the neck of the diverticulum (*Fig.* 338).

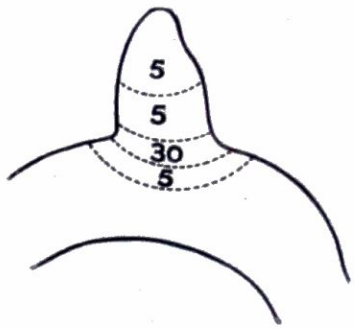

Fig. 338.—The location of the lesion in 45 cases of peptic ulceration occurring in Meckel's diverticula. (*After D. B. Cobb.*)

Statistics indicate that males possessing a Meckel's diverticulum outnumber females in the ratio of 3 : 1. Infrequently Meckel's diverticulum possesses a mesodiverticulum. In nearly 90 per cent of cases the diverticulum arises on the antimesenteric border; in the remainder it is situated near the mesenteric border. Exceptionally the diverticulum is intramesenteric and requires transillumination to reveal it.

When a silent Meckel's diverticulum is encountered in the course of an abdominal operation, provided the diverticulum can be excised without appreciable additional risk, this should be done. The wisdom of this advice has been confirmed by the frequency and severity of the complications that are liable to ensue in connexion with this anomalous structure.

The diverticulum may remain symptomless throughout life, and is found at necropsy. In a case of Meckel's diverticulum giving rise to symptoms, failure to visualize a diverticulum by radiography after a barium meal is of no significance, because so often the entrance of the diverticulum is blocked by œdema.

MECKEL'S DIVERTICULUM CAUSING URGENT SYMPTOMS

In an analyais of 1605 cases of Meckel's diverticulum collected from the literature, Moses found the acute disorders connected with the diverticulum were as follows:—

Intestinal hæmorrhage	496 (30·9 per cent)
Intestinal obstruction	383 (23·8 per cent)
Diverticulitis	165 (10·3 per cent)

The complications of Meckel's diverticulum in childhood have been stressed by many writers. While such studies are valuable, the importance of these complications in adults has been overshadowed by these communications. In a series of 16 cases occurring at the Central Middlesex Hospital, two-thirds occurred in patients between the ages of 21 and 63. Large series of cases show that while symptoms may become manifest at any age, they do so more frequently during the first, second, and third decades.

Serious Hæmorrhage per rectum from a Meckel's diverticulum (due to peptic ulceration) occurs most frequently between the ages of 10 and 15 years, but it is not uncommon in adults. Observing that the characteristic blood passed per rectum is dark red in colour

—intermediate between the tarry stool of melæna from a bleeding duodenal ulcer and the bright red hæmorrhage from a lesion of the colon—provided the patient is a child or a youth, it is not difficult to strongly suspect a Meckel's diverticulum as the site of the hæmorrhage. In infants, the hæmorrhage is first likely to be attributed to an intussusception, but the absence of a lump in the abdomen and the fact that there is no mucus admixed with the blood should direct the clinician's thoughts to a Meckel's diverticulum. In adults it is much more difficult to even suspect Meckel's diverticulum as the source of the hæmorrhage. A feature of value in differential diagnosis is that if vomiting occurs, which is not unusual, the vomit contains no blood.

Hæmorrhage, penetration, or perforation of a peptic ulcer connected with a Meckel's diverticulum may be, or, more usually, is not, preceded by pain. When pain does occur it is commonly periumbilical colic, and is due to distension of the diverticulum and juxta-ileum by fluid blood or clots. Sometimes bleeding precedes perforation.

When operative treatment is required for uncontrollable melæna, and at laparotomy there is no visible or palpable lesion in the stomach or the duodenum, before proceeding further it is an excellent practice to examine the last 2 ft. of the ileum for a Meckel's diverticulum. When a Meckel's diverticulum is the source of the bleeding, the terminal ileum and the large intestine can be seen filled with blood, whereas in the rest of the small intestine blood is absent.

Diverticulitis with or without Perforation.—Meckel's diverticulum is liable to become inflamed (*Fig.* 339), when it gives rise to symptoms and many of the signs similar to those of appendicitis. It is impossible to distinguish between these two conditions, except in the rare event of the patient having undergone appendicectomy previously. Even so, probably a diagnosis of perforated duodenal ulcer will be made. When perforation of a Meckel's diverticulum (*Fig.* 340) occurs, diffuse peritonitis follows quickly, and is more lethal than that occurring with perforated appendicitis, owing to the fact that the diverticulum is placed more centrally and there are fewer anatomical barriers to the rapid extravasation of liquid fæces. An important precipitating factor in the development of acute inflammation is the accumulation in the pouch of coarse intestinal residue, or lodgement of a foreign body. In several cases of peritonitis (usually diffuse) the diverticulum has been found perforated by a fish-bone. In Lindquist's case the perforation was due to a sharp piece of wood.

Fig. 339.—Acute Meckelian diverticulitis.

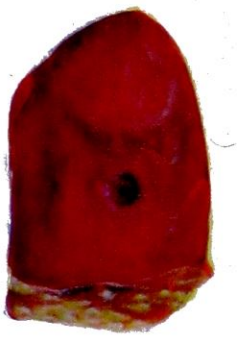

Fig. 340.—Excised Meckel's diverticulum showing a perforation. (*J. T. Chesterman*, '*British Journal of Surgery*'.)

Meckel's Diverticulum as a Cause of Intestinal Obstruction.—*See* p. 429.

MECKELIAN DIVERTICULECTOMY

A Meckel's diverticulum should not be amputated and its base invaginated in the same way as an appendix, because often this is a cause of considerable narrowing of the intestine. For routine excision the following technique is satisfactory. In the unusual event of a mesodiverticulum being present this is divided between hæmostats near its mesenteric attachment, and ligated. Two Kocher's clamps are placed obliquely across the base of the diverticulum, as shown in *Fig.* 341, and the diverticulum is excised by cutting between the clamps (*Fig.* 342), preferably with a diathermy needle. For closure it is sufficient to employ a single row of closely-placed mattress sutures of thread[1] (*Fig.* 343). The obliquity of the line of suture (*Fig.* 344) prevents narrowing of the intestine. It is a wise precaution to cover the area with a free omental graft, more especially to minimize subsequent adhesions.

[1] Ferments from islets of ectopic pancreatic tissue have been known to digest catgut sutures.

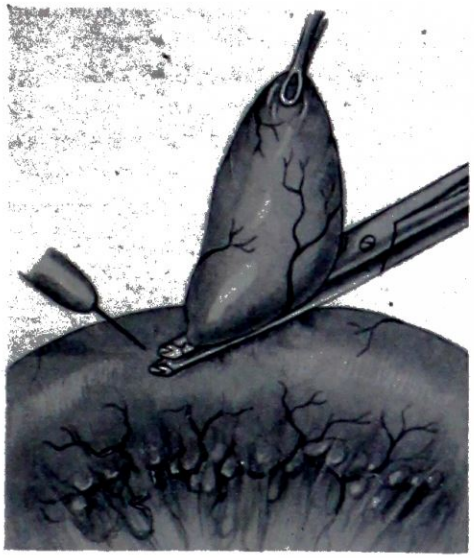

Fig. 341.—The diverticulum is excised, preferably with a diathermy needle as shown. Note the obliquity of the clamps in relation to the long axis of the intestine.

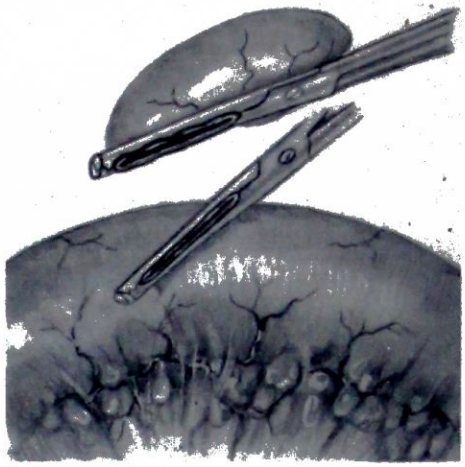

Fig. 342.—The diverticulum excised.

Fig. 343.—Mattress sutures are inserted over the clamp. This method constitutes aseptic resection.

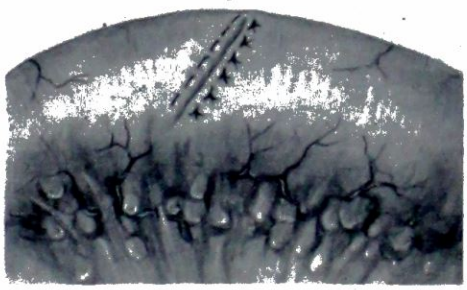

Fig. 344.—Oblique resection, and suture in this manner does not narrow the lumen of the intestine.

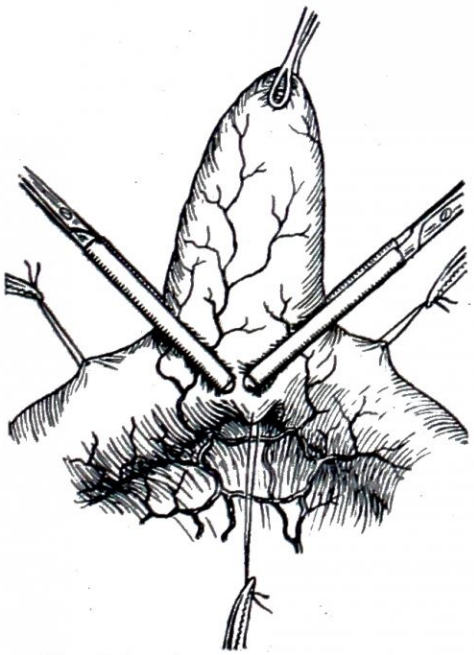

Fig. 345.—Wedge resection of a Meckel's diverticulum.

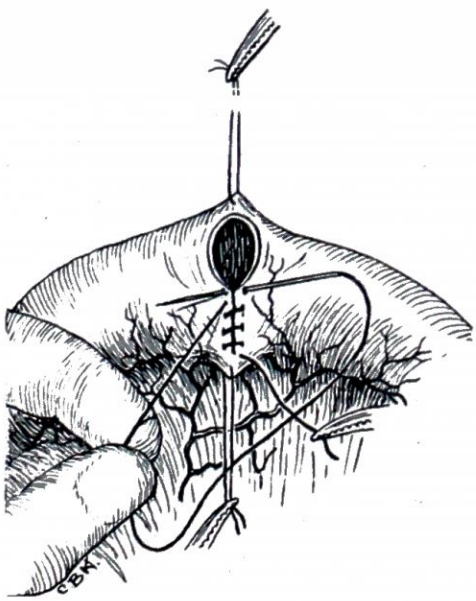

Fig. 346.— Repair of same.

A diverticulum with an indurated or perforated base more than probably contains œdematous gastric or pancreatic epithelium, and diverticulectomy by the method described becomes inapplicable. In such cases a wedge resection with appropriate repair, as shown in *Figs.* 345, 346, usually suits the case.

When the amount of induration around the base is considerable, and particularly when it extends into the neighbouring ileum, it is advisable to resect a short segment of the ileum containing the diverticulum, and to restore the continuity of the bowel by end-to-end anastomosis, or by the method of Poth (*see* p. 406).

OTHER DIVERTICULA OF THE SMALL INTESTINE

Diverticula of other parts of the small intestine, especially of the upper jejunum, can also give rise to severe hæmatemesis and melæna, and on occasions one of these diverticula

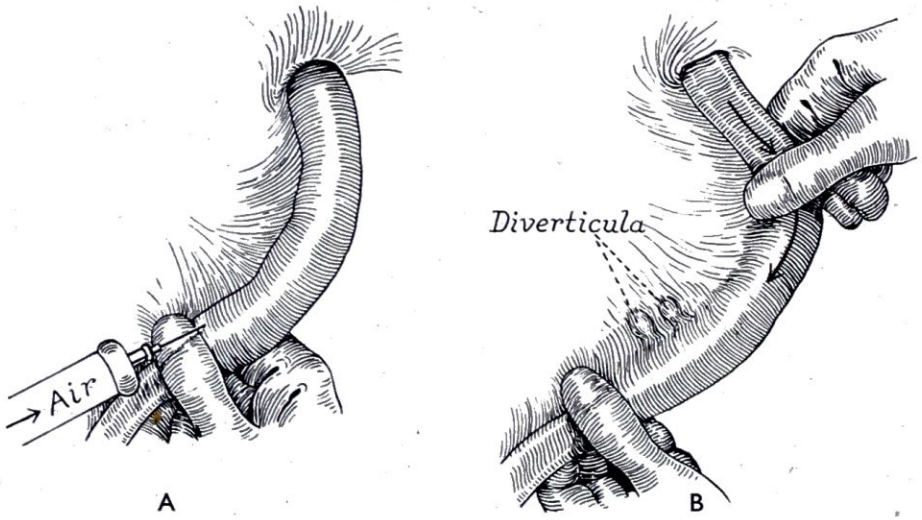

Fig. 347.—A, Air is injected into the jejunum by a syringe and needle. B, With the jejunum occluded by compression distal to the diverticula, stripping is conducted as shown in order to distend the diverticula with air. (*After C. W. Mayo et al.*)

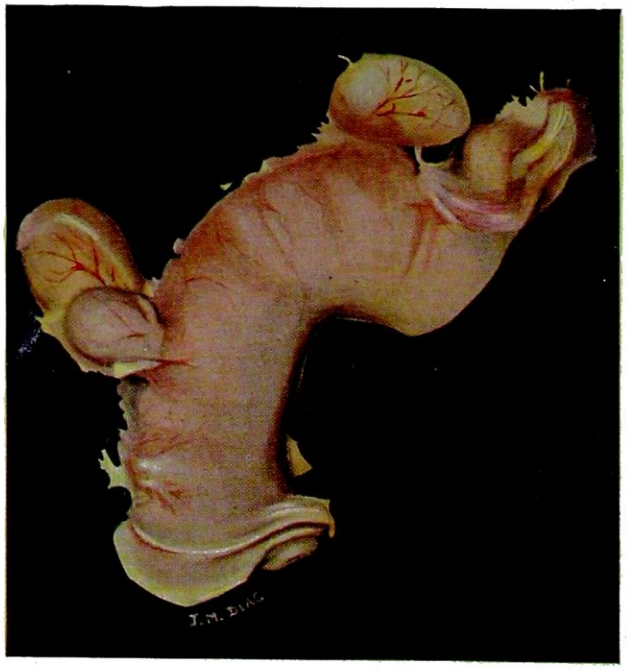

Fig. 348.—Hæmorrhage from jejunal diverticula ; resected specimen. (*I. M. Orr and J. Y. W. Russell.*)

perforates. A bleeding jejunal diverticulum is sometimes situated on the mesenteric border of the intestine, and is difficult to find, even after radiological confirmation of its presence. In order to demonstrate such diverticula at operation, C. W. Mayo advises

inflation of the jejunum with air by means of an aspirating syringe (*Fig.* 347 A), and by milking the air into various parts of the jejunum, diverticula, if present, are displayed by becoming ballooned (*Fig.* 347 B). Resection of that segment bearing the diverticulum (*Fig.* 348) is the only satisfactory method of treating a bleeding jejunal diverticulum.

A perforated jejunal diverticulum is nearly always situated on the antimesenteric border of the intestine. The best treatment is excision of the diverticulum.

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CHAPTER XXVII

PERFORATED GASTRIC AND DUODENAL ULCER

Perforation of a gastric or duodenal ulcer is one of the most serious and most overwhelming catastrophes that can befall a human being.—LORD MOYNIHAN.

First-aid Treatment.—To administer morphine to a patient with undiagnosed abdominal pain before sending him to hospital is a pernicious practice still too much in evidence.

If a perforated peptic ulcer is even suspected, why not pass a gastric aspiration tube and empty the stomach forthwith? Keep the tube in place, and, particularly if the patient has a long ambulance journey before him, have the stomach emptied at intervals. As the majority of peptic perforations are on the right of the middle line the patient should be encouraged to lie on his *left* side; this will minimize the escape of fluid into the peritoneal cavity. Common sense dictates that these easily applied measures must minimize leakage, and thereby delay and localize peritonitis. Gastric aspiration for the prevention of unbridled outpouring from a gastric or duodenal perforation should become a first-aid ingrained principle in the management of these cases by the whole profession.

The Inestimable Value of Early Diagnosis.—There is no intra-abdominal catastrophe where a successful outcome is more dependent upon early diagnosis and prompt transportation (*Fig.* 349). Especially in the great urban districts, the improvement during the past twenty years in both these desiderata has been noteworthy, but there is still room for general improvement in earlier diagnosis, particularly among female patients and elderly men (the catastrophe is very rare in elderly women). Because of the comparative rarity of perforated peptic ulcer in women, general practitioners are liable to attribute the symptoms and signs to other conditions, notably gall-stone colic, and having arrived at the latter diagnosis, to administer morphine.

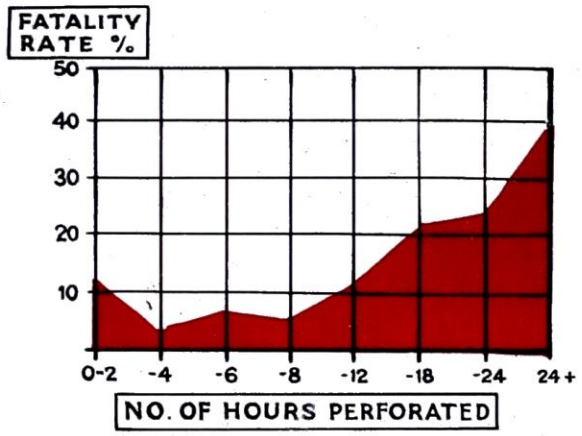

Fig. 349.—Deaths by delay in operation. (*After R. A. Jamieson.*)

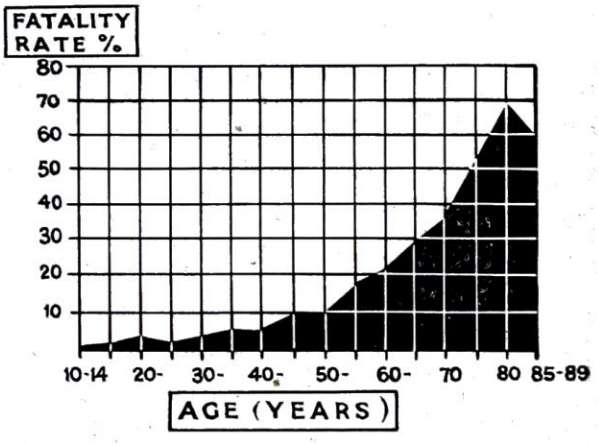

Fig. 350.—Fatality rate for perforated peptic ulcer (1944–53). (*After R. A. Jamieson.*)

Age and Sex. In assessing methods of treating perforated peptic ulcers and also the published mortality figures relating thereto, it is important to take into consideration the type of individual who is stricken with this catastrophe. The sex and average age of the victim vary enormously not only from decade to decade, but geographically. Prior to about 1912 the majority of patients were women; reports that as many as 70 per cent of the patients were females were not uncommon in individual series. By 1920 it was rare for more than 2 per cent of any series of cases to be females. The great preponderance of males remains a notable feature of perforated peptic ulcer, but this preponderance is less than it was a decade ago. During 1924–43 the ratio was 19 males to 1 female; during 1944–53 the ratio was reduced to 12 males to 1 female (Jamieson). The practical outcome of this assessment should be that a sharper look-out be kept for cases of a peptic perforation in females.

The country, and even the district, in which the surgeon practises makes a difference as to the type of individual he will be called upon to treat, and also the number of hours which will have elapsed before the patient reaches the hospital. Regarding the former factor, the observations made in 1933 by A. M. Graves are pertinent. He wrote : " The perforated peptic ulcer patient in Germany differs from the one often pictured by American authors. He is usually a strong, well-nourished individual who eats an excessive amount of coarse foods, drinks a considerable volume of fluids, and works hard. Sixty per cent of perforations occur in labourers."

While it is obvious that with advancing years the recovery rate from any major disaster will be correspondingly lower (*Fig.* 350), it is not appreciated sufficiently that perforated peptic ulcer is a condition that can, and does, occur in sexagenarians, septuagenarians, and octogenarians. Elderly male patients, like women in the prime of life, with peptic perforations are too often sent to hospital late—and for the same reason.

As is emphasized in several chapters of this work, one should never ' throw in the sponge ' on account of old age. Perforated peptic ulcer is no exception to this aphorism. Successful closure of a perforated peptic ulcer has been performed in patients aged 82 (Sandell) and 81 (Norris). My oldest patients with this condition who survived were 79 and 76 respectively, while Tanner has had five recoveries between the ages of 77 and 79. Coming to the other extremity of life, perforated peptic ulcer occurs occasionally in children, and even in the newborn.

Peritoneal Cultures following Perforation.—A higher incidence of positive cultures is obtained by collecting some of the peritoneal fluid for implantation in the culture medium than when a swab dipped in the exudate is submitted. For the first 10 hours cultures are often sterile because of the bacteriostatic effect of hydrochloric acid from the stomach ; the peritonitis at this time, although often intense, is a chemical peritonitis. After 12 hours inhibition due to the acid is no longer present, and staphylococci, streptococci, and colon bacilli are then often encountered, the first two being found most frequently.

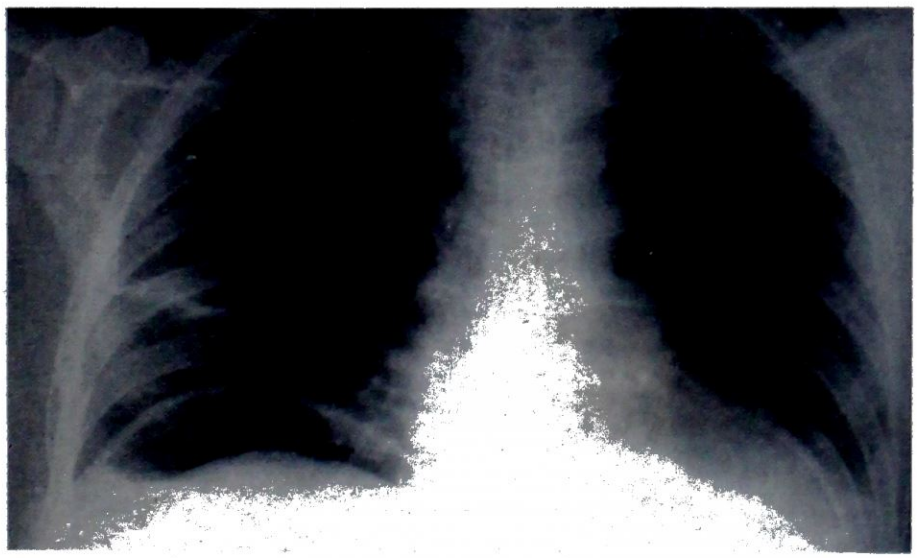

Fig. 351.—Crescentic gas-shadow beneath the right cupola of the diaphragm. Perforated duodenal ulcer, seven hours' duration. (*The London Hospital Radiological Department.*)

Radiography.—A plain radiograph that reveals a crescentic translucent area beneath the right cupola of the diaphragm (*Fig.* 351) confirms the diagnosis of perforated peptic ulcer, and is extremely valuable in atypical cases. Radiographs should be taken as early as possible after the perforation, because small amounts of air are absorbed rapidly. The left lateral decubitus gives the highest percentage of positive results, but films in the erect position should be taken also. However, the time expended and the manipulations involved are unwarranted except when the diagnosis is in doubt (coronary thrombosis, pneumonia, and acute pancreatitis can all, on occasions, simulate a perforated peptic ulcer), or in the event of non-operative treatment being advised. In about 70 per cent of cases of perforated peptic ulcer air can be demonstrated beneath the diaphragm, whereas negative findings accrue in at least 20 per cent ; the remainder are indefinite. In cases of real

clinical doubt, for instance when the patient has been given morphine, after the gastric contents have been aspirated 20–30 ml. of air can be injected into the stomach. The patient lies on his left side for a few minutes, and then a radiograph is taken in the sitting posture. In these circumstances if a perforation is present the crescentic translucent area referred to will be seen in a very high percentage of cases.

Operation has been decided upon.—Once the diagnosis has been settled by the surgeon who is about to operate, morphine can be administered, but written permission for operation should be obtained before this drug is given. The relief morphine affords may be followed by refusal or delay of the patient to submit to treatment. Morphine helps in several ways. It saves the patient at least twenty minutes' agony ; it allows the abdomen to be shaved and prepared before the anæsthetic ; above all, it means less anæsthetic and more relaxation, important factors when dealing with muscular men.

LOCAL INFILTRATION OF PROCAINE SOLUTION COMBINED WITH INTRAVENOUS THIOPENTONE

For suture of a perforated peptic ulcer, this form of combined anæsthesia is unexcelled, and is followed by a very low incidence of pulmonary complications. It is of cardinal importance to avoid an inhalation anæsthetic in unselected examples of this catastrophe.

Although the procedure is absolutely simple, and, if carried out in the manner about to be detailed, it is safe, experience shows that there are a surprising number of possible errors and misunderstandings, many of which may spell disaster. Among these mistakes are : injecting the thiopentone solution into the rubber tubing near the interceptor as opposed to near the vein ; injecting the thiopentone, and then turning on the saline (which was dripping slowly) to a faster rate ; all eyes focused on the operation or the patient's face, the receptacle containing the saline solution has been allowed to run dry ; preparing two 1-G. doses of thiopentone (larger ampoules) instead of two ½-G. doses.

Technique.—

In the Ward.—The stomach is emptied with a gastric aspiration tube, which is left in place. The patient is given a suitable dose of morphine, and his eyes are blindfolded securely. He is transported to the operating theatre.

In the Operating Theatre.—Intravenous fluid therapy (usually dextrose-saline) is commenced, continued throughout the operation and as long afterwards as is deemed necessary.

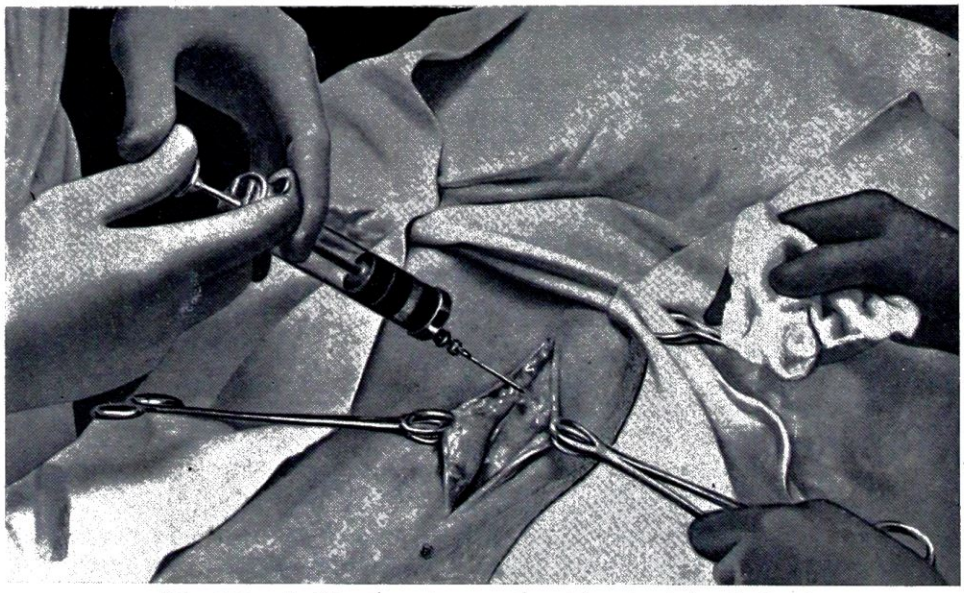

Fig. 352.—Infiltrating the muscle with procaine solution.

Haste is unnecessary : Once the fluid is dripping into the circulation, unless he is moribund, the patient's general condition commences to improve rather than to deteriorate. If necessary, he can receive a pint of plasma before the introduction of the intravenous dextrose-saline solution ; indeed, until the patient has an adequate blood-pressure (at least a systolic pressure of 110 mm. Hg) the operation should not be commenced. The abdomen

can be shaved and prepared more conveniently than if he were in bed. The theatre staff preparing for the operation should be instructed to carry out their duties quietly, and told that as there is no undue haste, there is no excuse for clattering instruments.

Preparing the thiopentone solution: The anæsthetist takes two ½-G. ampoules of thiopentone and two corresponding ampoules of sterile water. Providing himself with two 10-ml. syringes, he proceeds to fill each, and thus has two 10-ml. doses of a 5 per cent solution of thiopentone in readiness.

Having made the necessary preparation and having ascertained that the patient's condition is satisfactory and that the gastric aspiration commenced in the ward is proceeding smoothly, what may be termed the operation proper can be commenced.

Infiltration of the abdominal wall: The skin from the umbilicus to the xiphisternum is infiltrated with 1 per cent procaine. A midline incision is made in the skin. There is usually little or no bleeding. The skin edges are grasped in Lane's forceps. After a little undermining of the skin edges on either side, each rectus sheath is infiltrated with local anæsthetic thoroughly (*Fig.* 352).

Introducing thiopentone into the circulation (*Fig.* 353): The saline solution must be running at a rate of at least 50 drops a minute. The anæsthetist sterilizes the rubber tubing near the cannula and injects ½ G. of thiopentone into the lumen of the rubber tube in exactly the same way as it would be injected directly into a vein, i.e., very slowly 0·1 G. at a time. While the thiopentone is being injected a nurse sits on the anæsthetist's seat at the head of the table, encourages the patient, tells him to count loudly and has her hands in readiness to hold the jaw forward should this become necessary. When the injection has been completed the anæsthetist returns to the patient's head. Unconsciousness is sometimes delayed a little longer than in the case of a direct injection into the vein. Usually the respirations become somewhat shallow, and the patient tends to become cyanosed. In all cases the lower jaw must be held forward, and in many instances oxygen should be administered.

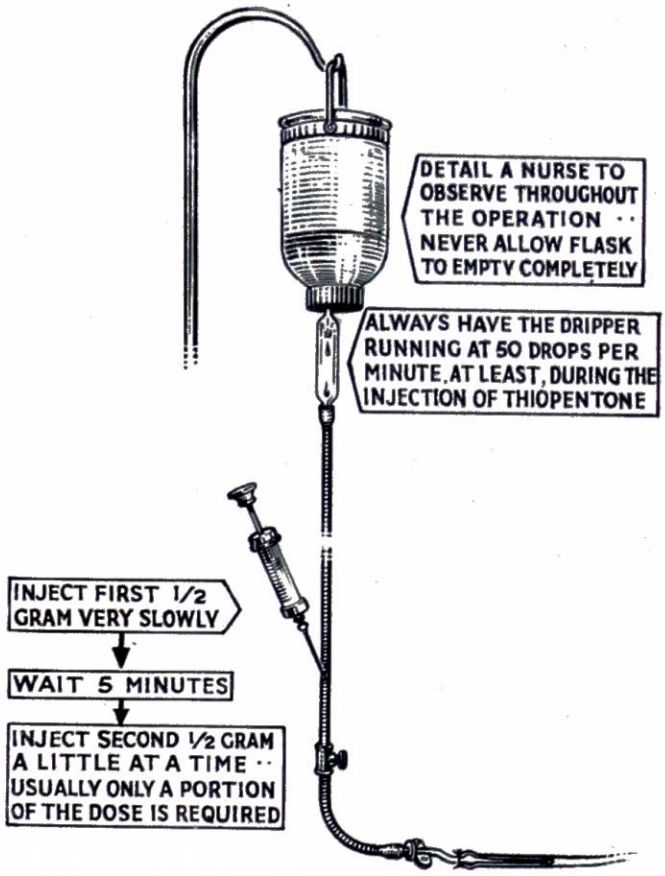

Fig. 353.—Symposium of essential details for supplementing local infiltration with intravenous anæsthesia.

We will assume that the patient has fallen asleep, that he is somewhat cyanosed, and that the anæsthetist is attending to him.

Opening the peritoneum: While the above has been proceeding, the surgeon has clipped towels to the wound edges, has completed the middle line incision, and has opened the peritoneum. Again, it is emphasized that there is absolutely no hurry. Time can be well spent sucking fluid from the peritoneal cavity. If all is well with the patient, the operation proceeds, and after a lapse of five minutes, a portion of the second ½ G. of thiopentone is injected according to the needs of the case. Usually, after a lapse of five minutes, the abdominal wall is well relaxed[1] and the patient's colour is a satisfactory pink. All that is necessary is to give just sufficient thiopentone in 0·1 G. doses to keep him asleep; the local anæsthetic is in full operation as far as the abdominal wall is concerned.

To illustrate what can be accomplished with this form of combined anæsthesia, I sutured successfully a perforated gastric ulcer in a patient at 2 a.m. in a small nursing home

[1] The administration of relaxants is not discussed, for it belongs to the province of anæsthesiology.

during an air raid. As, owing to the circumstances, no medical assistance could be obtained, a nurse injected the thiopentone under my instructions.

Plasma as the Vehicle.—In exceptional circumstances it may be advisable to carry out the operative procedure while the patient is having the plasma infusion. Under such circumstances it is necessary to speed up the flow of plasma while the thiopentone is being injected into the tubing. Consequently, it is advisable to fix a Higginson's syringe on to the inlet glass tube of the bottle of plasma or, better, to employ a Martin's pump (*see* p. 50). In this way plasma can be substituted for dextrose-saline solution and the rate of flow of plasma is so speeded up as to render it comparable to that of an electrolyte solution. Only in these circumstances can thiopentone be injected safely.

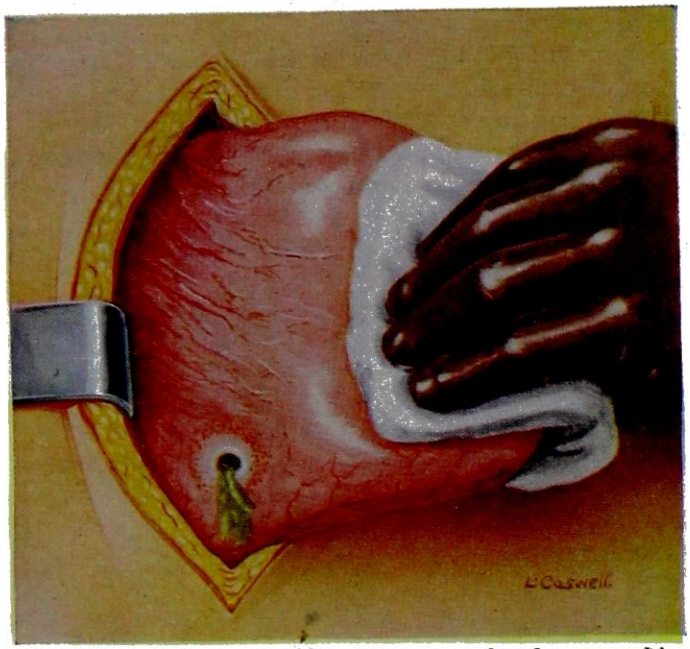

Fig. 354.—Method of holding the stomach when searching for and closing a perforated peptic ulcer.

Displaying the Perforation.—When the peritoneum is opened, the operator should listen intently; otherwise a muffled 'pop' of escaping gas may pass unnoticed: this phenomenon is present in under 10 per cent of cases.

Unless the perforation is a small one, fluid gushes forth with each expiration. When enough fluid has been mopped up (or sucked out) to enable its anterior surface to be seen clearly, the stomach near the greater curvature is grasped in the right hand with a moist abdominal pack (*Fig.* 354). The left hand contains another pack, and by wiping the stomach and duodenum the perforation is sought. Obviously it is best to commence looking for the perforation where fluid is welling up most plentifully. In this connexion a pitfall must be known. When the perforation has occurred into the lesser sac (i.e., the ulcer is on the posterior surface of the stomach) the fluid pours out of the foramen of Winslow; this makes one think that it is the anterior surface of the duodenum which has perforated. *In eight cases out of ten the perforation is located easily.*

Perforations high on the lesser curvature are certainly difficult of access, but if the midline incision recommended in this work has been employed, by extending the incision right up to the xiphisternum the perforation can usually be displayed adequately.

Methylene Blue for Quick Localization of the Perforation.—When the perforation is not found easily, if the anæsthetist injects 30–60 ml. of a 1 per cent solution of methylene blue down the gastric aspiration tube, the site of the perforation becomes readily apparent (*Fig.* 355). One per cent of methylene blue in normal saline which has been autoclaved should be kept in suitable quantities for this purpose in the operating theatre. The ready-for-use capsules of indigo-carmine used in chromocystoscopy also serve for this purpose.

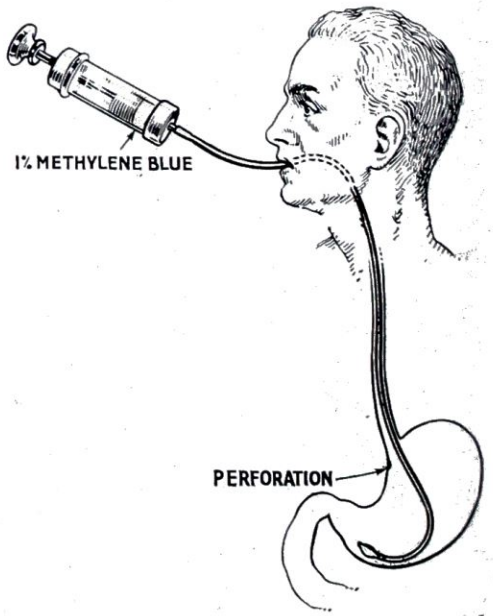

Fig. 355.—Methylene blue to aid quick localization of an elusive perforated peptic ulcer. (*After Jaffe.*)

The hole having been found, retraction of the abdominal wall and traction upon the stomach are so arranged as to bring the perforation into the best possible view. This position is maintained by the assistant. Further, to aid exposure, it is often advisable to insert an abdominal pack, in order to tuck away the transverse colon.

Closing the Perforation.—The best method of closing the perforation is to employ interrupted catgut sutures on a medium-sized curved, round-bodied needle. The first stitch is placed a little distance from the perforation. A considerable 'bite' of the stomach wall (*Fig.* 356) is taken with the stitch in order to prevent cutting out, which is prone to occur especially in œdematous tissues. This stitch is the key to the situation, and as soon as it has been tied and it has been ascertained that it will hold, the stitch can be employed as an efficient retractor. The next interrupted stitch is inserted in the same way and tied, and so on until the perforation has been closed. When the surgeon considers that sufficient stitches have been inserted, their long ends are cut short, except the first and the last. These are retained in order that the suture line may be examined; if it passes inspection and the condition of the patient is satisfactory, the suture line should be reinforced (*see below*).

Fig. 356.—Closing the perforation; the first stitch. Photograph of an actual case. The perforation is situated in the first part of the duodenum.

When, on inspecting the suture line, doubt is felt regarding its integrity, probe the suspicious area (*Fig.* 357) with a view to finding a crevice; an extra stitch may be deemed advisable.

Fig. 357.—A large perforated gastric ulcer has been sutured, and a Watson Cheyne dissector is being used to ascertain if the suture line is secure.

Reinforcing the Suture Line.—

1. *The gastro-hepatic omental flap.* When the perforation is situated near the upper border of the anterior surface of the first part of the duodenum (a very common situation) it is remarkable how often a suitable little flap of lesser omentum having an attachment to the upper border of the juxtapyloric portion of the duodenum is present. Seize the free border of this flap delicately, but firmly, in a hæmostat and draw it over the suture line. So frequently can it be made to cover the area of the perforation without tension that one is inclined to conjecture that Nature has provided material for patching a perforation just where it is required most often. When the flap cannot be drawn over the area without tension, a snip with scissors here and there in an avascular area near the base of the flap will frequently render it more mobile.

Having prepared the flap as required, and having spread it over the sutured perforation using, if necessary, another hæmostat (*Fig.* 358), the flap is stitched down with interrupted unabsorbable sutures so as to form a patch in the true meaning of the term (*Fig.* 358, inset).

2. *The free omental graft: patching the perforation.* Closure of an indurated perforated lesser-curve ulcer is sometimes unsatisfactory, for the sutures tend to cut out. It is in such a case that a free omental graft to reinforce the suture line is indicated. Spread the free edge of the greater omentum upon the towel covering the abdomen, and select a suitable portion. By cutting between hæmostats remove a piece about the size of four postage stamps. The technique of carrying this out neatly and expeditiously is to apply two long hæmostats close together, taking a large bite of the free edge of the omentum and, at a point an inch or one-and-a-half inches away, to repeat the procedure. With scissors the omentum is divided between each pair of hæmostats. The medial two are then lifted up, and the attached pedicle of omentum is grasped in the jaws of a fifth hæmostat (*Fig.* 359). The omental graft is cut free, and we have in our possession the piece of patching material grasped between two hæmostats as is shown in *Fig.* 360. The graft is wrapped in a moist pack while transfixion ligatures are applied to the stump of omentum grasped in each of the three attached hæmostats. The greater omentum requires secure ligation. The detached piece of omentum is ready for transfer, and if it is kept taut between the hæmostats they function as spreaders until the graft has been sutured into place. If the graft is not handled in this way, omentum tends to curl up, and bungling, with concomitant loss of time, will assuredly follow.

Fig. 358.—Reinforcing a sutured perforated duodenal ulcer with a tag of the gastro-hepatic omentum.

3. *Utilizing the falciform ligament: Fontana's method.* When the round ligament has been divided between hæmostats inferiorly, and the associated falciform ligament has been freed from its attachment to the abdominal wall (*Fig.* 361), both the stumps attached to the abdominal wall will require ligation, for they contain blood-vessels. There is now available a hinged, triangular (base downwards) piece of patching material possessing admirable qualities. It can be swung over to patch a sutured perforation in any part of the area shown in *Fig.* 361, inset. It is particularly valuable for reinforcing sutured perforations in the neighbourhood of the lesser curvature of the stomach, for so often friability in this area renders a perforation difficult to close securely.

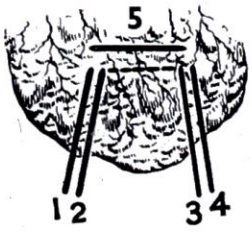

Fig. 359.—Showing the disposition of the five hæmostats. The graft is removed by cutting between Nos. 1 and 2, and between 3 and 4. Lifting up 2 and 3, No. 5 is applied, and finally the graft is freed by cutting along the dotted line.

Fig 360.—Free omental graft. Method of transferring the graft.

Looking for a Second Perforation.—It is worth while making a practice of looking for a second perforation; a few seconds will suffice. Several examples of simultaneous perforation of two ulcers have been reported, and I have seen at necropsy a case where one perforated ulcer had been closed satisfactorily and another perforation had been overlooked.

Removing Extravasated Fluid.—The advent of the mechanical sucker has helped in no small measure to improve the results of operations for perforated peptic ulcer, for it removes the fluid without disturbance and without abrasion of the peritoneal coat of the viscera. There are still many hospitals without a mechanical sucker, and suckers,

Fig. 361.—Fontana's method. Showing the round and falciform ligaments freed from their attachment inferiorly and laterally and ready to be utilized for patching a sutured perforated lesser curve ulcer. Inset shows the area of the stomach where Fontana's method is applicable.

especially electrical ones, are only too often out of order or away being repaired. For this reason an alternative method is given: employ *dry* abdominal packs to absorb such of the fluid that is accessible without disturbing the viscera, or disturbing them as little as possible. On no account 'cleanse' the peritoneal cavity with packs wrung out in warm saline solution. If this is done not only will the delicate peritoneal coat become abraded but infection will be distributed, particularly to the subdiaphragmatic region.

Drainage.—Except in cases of under 12 hours' duration without gross peritoneal contamination, I think it is wise to drain the peritoneal cavity. A suprapubic drainage tube can be placed easily by passing the left hand through the upper abdominal incision and inserting the tube as shown in *Figs.* 236, 237, p. 187.

Excellent results have been published where the abdomen has been closed without drainage, but nothing is gained by omitting to place a drainage tube in the rectovesical pouch. The argument in favour of drainage is that as we do not know what was in the stomach before the perforation occurred, it is advisable to drain the peritoneal cavity even in comparatively early cases, when the stomach was full at the time of the perforation.

I have seen at necropsy a case operated upon three hours after perforation where drainage had been omitted—death was due to peritonitis. On at least six occasions I have been called to see patients with a pelvic abscess where the perforation was closed without draining the peritoneal cavity; moreover perforated peptic ulcer is the commonest cause of subdiaphragmatic abscess.

Following the repair of a perforated peptic ulcer a drainage tube left in position for not more than 48 hours cannot do any harm, and is sometimes instrumental in saving the patient's life. For late cases of perforated duodenal ulcer a second tube in the musculature of the right flank, designed to drain Rutherford Morison's pouch, is advisable.

Sump drainage (*see* p. 189) of the rectovesical pouch is most efficacious.

SPECIAL CASES AND METHODS OF DEALING WITH THEM

The Diagnosis is Doubtful (? Appendicitis, ? Perforated Duodenal Ulcer).—Occasionally it is well-nigh impossible to be certain whether the case is one of a perforated duodenal ulcer leaking into the right iliac fossa (via Moynihan's gutter—*Fig.* 362), or acute appendicitis. When this doubt exists it is a good practice to make a small gridiron incision. If the fluid in the peritoneum is odourless and the appendix is unperforated, the latter is

Fig. 362.—'Moynihan's gutter', which explains how the symptoms and signs of perforated duodenal ulcer may be referred to the right iliac fossa.

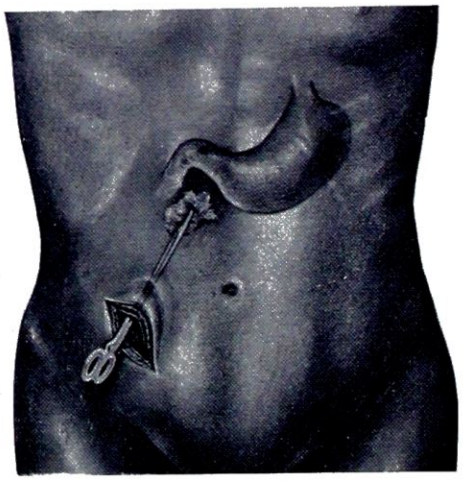

Fig. 363.—The appendix is not culpable. Ascertaining if there is fluid in the upper abdomen.

obviously not the source of the trouble, and the appendix is removed, the gridiron incision closed, and the upper abdomen opened. It should be noted that the appendix often looks a little inflamed when it has been bathed in duodenal contents. If there is purulent fluid in the peritoneum, and the inflamed appendix is unperforated, get someone in the theatre to slit up the appendix.

If the appendix is the source of the trouble it will surely be more pathological on the inside than on the outside (*see Fig.* 293, p. 222); if not, this organ is blameless. Search elsewhere. On more than one occasion I have derived help from passing up a swab on a holder towards the duodenum and leaving it in situ for a moment or two (*Fig.* 363). Obviously, if on removal the swab is soaked with non-odorous fluid it is imperative that the upper abdomen be explored.

'Dry' Perforated Peptic Ulcer.—By this is meant that perforation of the stomach or duodenum has occurred, but the stomach is empty, or, what is more usual, the perforation is sealed by a tag of omentum or the fundus of the gall-bladder. These cases are not quite so difficult to diagnose as the foregoing group; indeed the condition is sufficiently common for a diagnosis of 'dry' perforation to be made with some confidence, in which case the advisability of aspiration treatment (*see* p. 281) may be considered.

The Perforation cannot be located easily; Searching for an Elusive Perforation.—When the perforation cannot be located by the measures described on page 272, the following plan is bound to lead to the discovery of a perforated peptic ulcer (*Fig.* 364), if such be present.

1. Place a retractor in the right side of the wound and hand it to an assistant. While the parietes are retracted to the right and the stomach is drawn to the left, after extravasated fluid has been removed from the right kidney pouch, the first and second parts of the duodenum can be inspected thoroughly, thereby enabling the operator to be certain whether or not this portion of the ulcer-bearing area is culpable. In one of my cases these expedients brought to light a perforation at the junction of the second and third parts of the duodenum—a most unusual situation.

2. After a non-productive search of the pyloric antrum and the duodenum, instruct the assistant to release his hold of the stomach and to place his retractor on the *left* lip of the wound. Proceed to examine the lesser curvature: between the fingers and thumb palpate the lesser curvature right up to the œsophageal orifice. There is never any difficulty in recognizing immediately the massive induration around the edges of a perforated *gastric* ulcer.

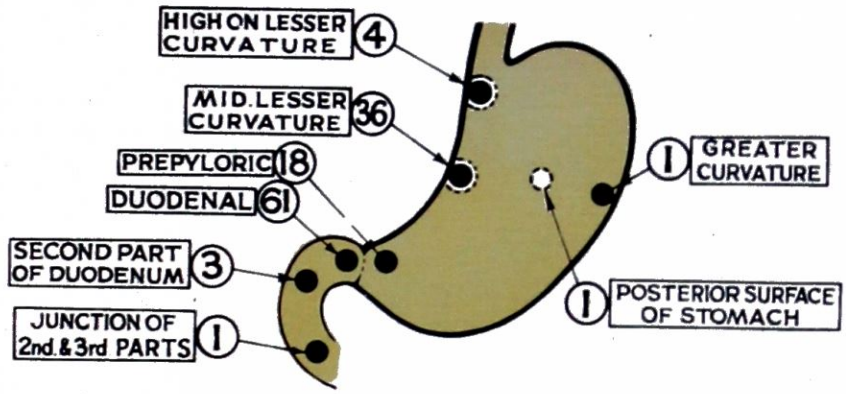

Fig. 364.—Location of perforated peptic ulcers in a series of 125 consecutive cases operated upon by the author. In a number of instances it was difficult to be sure on which side of the pylorus the perforation had occurred, consequently a few pre-pyloric ulcers may have been listed as duodenal ones. All the lesser curve ulcers were characterized by surrounding induration. Three examples of perforated hour-glass stomach are included in the mid-lesser-curve group.

3. When the search along the lesser curvature proves fruitless, an opening is made in the omentum between the stomach and the colon. This permits an examination of the posterior surface of the stomach. When the lesser sac is found to be filled with gastric fluid, assuredly a perforation will be found somewhere on the posterior surface of the stomach.

A Perforation cannot be found in the Stomach or Duodenum.—Sooner or later the surgeon will be confronted with a case where he opens the upper abdomen in confident expectation of finding a perforated peptic ulcer. Fluid is present, but a perforation cannot be found. Once a systematic search has been conducted in the manner detailed above, do not waste time by going over the ground again. Proceed as follows: the physical characteristics of the fluid will sometimes lead to a short cut of the full programme.

1. Examine the gall-bladder.

2. Consider the possibility of acute pancreatitis and make the relevant examination (*see* p. 333). Sometimes there is a prodigious outpouring of free fluid in this condition, and the fluid is not necessarily blood-stained. It is never milky (opaque; semi-purulent) or bile-stained.

3. Examine the jejunal mesentery for suppurating mesenteric lymph-nodes or a ruptured mesenteric cyst. In this connexion a ruptured intraperitoneal hydatid cyst is worth bearing in mind. A perforated primary jejunal ulcer is another possibility; it is extremely rare.

4. Suitably cover the upper laparotomy wound and make a gridiron incision in the right iliac fossa. Examine the appendix. If in real doubt as to its culpability, remove it and have it slit up (*see* p. 222). In other circumstances proceed to examine the last 2 ft. (60 cm.) of the small intestine for the presence of a perforated Meckel's diverticulum. On two occasions, while examining the lower ileum, I have come across a perforated ulcer of the ileum itself. In both cases the cause of the perforation remained obscure, it was due neither to typhoid nor to tuberculosis.

5. On one occasion I had reached this stage without finding the causative lesion. There was a quantity of odourless fluid in the peritoneum. The patient was a muscular

man in his thirties. As a last resort a swab on a holder was passed through the gridiron incision towards the pelvic colon. On removing it the swab was malodorous. A third incision was therefore made in the left iliac fossa, and a perforated diverticulum of the pelvic colon was revealed.

6. If nothing can be found to account for the profuse odourless peritoneal exudate, the only course is to insert a suprapubic drainage tube, close the incisions and rely on antibiotic therapy. At what stage of the proceedings this is done must rest with the judgement of the surgeon. It is highly desirable to collect some of the fluid for bacteriological investigation.

Friable Gaping Perforations.—An expedient which considerably minimizes sutures cutting out is to instruct the assistant to relax traction (but *not* his hold) upon the stomach after each suture has been inserted. As the stomach and duodenum fall back the suture is tied—if necessary, blindly. At the appropriate moment the assistant renews his traction on the stomach, and the result of the surgeon's handiwork is displayed.

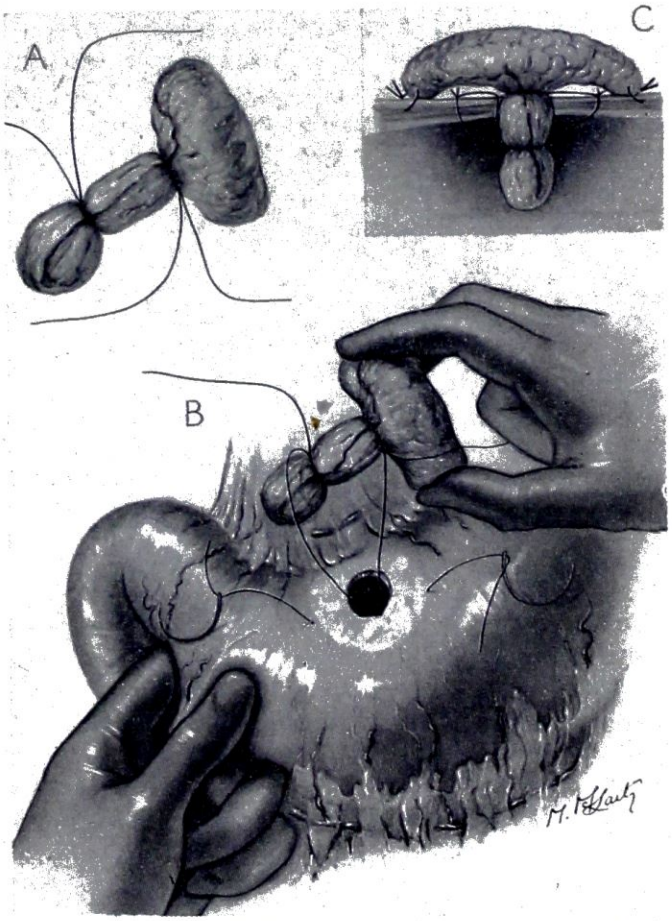

Fig. 365.—A, Method of constructing an omental plug; B, Method of fixing the plug into the perforation; C, The plug operation completed.

From time to time examples are encountered where the environs of the perforation are so friable and undermined that attempts at closure, even by the above method, result in a large, gaping hole.

In such circumstances water-tight closure by the standard method is impossible or risky, and resort must be made to one of the following expedients.

The omental plug is suited particularly to *gastric* perforations belonging to this category. A free omental graft of suitable dimensions is cut, erring on the side of liberality. The graft is rolled and fashioned into a dumb-bell, one end being considerably larger than the other. Such a plug is easily constructed by tying two sutures around its waist; the ends of these are left long (*Fig.* 365, A). One end of each of these sutures is passed, via the perforation, through the stomach wall beyond the friable area (*Fig.* 365, B). The smaller end of the dumb-bell is pushed through the perforation. Each suture is tied to its fellow quite lightly, so as to avoid cutting out. The only object of these sutures is to anchor the plug for the next step, which is most important. The large end of the dumb-bell is attached to healthy stomach wall by interrupted sutures all around its periphery (*Fig.* 365, C).

Gatch and Owen's method is suited only to juxtapyloric duodenal perforations, a relatively common site for large friable, gaping perforations. To employ this method in cases belonging to, or bordering upon, this category, would prevent a number of cases of subdiaphragmatic abscess. Several sutures are inserted as shown in *Fig.* 366 A. They are not tied until they have all been placed. It will be noted that on the one hand the stomach wall is traversed $1\frac{1}{2}$–2 in. (3·8–5 cm.) proximal to the pylorus, while on the other the sutures pick up indubitably healthy duodenum. If possible the first (uppermost) stitch catches the gastro-hepatic omentum, so when this stitch is tied the latter structure reinforces the roof. The remainder of the stitches, when tied, draw the anterior surface of the stomach over the perforation and close it without tension upon the sutures (*Fig.* 366 B). The suture line is strengthened, where necessary, by additional stitches and then covered

completely by an omental graft. Contrary to what might be thought, this procedure does not obstruct the duodenum, and there is no necessity to perform gastrojejunostomy on this account.

Inaccessible Ulcer High on the Lesser Curvature.—Exceptionally, cicatrization of the gastro-hepatic omentum has so fixed the stomach that it cannot be drawn down. In these circumstances in order to get more direct access to the ulcer it may be advisable to excise some of the left cartilaginous costal margin, which is readily removed with a scalpel. This is infinitely preferable to pulling on the stomach unduly.

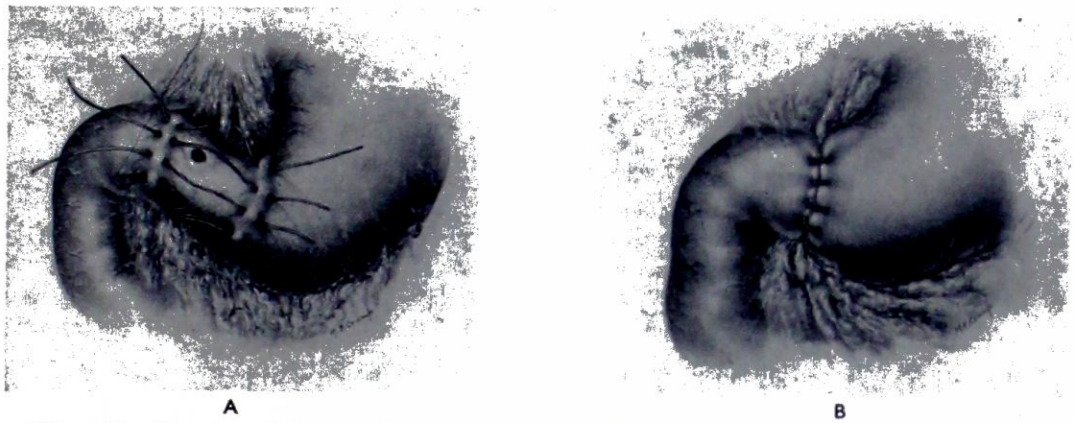

Fig. 366.—Gatch and Owen's method of closing a friable gaping perforation on the duodenal side of the pylorus. A, Shows how the sutures should be placed. All should be inserted before they are tied. B, Shows the perforation closed by this method. A free omental graft completes the operation.

Perforated Hour-glass Stomach.—The ulcer which gives way is saddle-shaped, and the perforation is a large one situated in a narrow isthmus. It thus comes about that the stomach may be almost in two halves. This is what was found in three of my early cases. Each was treated by simple suture reinforced by an omental graft. In each instance death occurred from hæmatemesis or internal hæmorrhage about the fourteenth day, in spite of blood transfusion. Undoubtedly the correct treatment for this condition is to perform partial gastrectomy. All that is necessary is to complete the bisection of the stomach, trim the proximal torn edge of the stomach, and in so doing excise the scar tissue: remove the distal end, and close the duodenal stump. The proximal end of the stomach is then anastomosed to the side of a loop of jejunum brought up in front of the transverse colon.

Pseudo-perforated Ulcer.—Occasionally cases are encountered which present many, if not all, of the characteristics of a perforated gastric ulcer, yet on laparotomy nothing is found. The gastric crisis of tabes, of course, is a well-known trap, but this is so familiar that I venture to think this error is very seldom made at the present time. In this connexion it is interesting to refer to *Case* 75 of my series. This patient had both tabes dorsalis and a perforated duodenal ulcer. The diagnosis of perforation was clinched by the elicitation of shifting dullness.

An acute exacerbation of symptoms of chronic gastric ulcer may simulate a perforation of that ulcer. Usually rigidity is localized, but occasionally it is not possible to be certain if the ulcer has perforated or not. If doubt exists, laparotomy should be performed.

W. C., aged 46, gave a typical gastric ulcer history extending over 5 years. At 6 p.m. he was seized with agonizing abdominal pain, and his doctor sent him to hospital at 10.30 p.m. with the diagnosis of perforation.

He presented a classical picture of perforated peptic ulcer, as regards board-like rigidity. There was one extraordinary feature of the case—the agonizing pain came in spasms, and radiated down the arms to the finger-tips. He had two such spasms whilst being examined. Wishing to exclude the possibility of a cardiac lesion I asked my medical colleague to see him. As the heart and lungs were found to be normal, laparotomy was undertaken. A large angry pyloric ulcer was found, but no perforation. Posterior gastro-jejunostomy was performed. Recovery and relief followed.

Re-perforation is rare. As shown by massed statistics, it occurs in 1–2 per cent of cases that have been treated by suture, or expectantly. That re-perforation is allowed

to occur is, in most instances, a reflection on the follow-up system that should always be inaugurated. Re-perforation usually takes place at the site of the first perforation.

Perigastric Abscess is an uncommon condition that usually arises in one of two ways: (1) The amount of fluid escaping from a leaking duodenal ulcer due to a minute perforation may be small enough to be confined to Morison's right kidney pouch, and there become shut off from the rest of the peritoneal cavity by adhesions; (2) An ulcer on the posterior wall of the stomach perforates into the lesser sac, the foramen of Winslow being occluded by adhesions.

Some days after an acute attack of upper abdominal pain a tender swelling appears in the epigastrium or right hypochondrium. Usually the temperature is elevated.

Treatment.—If, on laparotomy, an abscess of the first variety is found, it is best to drain it through a counter-incision in the flank. An abscess of the lesser sac can be drained conveniently through the gastrohepatic omentum. An unavoidable complication that is prone to occur is the development of a gastric or duodenal fistula (*see* p. 529).

Perforated Gastrojejunal Ulcer.—Here simple suture with reinforcement by an omental graft is indicated. A jejunostomy (*see* p. 523) can be added with advantage in most cases. The patient can be fed through the jejunostomy, thereby giving the ulcer a chance to heal, but in most instances further surgical treatment will be necessary when the patient's condition allows. Usually at least two or three months should elapse before such treatment is undertaken.

Perforation of an Inflamed Duodenal Diverticulum (*G. P. B. Huddy's Case*).—A married woman, aged 27, complained of epigastric pain. On the following day the pain became more acute, and she vomited four times. On examination, the temperature was 101·5° F. (38° C.) and there was rigidity and tenderness over the upper part of the right rectus muscle. A diagnosis of acute appendicitis, with the appendix under the right lobe of the liver, was made.

On opening the abdomen by a paramedian incision the appendix was found to be normal. This was removed. Flakes of lymph were seen on the peritoneum in the upper part of the wound and a lump was palpable in front of the right kidney. The skin incision was prolonged upwards, and an incision made through the peritoneum on the outer side of the second part of the duodenum. It was then possible to isolate a pouch connected with this part of the duodenum. The pouch had a diameter of an inch, was thin-walled, and black in the centre. The diverticulum was excised, and the base closed. It was found impossible to invaginate the suture line satisfactorily. The friable peritoneum was approximated as well as possible, and a stab drain inserted.

On the third day after operation duodenal contents began to pour out of the stab drain. This gradually ceased, and the stab wound closed on the 17th day. Recovery.

Perforated Carcinoma of the Stomach.—In approximately 40 per cent of cases, by the time a carcinoma of the stomach has perforated, metastases are present. Ten per cent of apparently simple *gastric* ulcers that perforate prove later to be cases of carcinoma (*see* pp. 281, 283). If the perforated ulcer is considered to be carcinomatous, and the patient is in fair condition, if the operator is experienced in its performance, this is an indication for partial gastrectomy, provided no more than a subtotal gastrectomy is required. Should a more extensive operation be required, or if the operator is not a practised gastrectomist, closure of the perforation should be undertaken. The friable edges of the perforation will almost certainly be difficult or impossible to approximate, and recourse must be made to omental plugging described already.

AFTER-TREATMENT OF CASES OF PERFORATED PEPTIC ULCER

Careful after-treatment will forestall many complications. If the pulse is satisfactory the patient is propped gradually into Fowler's position, unless he finds the position uncomfortable, which is unusual.

Post-operative gastric suction should be maintained until the abdominal wall becomes flaccid, and the patient has passed flatus; this usually occurs between the third and the fifth post-operative days. Penicillin, 500,000 units, and streptomycin, 0·5 G., are given intramuscularly 12-hourly for seven days. Fluid is given parenterally for three days, or until such a time that the necessity for gastric aspiration has ceased, and it has been proved that coloured barley water passes onwards through the pylorus (gastric motility test (*see* p. 197)). Milk feeds can then be commenced. A day or two later a light gastric diet is given, with gradual return to a full normal diet.

Special Nursing Instructions.—The suprapubic tube is to be shortened and turned 48 hours after operation, and removed at 72 hours.

If the patient vomits stop all feeds.

In the event of vomiting, a gastric aspiration tube must be re-inserted with as little delay as possible.

The Prevention of Complications.—If special precautions are taken, the incidence of chest complications, so lethal in these cases, can be reduced. Regular breathing exercises, inhalations of CO_2 for the first four days, and early ambulation are all most valuable, but unless the surgeon insists it is unlikely they will be carried out as a routine. Another point to bear in mind is that many of these patients are suffering from vitamin-C (ascorbic acid) deficiency, which is seriously detrimental to wound healing. Vitamin C must be administered in some form or other as soon as the immediate crisis is over.

Unless the surgeon is satisfied that the patient is not anæmic, a hæmoglobin estimation should be carried out during the first few days after the operation ; in minor degrees of anæmia ferrivenin is sufficient to restore the hæmoglobin level to normal. When the hæmoglobin is low, blood transfusion will do much to hasten recovery. Especially in patients between 50 and 60 years of age who have undergone successful suture of a perforated peptic ulcer, it is most necessary to be on the look-out for melæna during the post-operative period.

Causes of Death following Operations for Perforated Peptic Ulcer.—It is a mistake to be too gloomy where the hours since perforation have reached double figures. Nearly 40 per cent of my patients had perforated more than twelve hours before they were admitted ; while in 16 per cent over twenty hours had elapsed. Ten out of 19 in the last group died.

Infrequently, even in comparatively fit subjects, death from shock occurs within two hours of perforation. As evinced by the comparatively slow pulse-rate, shock is usually not a notable feature of perforated peptic ulcer. The principal cause of death is peritonitis. Pneumonia and other complications of the lungs are second ; not far behind comes bleeding from a sutured ulcer within three weeks of the perforation. Subdiaphragmatic abscess and pulmonary embolism account for a much smaller proportion of the fatalities.

Age (mortality increases greatly over 60 years of age) and delay between the moment of perforation and the commencement of treatment remain the most important factors in prognosis. The mortality of perforated gastric ulcer is twice that of perforated duodenal ulcer. To this must be added late deaths from carcinoma of the stomach in cases of perforated gastric ulcer. Avery Jones and Doll found that in 10 per cent of cases of perforated gastric ulcer the patient had died of carcinoma of the stomach from between 18 months and 12 years after successful suture of the perforation.

Mortality Statistics.—Many recent series of cases showing very low mortality figures emanate from hospitals serving a crowded, but limited, industrial area ; thus the patients live near the hospital, and their doctors have comparatively little difficulty in obtaining prompt acceptance for admission of their patients. Furthermore, delays in transportation are reduced to a minimum.

In this chapter the surgeon who has to deal with a comparatively unfavourable type of patient and under conditions which are not ideal has been catered for. The methods I have set out have been designed to override difficulties, and if success follows how much more certain will be the outcome in more favourable circumstances ?

OTHER METHODS OF TREATING PERFORATED PEPTIC ULCERS

Non-operative Treatment.—Hermon Taylor prefers to call the method *the aspiration treatment of perforated peptic ulcer.* It has been the subject of many recent papers and much controversy. A few surgeons enthusiastically commend it as a method suitable for general adoption, but the majority consider that its dangers considerably outweigh its advantages.

Details of the Method.—

1. *The Pulse and Temperature Charts* are similar to those for the Ochsner-Sherren treatment of appendicitis (*see* p. 232).

2. *Repeated Radiographs* must be looked upon as an essential part of the aspiration treatment. In the first place, without their aid it is impossible to be certain that the tip of the gastric aspiration tube is well within the stomach. Secondly, an initial radiograph and one repeated 12 hours after admission will show the tell-tale layer of air beneath the diaphragm. If the perforation becomes sealed by fibrinous lymph, this subdiaphragmatic shadow slowly diminishes in size. Conversely, if the shadow has increased in size after

the passage of a stomach tube the size of an index finger, to allow air in the stomach and peritoneal cavity to escape, operation should be performed without further delay.

3. *Gastric Aspiration* should be done *only by hand.* An electric suction pump, Wangensteen's apparatus, and other mechanical devices can never replace a special nurse. At any time a gastric aspiration tube is liable to become blocked, and requires human attention immediately; without such attention the patient's life is in jeopardy. The actual point in question is not that intermittent aspiration is more effective than continuous, but rather by which method will the fact that the aspiration tube has become ineffective as a result of blockage or displacement of the tube, be discovered first? Undoubtedly the need to return every fifteen minutes to the patient, in order to undertake intermittent aspiration, ensures more frequent clinical observation of the patient's condition.

4. *Fluid Balance* must be adjusted accurately.

First twenty-four hours: Aspiration every fifteen minutes. Three pints (1·7 l.) of fluid parenterally plus the amount of fluid aspirated.

Second twenty-four hours: Aspiration every half hour, followed by a drink of one ounce (30 ml.) of water.

Third twenty-four hours: Aspiration every hour, but a mixture of milk and water instead of water only.

On the fourth day the tube is removed if the fluid chart proves that all the fluid taken by mouth is indubitably passing onwards.

5. *Drugs.* Having decided on non-operative treatment, the patient should receive not more than $\frac{1}{4}$ gr. morphine (16 mg.) subcutaneously. If he does not experience considerable relief of pain after 6 hours of gastric aspiration, a second radiograph is taken with a portable machine, and a consultation is held questioning the diagnosis. *Only in the most exceptional circumstances is even a second dose of morphine prescribed.*

6. *Antibiotic Treatment.* Penicillin, 500,000 units and streptomycin, 0·5 G. are given intramuscularly 12-hourly.

Indications and Contra-indications.—As yet there is no conclusive evidence that treatment by aspiration, which is practised much less frequently than operative treatment, has effected a lowering of the mortality, even when the desirable nursing facilities are of a high order. The method is contra-indicated in the presence of bleeding or pyloric stenosis, after a heavy meal, and in air swallowers. It should be noted especially that air swallowers can swallow air faster than it can be aspirated; for them, gastric aspiration treatment is forbidden absolutely. Undoubtedly it is the method of choice in cases of 'dry' perforation (*see* p. 276) and in patients with a cardiac lesion, emphysema, or some other condition which renders operation dangerous. It is also indicated when facilities for operation are practically non-existent (e.g., a small ship at sea).

N.B.: Aspiration treatment is nearly always fatal in patients severely ill with diffuse peritonitis. Therefore it must not be used in the very type of case that on a prima facie acquaintance with the subject one would think is more suitable for non-operative treatment than almost any other.

Disadvantages and Dangers of Aspiration Treatment.—

1. One cannot judge, without operation, whether the peritoneal contamination is, or is not, excessive. Even if the stomach is kept empty, peritoneal contamination can occur from regurgitation from the duodenum and the ileum.

2. A perforated carcinoma cannot be diagnosed.

3. There is a risk of leaving unoperated another condition requiring operation.

4. The incidence of lung complications is higher than with operative methods, as also is the occurrence of intraperitoneal and subdiaphragmatic abscesses.

Iselin considers that if the pain has not gone within three hours of conservative treatment the diagnosis and the treatment should be questioned. An increasing pulse-rate or failure of the pulse-rate to diminish are also reasons for abandoning conservative treatment.

Non-operative treatment demands frequent repeated expert clinical and radiological assessment, and an error in gastric aspiration, or transient relaxation of vigilant nursing observation may be followed by a disaster. The method is safe only in the hands of a surgeon trained in the method, who has at his disposal ample medical, radiological, and nursing assistance. Definitely it is unsuitable for routine use.

Additional Gastrojejunostomy.—All the benefits of keeping the stomach empty can be achieved by a gastric aspiration tube in the early post-operative period. The only indication

for a gastrojejunostomy is the presence of obvious obstruction due to cicatricial stenosis; œdema does not fall into this category.

Immediate Partial Gastrectomy for Perforated Peptic Ulcer is performed in a high percentage of cases in some well-equipped hospitals. The possibility of a perforated *gastric* ulcer proving to be carcinomatous, the facts that the mortality from a hæmatemesis and melæna following suture of a perforation is greater than is commonly supposed, and that partial gastrectomy is easier to perform at the time of operation for the perforation than at a second operation, are the main arguments put forward by protagonists of the method. For its successful performance :—

1. The surgeon must be experienced in gastrectomy.
2. The case should be an early one (under 10 hours' duration).
3. The patient must be in a fit condition to withstand a severe operation.

However, in most clinics the indications are limited to :—

1. When bleeding has preceded the perforation.
2. When the ulcer is believed to be carcinomatous, and a partial gastrectomy may cure the patient of the neoplasm.
3. Perforated hour-glass stomach.

Obesity, abdominal distension, œdema of the duodenum (difficulty in closure of the duodenal stump) are among the less obvious contra-indications to this formidable operation.

Approximately 10 per cent of patients with partial gastrectomy will suffer from one or other of the post-gastrectomy syndromes. As 30 per cent of patients with perforated ulcer simply closed suffer no further ulcer symptoms, why burden them with a 10 per cent chance of having disabling post-gastrectomy syndromes ?

END-RESULTS

As might be expected, after both suture and aspiration treatment there is a transient remission of symptoms due to the rest in bed and the careful dietetic supervision during convalescence. Elderly patients and those of any age with a short dyspeptic history are the ones who are likely to remain symptom-free after successful treatment of a perforation (Illingworth). Nevertheless, within one year 40 per cent of patients relapse, and within five years 70 per cent. On this account the surgeon should warn those who have been fortunate enough to survive perforation to report, so that, if necessary, they may receive timely treatment for an active ulcer. Many require medical supervision for years, and in at least 50 per cent of cases further surgical treatment is indicated.

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