

CHAPTER XXVIII

HÆMATEMESIS AND MELÆNA

In about 95 per cent of cases of hæmatemesis and melæna the bleeding comes from a gastric or a duodenal ulcer. The ulcer in question can be either acute or chronic, but in two-thirds of these cases it is a chronic ulcer that is responsible.

Chronic Bleeding Gastric Ulcer is commonly situated on the posterior wall of the stomach towards the lesser curvature. Such an ulcer is often adherent to, or has penetrated, the pancreas or the liver, and the bleeding occurs from a comparatively large vessel in the floor of the crater (*Fig. 367*). In rare instances the splenic artery is eroded.

Chronic Bleeding Duodenal Ulcer is nearly always situated on the posterior wall of the first part of the duodenum. Frequently the bleeding comes from a large branch of the gastroduodenal artery; on rarer occasions from the gastroduodenal artery itself.

A chronic duodenal ulcer is the cause of serious hæmorrhage five times more frequently than a chronic gastric ulcer.

Acute Bleeding Ulcer occurs most often in the distal half of the stomach, but the proximal half of the stomach and the duodenum are not immune. Two or more ulcers are sometimes present. Acute ulcers involve the mucosa only; they are impalpable externally, and even if the stomach is opened, they are difficult or impossible to feel among the innumerable folds of mucous membrane. In not a few cases there is no real ulcer present, but multiple minute erosions causing the whole stomach to weep (blood gastrostaxis). Although true acute ulcers can be seen gastroscopically, they do not show radiologically. In the majority of cases patients with acute bleeding lesions of the stomach suffer little or no pain or discomfort, either before or after the bleeding occurs. One-third of all cases of hæmatemesis and melæna are proved eventually to be caused by acute lesions.

Notwithstanding the comparative insignificance of the blood-vessels involved, hæmorrhage from an acute ulcer, in spite of conservative treatment including blood transfusion, can on occasions prove relentless. The mortality of bleeding gastric ulcer (mostly chronic cases) is about twice that of bleeding duodenal ulcer. Speaking generally, hæmatemesis carries a worse prognosis than melæna alone (Crohn and Janovitz).

In cases where portal hypertension is suspected, the bromsulphthalein test gives valuable diagnostic confirmation. Retention of 17 to 60 per cent of the dye favours hepatic cirrhosis (Zamcheck et al.), but the most reliable method is to perform œsophagoscopy and visualize the bleeding varices.

Onset.—Referring to peptic ulcers, and in particular to chronic peptic ulcer, quite often the bleeding comes on during a quiescent period of the ulcer, the patient having been free from symptoms for weeks or months. Conversely, if the patient has been experiencing pain prior to the hæmorrhage, as a rule, when the bleeding commences the pain passes off, due, it is thought, to relief of congestion. On the other hand, if pain continues there seems to be a special tendency to further hæmorrhage.

Serious hæmorrhage from a *gastric* ulcer is ushered in by collapse and pallor, followed by hæmatemesis, which is effortless vomiting of coffee-ground material, sometimes followed by bright-red blood. When severe hæmorrhage takes place from a *duodenal* ulcer the

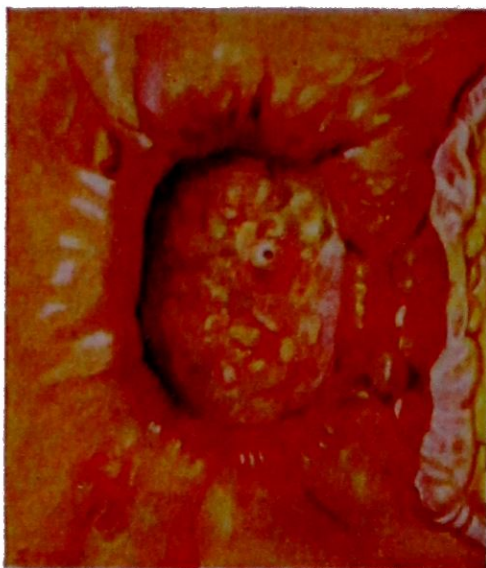


Fig. 367.—The open mouth of a bleeding artery can be seen at the bottom of this ulcer crater. In such a case how can conservative measures do more than tide the patient over a hæmorrhagic crisis? (*Collinson and Stewart, 'British Journal of Surgery'.*)

patient says he feels faint. This is followed by the passage of a melæna stool. So great may be the bleeding that bright-red clotted blood is passed per rectum.

COMPARATIVELY RARE CAUSES OF SEVERE GASTRO-INTESTINAL HÆMORRHAGE

AVENUE	CAUSE OF HÆMORRHAGE	CLINICAL DIAGNOSTIC AID	
1. Mainly hæmatemesis	Stomal ulcer	—	
2. Mainly hæmatemesis	Portal hypertension (œsophageal varices)	Spleen and liver enlarged. Spider nævi. Caput Medusæ	See p. 743
3. Blood per rectum	Bleeding Meckel's diverticulum	When the patient is a child, diagnosis not difficult	See p. 263
4. Hæmatemesis and melæna	Bleeding jejunal diverticulum (See Fig. 348)	—	
5. Blood per rectum	Bleeding colonic diverticulitis	Blood bright red	See p. 255
6. Blood per rectum	Purpura with intestinal symptoms	'Flea-bites' on skin and sometimes bruising	See p. 491
7. Blood per rectum; occasionally hæmatemesis	Mesenteric vascular occlusion	Abdominal pain considerable	See p. 459
8. Hæmatemesis and/or melæna	Hereditary telangiectasia	Usually history of recurrent epistaxis	See Chapter XC
9. Hæmatemesis or melæna	Gastric or intestinal neoplasm	—	
10. Blood per rectum	Solitary peptic ulcer of the small intestine	—	
11. Melæna	Appendicectomy	—	See p. 293
12. Hæmatemesis	Idiosyncrasy to aspirin	—	

Even when a large vessel is eroded, death seldom results from the initial hæmorrhage. Far more frequently a large hæmorrhage is heralded by two or three smaller ones on consecutive days, as in other cases of secondary hæmorrhage. Soon after the initial bleeding the presence of sweating, as well as anæmic pallor (as shown in the palms of the hands and the palpebral conjunctivæ), are more valuable indications of a considerable loss of blood than the pulse-rate. Conversely, after the first hour of treatment quickening of the half-hourly pulse-rate is the best single sign of renewed bleeding.

When loss of blood is sufficiently rapid to produce signs of peripheral hypotension (shock) or necessitate the administration of $2\frac{3}{4}$ pints (1500 ml.) or more of blood in 24 hours, by convention the hæmorrhage is said to be massive.

Management.—The patient having been put to bed, if the pulse is weak and rapid, the foot of the bed is raised; otherwise he is laid flat with one pillow beneath his head. He is kept warm, but not heated artificially in any way. The pulse-rate and blood-pressure are taken, and orders are given that the pulse be recorded every half-hour, and that any noticeable change in it is a signal for a further estimation of the blood-pressure. Five ml. of blood must be aspirated from a vein for an initial hæmoglobin estimation, blood-grouping tests (including Rhesus testing), a blood-urea estimation, and for serum for direct testing. This is followed by the slow intravenous injection of $\frac{1}{4}$ gr. morphine.

Gastric Lavage plus Adrenaline and Stypven.—The most successful time for the use of adrenaline and stypven is immediately after the bleeding has taken place. A gastric aspiration tube is passed, and the stomach is irrigated with 1 pint (568 ml.) of sterile water. Twenty ml. of adrenaline hydrochloride (1-1000 solution) is injected down the tube, and the tube is left in situ. After 20 minutes gastric lavage is repeated, and a further 20 ml. of adrenaline is injected, followed a few minutes later by 5 ml. of stypven.¹ In order to ensure that none of the stypven remains in the tube, 5 ml. of sterile water is injected. It is probably safer to leave the gastric aspiration tube in place and to aspirate at intervals, in order to detect fresh hæmorrhage.

¹ Stypven (Burroughs Wellcome & Co.) Russell Viper venom.

Sometimes the stomach is full of clots, and lavage will not remove these. Occasionally the initial dose of adrenaline acts as a mild emetic; should it not do so, the interval between the first and second gastric irrigations permits the bulk of the clot to be evacuated through a patent pylorus. A second lavage then removes most of the remainder. Acute gastroduodenal lesions stop bleeding immediately after the administration of adrenaline and styppen; adequate transfusion then nearly always ensures an uneventful recovery. A high proportion of chronic gastroduodenal lesions respond in the same way (Brandon).

After the gastric lavage, usually the patient should be permitted to have an hour's rest. During this time relatives are interviewed and particulars of the onset and previous history are obtained. The opportunity is taken to enlist their services as possible blood donors.

Revisited, if the patient is fit to be interrogated without undue fatigue, a careful, unhurried history is taken, for on this much reliance must be placed.

Physical Examination.—To ascertain if the diaphragm is moving, gentle palpation for tenderness and rigidity (to exclude a concomitant perforated peptic ulcer or acute appendicitis) are a *sine qua non*, but deep palpation for a lump in the epigastrium should be eschewed at this early hour, also detailed examination of the bases of the lungs, which can be postponed for hours as part of the designed plan to disturb a partially exsanguinated patient as little as possible. None the less, the sign of Troisier should be sought, and information gained by rectal examination as to whether the rectum is loaded, or the stools tarry, is always of great value. If, at this second examination, increasing pallor, beads of perspiration on the forehead, clammy hands, and especially quickening of the half-hourly pulse-rate bespeak of a seriously depleted blood-volume, and that bleeding is probably progressing, taking the history and making a physical examination are abandoned *pro tem*. in favour of transfusion as soon as matched blood is available.

Blood Transfusion is required in all cases of serious hæmatemesis and/or melæna. It is impossible to state how much blood will be needed: to be provided with a pint of blood in reserve is a matter for considerable forethought and planning in outlying districts.

When, as a result of a dose of morphine, the patient has become tranquil in bed is the time to commence transfusion. The usual rate of the drip transfusion should be 60 drops per minute, the aim being to give one pint in four hours, but more rapid transfusion is required in cases of continued or renewed hæmorrhage. Usually it is sufficient to give two or three pints on one occasion, although this frequently needs repetition. It is essential to prevent the onset of anæmic anoxæmia, with its restlessness leading to irreversible shock. If bleeding has been severe, the risk of raising the intravenous pressure and precipitating acute heart failure by too rapid transfusion must be guarded against by watching the veins of the neck, especially the external jugular vein in the supraclavicular triangle.

In a case of moderate severity, after one pint has been given at the rate of 60 drops a minute, slowing and steadying of the half-hourly pulse-rate and a decrease in pallor are signs that the blood is being retained in the circulation.

Frequent pulse-rate and blood-pressure readings are continued for at least three days after apparent cessation of hæmorrhage. The drip transfusion is continued at a rate of 30 drops per minute until the hæmoglobin level has reached at least 75 per cent. A serious depletion in the blood volume is more dangerous in the elderly, because with depleted erythrocytes sufficient oxygen is not carried through the atheromatous coronary arterioles to the cardiac musculature, therefore such patients, in addition to blood transfusion, should receive oxygen therapy.

It should be noted that in cases of a low hæmoglobin estimation associated with an adequate blood-pressure, the administration of packed red cells is effective, and carries much less risk of untoward reactions than massive transfusion of whole blood (*see below*).

In rare cases of catastrophic hæmorrhage, intra-arterial transfusion of several pints is necessary to preserve life.

Laboratory Aids in assessing how much blood will be required are as follows:—

Hæmoglobin Estimation.—Very soon after a severe hæmorrhage the level of the hæmoglobin is often within normal limits,¹ and therefore no reliance should be placed upon it

¹ Estimation of blood volume or hæmatocrit gives more valuable information in early severe hæmorrhage.

at this critical time. After three hours, estimations, repeated at frequent intervals, provide valuable information. A hæmoglobin level of 60 per cent or under is an indication that the patient is in dire need of blood.

Blood-urea.—A rise in the blood-urea (70–100 mg. per 100 ml.) is so consistent as to be of some value as an index of the severity of the hæmorrhage. The probable explanation for the rise is a diminished flow of anoxæmic blood through the kidneys. A blood-urea of over 150 mg. is likely to be due to dehydration, chronic nephritis, or alkalosis. In all, extra fluid by mouth should be given.

Failure of Repeated Transfusions in Prolonged and Recurrent Hæmorrhage.—If operative treatment is withheld, especially in patients of the older age groups, in spite of, or because of, numerous transfusions, a stuporous state sometimes supervenes, accompanied by a high blood-urea and a low output of urine. The cause of this condition is not known, but it is believed to be due to liver failure. When such a state ensues it is too late for surgical treatment, and the patient usually succumbs.

Diet.—Even the presence of active bleeding is not an occasion to starve the patient. Within two hours of admission, feeding is commenced. The majority of gastro-enterologists and surgeons recommend that until the bleeding has ceased, and for two days thereafter, the diet should be entirely fluid. Especially in the weak and prostrated, and indeed almost as a routine, there is much to be said for giving the nourishment by the drip method (*see p. 38*) through an indwelling gastric tube with a diameter of 7 mm. A great advantage of this method is that the tube serves a dual purpose. Every two hours, day and night, 5–10 ml. of stomach contents are aspirated; the nurse reports at once if the fluid is blood-stained. Feeds consist of milk, eggs and milk, alternating with Bengers' food and Ovaltine, together with vitamins; all must be diluted to flow freely. After 72 hours the tube is withdrawn, and if progress is satisfactory milky porridge is allowed.

Additional Fluid.—Thirst must be prevented entirely by allowing the patient to drink as much one-third normal saline flavoured with fruit juice as he pleases. It is of the utmost importance to stimulate the nursing staff to make sure that at least 3½ pints (2 l.) of this fluid is imbibed by the patient (or given in the intragastric drip) during the 24 hours, and that a fluid balance sheet is kept accurately. When pyloric stenosis is present some of the fluid must be given as dextrose-saline intravenously.

Drugs.—To keep the patient at rest, morphine may have to be repeated, but as soon as it is considered safe to do so, phenobarbitone 0.5–1.0 gr. two or three times a day, to maintain mental relaxation, is substituted. Morphine is lethal to patients with emphysema; in such cases phenobarbitone should be prescribed instead. Ascorbic acid, 500 mg., is given daily. When progress is satisfactory, it is desirable to give an antacid such as magnesium trisilicate or aludrox, 2 teaspoonfuls t.d.s. after meals. During convalescence iron is given in full doses.

Bowels, if they have not acted before, should be emptied on the fourth day with a glycerol suppository, supplemented, if necessary, by a particularly gentle enema. To allow the patient to strain at stool must be rigorously circumvented by the nursing staff.

PERFORATION DURING, OR SOON AFTER, BLEEDING FROM A CHRONIC ULCER

Perforation during, or soon after, bleeding from a chronic ulcer occurred in 75 of 650 cases reported by Avery Jones. When perforation follows upon the heels of bleeding, it usually does so within 24 hours of the commencement of hæmatemesis or melæna. In such cases classical boardlike rigidity is often absent. If the condition of the patient seems more serious than would be expected from the bleeding, or if pain is a prominent feature, the possibility of concomitant perforation should receive full consideration.

BLEEDING AFTER PERFORATION

Serious bleeding after suture (or conservative treatment) usually occurs between the third and tenth days after admission. The association of bleeding and perforation usually indicates a double duodenal ulcer—the anterior ulcer perforating and the posterior ulcer bleeding—or a giant gastric ulcer. With these probabilities in mind operative, as opposed to conservative, treatment is definitely indicated.

OPERATIVE TREATMENT OF HÆMATEMESIS AND MELÆNA

Finsterer, of Vienna, advised operation within 24 hours in all patients with a long history of peptic ulcer, and in the absence of such a history when the bleeding continues or recurs in spite of transfusion. While subscribing to the latter injunction, the majority of surgeons, recognizing that conservative treatment is very often successful and that very few patients die of the initial hæmorrhage, pin their faith on conservative treatment, and operate only when non-operative treatment is unlikely to succeed.

INDICATIONS FOR URGENT OPERATION

1. If, after 6, and before 36, hours of conservative treatment, there is one or more of the following: (a) hæmatemesis; (b) fainting followed by a severe melæna; (c) a pulse-rate remaining over 90 in spite of transfusion; (d) failure of the hæmoglobin to rise.

2. If at any time while conservative treatment is in progress bleeding, which has stopped, starts again.

3. In exceptional circumstances so violent or persistent is the hæmorrhage that it is not advisable to proceed with the 24 hours' trial of conservative treatment.

4. The presence of other complications of a chronic ulcer, to wit, pyloric stenosis, hour-glass stomach, bleeding following perforation.

In doubtful cases the fact that the patient is over 50 years of age, or that he has hardened radial arteries, weighs in favour of advising urgent operation.

The added risk due to the presence of unrelated disease such as emphysema, bronchitis, cardiac disease, or nephritis renders the risk greater than that of conservative treatment. Therefore the latter is chosen, unless the need for operation is imperative.

Ogilvie et al. point out that should the rate of respiration increase *pari passu* with that of the pulse, the cause is more likely to be cardiac failure or bronchopneumonia than renewed bleeding, particularly if increasing pallor is not in evidence.

Immediate Pre-operative Treatment.—It is essential to empty the stomach. Although it does not happen often, if the gastric aspiration tube becomes blocked with clot, a No. 11 rubber œsophageal tube is passed, of course, via the mouth, and the stomach is irrigated with normal saline solution. In all cases transfusion is continued throughout the operation, and for 24 hours afterwards.

LAPAROTOMY FOR BLEEDING PEPTIC ULCER

The Incision.—The abdomen is opened through a midline incision, unless it is known beforehand that a chronic duodenal ulcer is present, when a transverse incision over the right rectus is preferable, especially in obese patients.

Choice of Operation.—Unfortunately, in many cases—particularly those due to acute ulceration—no operation simpler than subtotal gastrectomy will stop the hæmorrhage. Concerning the latter type of case, if the bleeding is of great severity and no lesion is found, gastrectomy is advisable because it removes four-fifths of the erosive area and partially devascularizes the remainder (Tanner). The stomach in these cases is free from adhesions; consequently the operation is straightforward. On the other hand, subtotal gastrectomy for an adherent callous ulcer, while being unquestionably the most desirable procedure, is likely to prove difficult, and when the patient is in poor condition and/or the surgeon lacks experience in this field, one of the alternative procedures to be described should be chosen. If the surgeon feels competent to carry out subtotal gastrectomy, he should do so by the technique with which he is most familiar. A description of the various methods of performing subtotal gastrectomy is beyond the scope of this book.

In performing subtotal gastrectomy, should the bleeding ulcer be situated in the duodenum and is penetrating the pancreas, a common situation, it is better not to attempt to remove the ulcer, and thereby risk injury to the common bile-duct or one of the pancreatic ducts. The duodenum should be divided obliquely proximal to the ulcer, so as to obtain a rather longer anterior than a posterior duodenal wall. The mid-point of the anterior wall is seized with tenaculum forceps, thus displaying the ulcer. Beneath the centre of the crater is placed a deep catgut stitch, and having filled the crater with a piece of gelfoam or oxyeel, the stitch is tied, not tightly, for fear of cutting out. The sides of the V created by traction of the anterior wall are approximated with interrupted stitches until the duodenal orifice is narrowed and the anterior part of the orifice formed by the duodenal

wall becomes equal in breadth to the posterior part bounded by the pancreas (*Fig. 368, a, b*). What F. H. Bentley describes as the 'pixie cap' of the anterior wall is now turned into the lumen abutting the gelfoam, and secured by a thread suture, which takes a firm bite of the mid-point of the proximal rim of the ulcer in the pancreas, and a seromuscular bite of the anterior duodenal wall at the base of the 'cap' (*Fig. 368, c*). A series of similar stitches on either side completes the first layer. The uppermost and lowermost sutures are passed before the remainder, so as to ensure closure of these two danger points. With

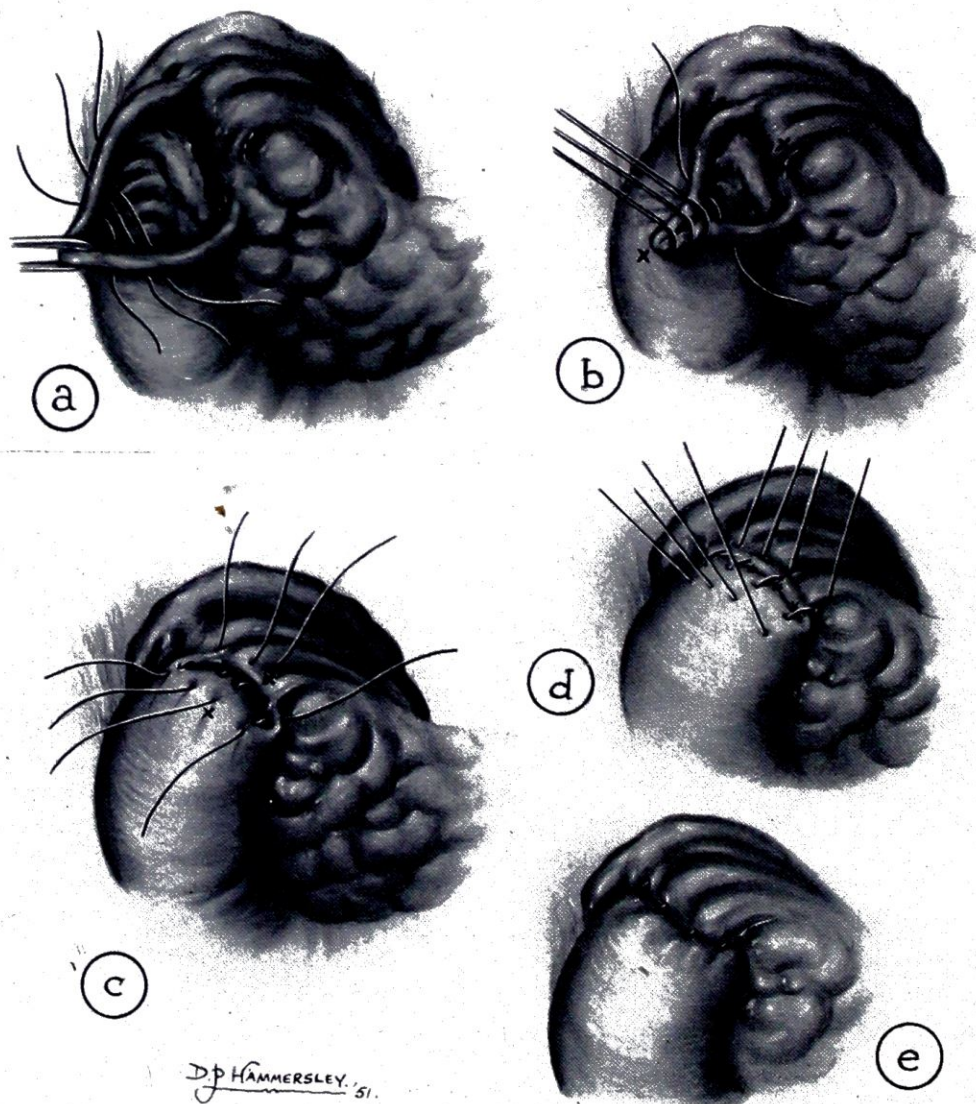


Fig. 368.—The inturning method of closure of the duodenum in the presence of a chronic penetrating ulcer in the posterior wall. (F. H. Bentley, 'British Journal of Surgery'.)

the exception of the central stitch, all sutures of this row are passed before they are tied. A second layer of interrupted thread sutures is passed to bury the first layer, each stitch taking a secure bite of the thickened edge of the pancreas behind, and of the anterior duodenal wall in front (*Fig. 368, d, e*). The suture line is reinforced by local omental flaps.

ALTERNATIVE TO SUBTOTAL GASTRECTOMY

1. A Gastric Ulcer penetrating the Pancreas or the Liver is found.—After opening the lesser sac, the stomach is separated from the organ to which it is attached by sharp and gauze dissection. The indurated margin of the resulting hole in the stomach is pared away with scissors; the defect is then closed with a series of interrupted stitches of strong

chronic catgut passed through all layers of the stomach. With a view to preventing re-adherence and leakage, the suture line is reinforced with a free omental graft. When the base of the ulcer is formed by the pancreas it is dangerous to cauterize the ulcer bed; leakage of pancreatic ferments will occur when the slough separates. If there is an open vessel in the floor of the ulcer, sutures are passed beneath the ulcerated area and tied lightly over oxycel or gelfoam; sutures tied tightly are liable to cut out. If there is no obvious vessel in the floor of the ulcer, it can be left alone. There is no objection to applying a diathermy or cautery to a cavity left in the liver. Whether in the pancreas or the liver, drainage of the ulcer cavity should be provided.

2. A Non-penetrating Chronic Gastric Ulcer is present.—

a. If, as is often the case, the ulcer lies on the posterior wall, transgastric suture can be carried out (*Fig. 369*). All the sutures must be deeply placed before tying. Should time and circumstances permit, a diathermy point can be thrust through the base of the ulcer, and the ulcer destroyed by electrocoagulation. The edges of the stomach surrounding the ulcer are then united firmly by sutures passing through the whole thickness of the stomach wall; they hold well. The incision in the anterior wall of the stomach is closed.

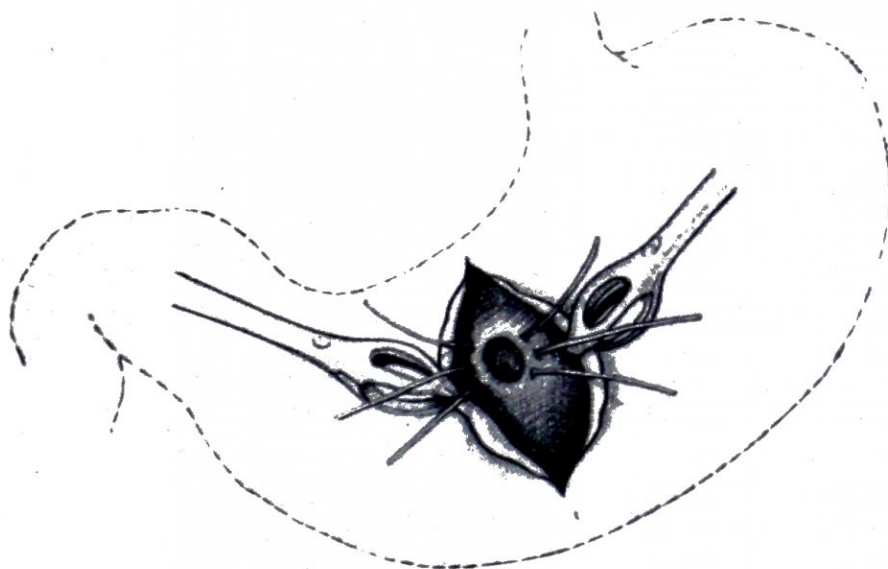


Fig. 369.—Transgastric suture of a bleeding gastric ulcer.

b. In the comparatively rare event of the ulcer being situated on the anterior wall of the stomach, the cautery is thrust through the centre of the ulcer and, by a rotatory movement, the greater part of the ulcer is destroyed. The resulting perforation is sutured.

c. The relatively common lesser curve ulcer is a somewhat more difficult problem. As a rule, if the lesser omentum in the neighbourhood is divided between ligatures, the base of the ulcer (sometimes saddle-shaped) becomes more accessible. Two stout ligatures are then passed deeply through the musculature of the lesser curve on either side of the ulcer. Incidentally, these ligatures secure the right and left gastric vessels, but their chief object is to act as tractors, while the cautery is plunged in a downward direction through the centre of the ulcer. After as much as possible of the ulcer has been destroyed, the perforation is firmly sutured.

3. There is an Ulcer on the Anterior Wall of the Duodenum.—

Even if there is a scar on the anterior surface of the duodenum, and, when rubbed with gauze, that scar exhibits surrounding petechial hæmorrhages (*Fig. 370*), thereby displaying activity, a second ulcer on the posterior wall of the duodenum should be excluded. This can be accomplished by burning a hole in the anterior wall of the duodenum through the centre of the scar, large enough to admit the little finger. If no ulcer can be felt on the posterior wall, the perforation is closed, and as far as the arrest of



Fig. 370.—Petechial hæmorrhages around the peritoneal aspect of a chronic peptic ulcer. These become very noticeable after gently rubbing the surface with gauze.

hæmorrhage is concerned, the result is likely to be highly satisfactory. If an ulcer is present on the posterior wall the opening in the anterior duodenal wall can be enlarged with scissors sufficiently to enable the ulcer to be undersewn with interrupted stitches. Closure of the rather large incision in two layers is likely to result in narrowing of the lumen of the duodenum ; as a consequence posterior gastrojejunostomy becomes necessary.



Fig. 371.—The stomach has been bisected one to two inches from the pylorus, and the anterior wall of the distal segment is about to be opened.



Fig. 372.—This manœuvre exposes a deeply-placed ulcer on the posterior wall of the duodenum. (After Allen and Benedict.)

Therefore, even if it is necessary to destroy an ulcer of the anterior wall, it is better to display the ulcer on the posterior wall in the manner next to be described.

4. When an Ulcer Crater can be palpated in the Posterior Wall of the Duodenum.—The best way of exposing the ulcer is as follows : after dividing the omenta in the immediate neighbourhood between ligatures, the pyloric antrum is bisected between clamps about $1\frac{1}{2}$ in. (3.8 cm.) proximal to the pylorus. The distal clamp is removed and two long hæmostats grasp the anterior wall of the distal segment (Fig. 371), which is divided between

them. The anterior wall of the duodenum is divided sufficiently to expose the ulcer fully (Fig. 372). The ulcer is then undersewn with interrupted sutures which, in the case of deep craters, are tied over a piece of oxycel or gelfoam. The divided anterior wall is sutured in two layers, and the cut distal end of the stomach is likewise closed and infolded. Finally the cut proximal end of the stomach is anastomosed to the side of the first coil of jejunum.

The pyloric antrum should be resected with or without the ulcer (depending on its site) in about two months' time. This operation is comparatively simple, for the œdema will have abated completely. The removal of this segment greatly minimizes the development of a jejunal ulcer.

LAPAROTOMY WHEN THE CAUSE OF THE HÆMORRHAGE IS DOUBTFUL

After palpating the stomach and the duodenum, if an ulcer is not readily apparent, proceed as follows:—

1. Inspect the liver for evidence of cirrhosis.
2. Examine an upper coil of jejunum. The colour of the intestinal contents is visible through the jejunal wall. If it is dark (due to contained blood) trace the coil to the duodenojejunal flexure. If darkness is evident as far as the third portion of the duodenum, obviously the blood must have come from somewhere above this point. Therefore re-examine the stomach and duodenum. Should no lesion be found, acute gastric ulceration must be assumed.
3. If the coil of jejunum referred to above is not dark, examine the lower ileum. Blood within the ileum is particularly obvious through the semitransparent wall of this part of the intestine. Look for a Meckel's diverticulum; in its absence, palpate the ileum for an intestinal polyp.
4. If there is no blood in the jejunum or ileum, and the hæmorrhage has occurred per rectum, it must have come from the large intestine. Therefore examine the large intestine, and particularly the pelvic colon, for an inflamed diverticulum.

MELÆNA AFTER APPENDICECTOMY

Very occasionally, not more than once in 800–1000 cases, melæna complicates appendicectomy. It is well to know of this possibility, for (rightly) the first thought is that the patient has a bleeding duodenal ulcer. The cause of hæmorrhage has invoked more discussion than its rarity and dangers warrant. Power's explanation that a tiny abscess under the purse-string suture bursts through the appendicular stump and causes secondary hæmorrhage is satisfying. I have seen but one undoubted example of this condition, and a transfusion of 2 pints (1 l.) of blood remedied matters permanently.

Massive Hæmorrhage from Œsophageal Varices.—See Chapter LXV.

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CHAPTER XXIX

THE STOMACH (*continued*)

ACUTE DILATATION OF THE STOMACH

OWING to the frequent use of post-operative gastric aspiration, acute dilatation of the stomach occurs less frequently than formerly. It can occur after any operation, or after the application (under an anæsthetic) of a plaster-of-Paris jacket, but the greatest incidence follows operations on the biliary passages and pelvic organs. More rarely, the condition complicates the state of shock, such as might be occasioned by a fractured femur.

It is of paramount importance to recognize this condition promptly, for practically all unrecognized cases end fatally. The day should have passed when the condition remains unsuspected until enormous effortless vomits, soon becoming the colour and consistency of the storm water of a peat-laden stream, make the diagnosis undeniable. Acute dilatation of the stomach can be diagnosed before the patient vomits.

Diagnosis.—We are summoned to the bedside because there is something amiss. The pulse is rising but the patient does not necessarily look gravely ill. He is not in any pain, but usually feels uncomfortable. Vomiting occurs relatively late. Let alone vomiting, at this stage he does not perhaps experience even nausea, but an occasional hiccup is not uncommon. The output of urine is invariably scanty, although during the first few hours this cannot be gauged with accuracy. A slight fullness may be seen in the hypochondria, obliterating the normal sulcus, immediately beneath the costal margin (*Fig. 373*), but in an obese subject this is difficult to assess. Even if the diagnosis of acute dilatation is merely on the horizon, no possible harm can accrue from passing a gastric aspiration tube. If large quantities of dark fluid are withdrawn, other things being equal, the diagnosis is confirmed.



Fig. 373.—Obliteration of the normal slight concavity beneath the costal margin is a somewhat characteristic sign in acute dilatation of the stomach.

Treatment.—

1. Empty the stomach, and keep it empty (*Fig. 374*). The fluid aspirated must be measured and charted.
2. Administer dextrose-saline intravenously. Remember, however, that in this condition the gastric aspirate contains a large quantity of chlorides. Therefore the second bottle should be normal saline without dextrose. Thereafter sufficient saline solution is given to prevent hypochloræmia. In cases where the condition persists for 36 hours, one bottle of Darrow's solution (to supply K ions) should be substituted for a bottle of dextrose-saline during the 24 hours.
3. Gastric lavage is unnecessary. Unless it is performed with normal saline solution, it has the danger of making the patient alkalæmic. It is best avoided altogether.
4. The patient is allowed to drink a few drachms of water each hour; it is aspirated promptly. Soon after the translucency of the gastric juice has been restored, Starr recommends that fluid and electrolytic balance be maintained by gravitating the necessary dextrose and electrolytic solutions through the gastric aspiration tube by the drip method, provided always that gastric motility has been proved to be adequate. In this way the danger of œdema of the lungs is avoided.
5. Frequent chemical examinations of the blood should be made, and as soon as the blood-chlorides return to normal, saline solution *per se* should be discontinued.
6. In cases where the blood-pressure remains low, intravenous infusion of dextran or, better, blood transfusion is required.
7. A high concentration of oxygen, given with a polymask or other type of mask for a long period, is decidedly beneficial.
8. The parenteral administration of vitamins B and C is of value, and should be given in every case.

If the case is one of early acute dilatation without other complications, signs of improvement are not long delayed (*Fig. 374*). The pulse improves, and the fluid aspirated lessens in quantity and becomes clearer. Even when the fluid aspirated is quite clear, danger is not passed, for gastric dilatation is prone to recur. The gastric aspiration tube should be left in place for at least thirty-six hours after the stomach has apparently regained its tone. Before withdrawing the tube a 'gastric motility' test (p. 197) is essential.



Fig. 374.—Severe acute dilatation of the stomach occurred four hours before this photograph was taken. The day previously the patient had had cystectomy performed for carcinoma of the bladder.

GASTRIC TETANY (ALKALÆMIA)

This rare complication, seen in cases with *chronic dilatation of the stomach*, may occur after gastric operations. The spasms are usually confined to the extremities, and the attacks are accompanied by dyspnoea and cyanosis. If the stomach is dilated, it must be emptied and kept empty by aspiration. Continuous intravenous saline and glucose should be administered without delay. Three cases of gastric tetany responded immediately to calcium gluconate, 10 ml. of a 10 per cent solution, injected intravenously (I. I. Price). In order to adjust the chloride balance, normal saline solution should be administered as soon as possible.

ACUTE VOLVULUS OF THE STOMACH

Volvulus of the stomach takes place in two main directions—around a vertical axis and around a horizontal axis (*Fig. 375*). In the latter variety, which is more usual, the pyloric antrum may come to lie in front of the cardia (*Fig. 376*). Normally the omenta, with their contained blood-vessels, allow the stomach to rotate through 90° around its longitudinal axis only. For abnormal rotation to occur, there must be considerable stretching of the gastric ligaments, and particularly of the gastrohepatic omentum. Diaphragmatic hernia, gastroptosis, and hour-glass stomach predispose to volvulus of the stomach, which is a very rare emergency. In spite of this, acute volvulus of the stomach should not remain undiagnosed for many hours, as is so often the case. The condition is extremely urgent.

Diagnosis.—Acute volvulus of the stomach is equally common in both sexes, and may occur at any age, although it is encountered most frequently in elderly persons. The condition usually gives rise to recurrent attacks of upper abdominal pain with distension, accompanied by retching. One day the volvulus fails to rectify itself. The symptoms

are: sudden pain, often excruciating, commencing after a full meal and increasing from hour to hour; considerable shock; retching, with small amounts of frothy vomitus *without bile*. Melæna occurs frequently. Often there is a large resonant swelling in the upper abdomen. The fact that a gastric aspiration tube often cannot be passed aids in the diagnosis. Radiography shows a large gastric air-shadow. Early operation is imperative, otherwise the distended stomach, with an impoverished blood-supply, will burst.

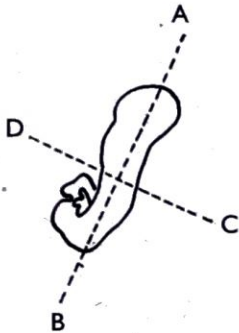


Fig. 375.—The main axes of rotation of the stomach. (E. A. Spriggs and O. A. Marxer.)



Fig. 376.—Horizontal volvulus of the stomach.

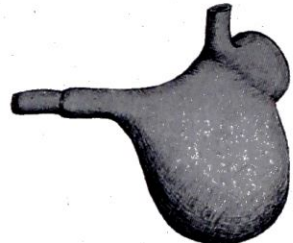


Fig. 377.—Stomach after reduction. (James Buchanan, 'British Journal of Surgery'.)

Laparotomy.—Even with the abdomen open volvulus of the stomach may be difficult to recognize. Buchanan found blood-stained fluid in the peritoneal cavity and a swelling that had the transverse colon above it. The swelling was covered with a thin layer of omentum. This was incised and a bluish mass presented. Further examination revealed large tortuous veins proceeding from the greater curvature. After a stomach tube had been passed by the anæsthetist, a large quantity of gas escaped, followed by blood-stained material. It was then found that the deflated stomach could be untwisted (Fig. 377).

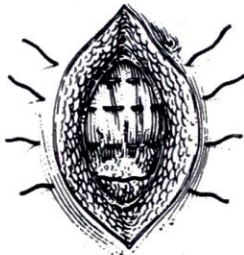


Fig. 378.—A simple form of gastropexy using unabsorbable sutures.

Often it is impossible to pass a stomach tube, in which case the wall of the stomach must be punctured in a manner similar to that shown in Fig. 592, p. 444. Afterwards the puncture is closed by the insertion of a purse-string suture. Detorsion can then be accomplished. When the condition of the patient permits, a simple form of gastropexy (Fig. 378) should be performed. Owing to delay in operation, the mortality rate is 60 per cent.

EMERGENCIES ARISING AFTER GASTRIC OPERATIONS

Probably no class of case is so worrying as dealing with an emergency following a gastric operation. Particularly unenviable is the lot of a young surgeon who has to decide the right course of treatment when he has not performed the original operation.

Two special emergencies after partial gastrectomy and gastro-enterostomy are: (1) Hæmatemesis; (2) Vicious circle vomiting. Fortunately, both of these are now rare; for this very reason, we must be adequately prepared for them.

Hæmatemesis and/or Melæna.—Loosening the clamps after a second row of sutures has been inserted and waiting a few moments to see if there is any bleeding point, has reduced the incidence of post-operative hæmatemesis enormously. Though bleeding following operations upon the stomach is nearly always from a vessel in the suture line, the possibility of the ulcer (if it has not been removed) being the source of the hæmorrhage must be considered. In order to get a thorough grasp of the type of case with which we are at present concerned we will describe an actual example.

The patient had subtotal gastrectomy performed early in the afternoon. At 10 p.m. he vomits rather bright-looking blood. Twenty minutes later he has a large vomit consisting of clots and bright red blood. How is the case to be managed?

If the general condition is good, adopt the following:—

1. Pass a gastric aspiration tube and wash out the stomach gently with normal saline solution at 120° F. (48.8° C.), and then proceed as described on p. 286. A sufficient time

having elapsed for the styptics to act, it is wise to continue with the continuous gastric aspiration, for bile is a powerful anticoagulant.

2. Have the pulse recorded every half hour on a separate piece of paper pinned to the chart.
3. Give morphine, $\frac{1}{4}$ gr. (16 mg.), subcutaneously. Further injections of $\frac{1}{4}$ gr. (10 mg.) can be given in due course, if required.
4. Commence blood transfusion as soon as possible.
5. Give vitamin K* intramuscularly twice or three times a day for two or three days.
6. Raise the foot of the bed on blocks.

While a most conservative attitude should always be adopted towards reopening the abdomen, there should be no such attitude towards blood transfusion. I have seen re-suture of a bleeding anastomotic suture line brought to a successful conclusion when death would have been inevitable without operation. Nevertheless, such cases are, unfortunately, exceptional. A more usual result is to find that, whilst the patient recovers from the second operation and gives every hope of recovery, a curious post-operative peritonitis supervenes about the fifth day, and death quickly follows, the terminal stages being characterized by a low muttering delirium. A former colleague of mine noted this unhappy sequence of events in three consecutive cases. This depressing picture should not induce us to fold our hands when we ought to be opening our instrument bags. If the bleeding continues in spite of transfusion, if it is thought wiser to hurry forward the operation, or if suitable blood cannot be obtained quickly enough, then operation must be undertaken.

Operation.—The skin is prepared as carefully as possible. The sutures are cut with scissors, and the incision is reopened. It is unwise to omit to place towels accurately on the skin edges, for infection is very prone to supervene when the abdomen has to be reopened before the original incision has had time to heal. In the case of a subtotal gastrectomy two deeply placed stay sutures are inserted near the extremities of the anterior wall of the gastric stump, in order to be enabled to draw it downwards and forwards. After the area has been isolated with abdominal packs, an incision is made into the stomach, parallel to the line of anastomosis. In the case of a gastrojejunostomy, the incision can be vertical (*Fig. 379*). After sucking and swabbing out the blood and blood-clot look first at the posterior suture line and then at the anterior. When no bleeding point is discovered, the posterior suture line is made more accessible by placing a stay suture at each end. Using a lockstitch the whole circumference of the stoma is oversewn. This must control any hæmorrhage from the suture line. The incision in the anterior wall of the stomach is closed by a double layer of sutures.

Remember that post-operative peritonitis and bronchopneumonia are prone to follow this reopening of the abdomen. Every possible precaution of packing off the area with damp abdominal packs should be taken. Antibiotic therapy should be commenced forthwith and parenteral fluid administered with especial care to avoid overhydration.

Remote Severe Post-operative Melæna.—Severe melæna sometimes occurs a week to ten days or more after gastrojejunostomy. The particular type of case this uncommon complication seems to favour is duodenal ulcer with stenosis. When hæmorrhage occurs so remotely, it is unlikely that the bleeding

is coming from the anastomosis—it is the ulcer that is bleeding. This type of hæmorrhage is liable to be overlooked until the patient is severely anæmic, especially as the patient has probably been doing well up to the time of the onset. The management of the case is in all respects similar to that of melæna from other causes (*see Chapter XXVIII*).

Failure of the Stoma to function: 'Vicious Cycle'.—During the first 48 hours after operations upon the stomach, in a large proportion of cases bile-stained fluid is aspirated; in most cases this lessens in amount 24–48 hours after the operation. The amount of

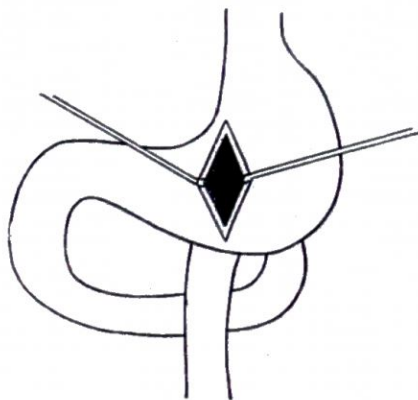


Fig. 379.—Method of inspecting the interior of the stomach by incising the anterior wall. By this method a bleeding point on the line of the anastomosis can be seen.

* Vitamin K—Synkavit (Roche); Kapilon (Glaxo).

fluid aspirated must be recorded accurately. If after 48 hours, large quantities of bile are recovered by aspiration or if vomiting commences, a serious view of the case must be taken. Obviously the stoma is not functioning—it is very suspicious of vicious cycle. True, it is possible that the obstruction may be due to oedema of the stoma, a rather theoretical concept. If the condition of the patient is not deteriorating, it is often advisable to rely upon gastric aspiration and continuous intravenous infusion until the fourth or fifth post-operative days, a course that should be pursued for even longer when the calculations show that even one-third of the bile is passing through the stoma. In order to make these calculations accurate charting of the fluid recovered by aspiration is essential.

While we are most reluctant to reopen the abdomen, a time is reached when, in our judgment, it is unwise to delay longer.

Special precautions to prevent infection when reopening the abdomen are the same as those described on p. 297. The first thing to ascertain is whether there exists an obvious obstruction distal to the anastomosis. By tracing the loop downwards for about a foot, especially if it is not dilated, this possibility is ruled out at once.



Fig. 380.—Anastomosing the efferent and afferent loops. The second layer of sutures is about to be inserted.

If the operation has been a partial gastrectomy (Polya type) anastomose the afferent to the efferent loop. These loops are accessible, and the technique is not difficult (Fig. 380).

If the operation was a posterior gastrojejunostomy turn up the colon and observe the transverse mesocolon and the stoma. Perhaps the hole in the transverse mesocolon is small, and the anchoring sutures have failed to prevent the anastomosis slipping upwards into the lesser sac, thereby kinking the jejunum. Such findings are quite exceptional. If there is a definite kinking of the efferent loop from this cause, the stoma is drawn downwards and the stomach wall in the region of the anastomosis is firmly sutured to the mesocolon, care being taken to avoid including the middle colic artery in one of the stitches. In the majority of cases the only safe course is to perform an anastomosis between the afferent and efferent limbs. Because 'no loop' gastrojejunostomy is always performed, the efferent loop must be brought to the afferent limb of the anastomosis and the operation, which is difficult, is best carried out with interrupted stitches.

If the operation was an anterior gastrojejunostomy, anastomose together the efferent and afferent loops. These loops are accessible and the operation is simple.

If the previous operation has been a gastroduodenostomy, the indication is clear—perform gastrojejunostomy.

Vomiting commencing after a Spell of Satisfactory Progress.—There are three possibilities to be considered :—

1. If the vomits are large, the patient collapsed, and particularly if these untoward symptoms come on suddenly, it must be assumed that some degree of *acute dilatation of the stomach* is present, and treatment is conducted accordingly (see p. 294).

2. If the stoma progressively fails to function, *cicatricial contraction of the mouth of the efferent limb* is probable, and the treatment is the same as that of vicious cycle.

In the case of a Billroth I operation, if cicatricial contraction occurs the material vomited is stomach contents only. When feeds are stopped and gastric aspiration is instituted, little or nothing is withdrawn. In such a case re-operation is the only course, and the best procedure is to unpick the anastomosis, close the duodenal end, and make a new anastomosis between the proximal end of the stomach and the side of a loop of the commencement of the jejunum brought up in front of the transverse colon.

3. The possibility of *high intestinal obstruction* should be considered. A plain radiograph may be of diagnostic assistance.

SMALL-BOWEL OBSTRUCTION FOLLOWING PARTIAL GASTRECTOMY

The condition is probably more frequent than published cases would indicate. Stammers collected 16 cases, in 15 of which the anastomosis was antecolic. The small intestine passes through the gap between the anastomosis and the transverse mesocolon. Herniation occurs either from right to left (*Fig. 381*) or from left to right. The amount of intestine so herniated may be as little as 9 in. (24 cm.) or as great as 19 ft. (5.7 m.). The condition is one of high intestinal obstruction which usually commences between the third and the eighteenth post-operative days, but the symptoms are atypical because so often gastric aspiration is in progress, or is re-instituted soon after the first or second vomit. In the presence of continuous intravenous fluid therapy and gastric suction, the pain is not always colicky; indeed, in most of the reported cases pain was continuous and of increasing severity. If the dual test (*see p. 465*) were applied after 24 hours' gastric suction, remitting pain of increasing severity would occur, as in other cases of intestinal obstruction.

Treatment.—When the condition is strongly suspected, the abdomen must be re-opened, if necessary under local anaesthesia. The hernia is usually reducible without particular difficulty. Gangrene due to long delay is present in 30 per cent of cases. The mortality is also 30 per cent, but the fatalities are not limited entirely to cases of gangrene.

The only method of preventing herniation through the hiatus created during the operation of partial gastrectomy is to obliterate it at the time of the operation.

In only one of Stammers' series was the anastomosis retrocolic.

Strangulation of small intestine around a gastrojejunostomy stoma is very uncommon, and has occurred most often about a fortnight or three weeks after the operation. The small intestine passes behind the afferent loop, and becomes strangulated (*Fig. 382*). Like similar obstruction occurring after partial gastrectomy, the hernia is usually easily reducible. Be-

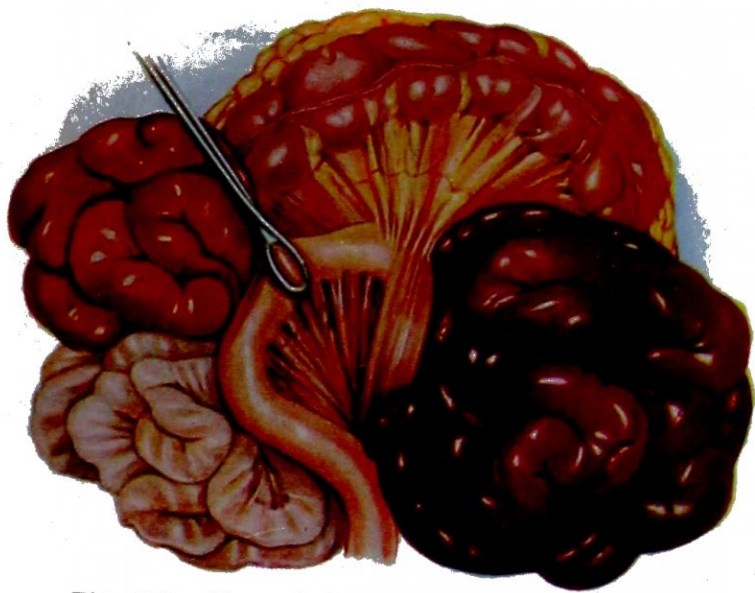


Fig. 382.—Strangulation of the small intestine by the afferent loop of a posterior gastrojejunostomy. (G. Armitage, 'British Journal of Surgery'.)

cause the transverse mesocolon is anchored to the stomach at the conclusion of a gastrojejunostomy, herniation of the small intestine into the lesser sac now hardly ever occurs; in days gone by, before this step was carried out meticulously, the complication was not infrequent.

LEAKAGE AND PERITONITIS AFTER GASTRECTOMY

Prevention of a Duodenal Fistula.—If towards the end of any operation of gastrectomy of the Polya type a gastric aspiration tube is passed through the stoma into the proximal jejunum towards the blind end of the duodenum, and continuous suction is applied for four days, the intraduodenal pressure is kept low during the early stages of healing of the closed end of the duodenum.

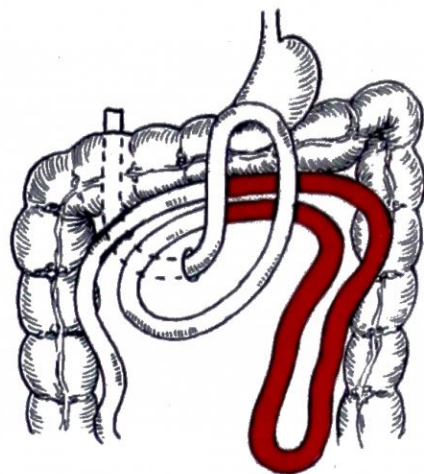


Fig. 381.—Herniation through the gap between an antecolic anastomosis and the transverse mesocolon. (After F. A. R. Stammers.)

A duodenal fistula develops in 3 per cent of cases of partial, subtotal, and total gastrectomy. Usually it occurs comparatively late, i.e., on the tenth to the twelfth day. For this reason, until this danger is passed, some form of drainage of the area should be provided. The drainage tube (or the piece of corrugated rubber) should be moved and shortened, but in cases where difficulty was experienced in closing the duodenum or the stomach, and particularly in cases where the ulcer penetrated the pancreas, a potential vent through the abdominal wall should be provided for at least 10 days. This advice is the outcome of a long association with gastric surgery. If leakage occurs and no drainage is provided, a common sequence of events is the development of a sub-diaphragmatic or subhepatic abscess which, after surgical drainage, results in a fistula that digests the abdominal wall. In other cases diffuse peritonitis results. Occasionally the provision of drainage fails to prevent the development of widespread peritonitis. Of 13 cases of duodenal leakage where no drainage was provided, 11 died (Larsen and Foreman).



Fig. 383.—Common sites of fistulae following partial gastrectomy.

A fistula can occur from the blind end of the duodenum (A) or, what is not very uncommon, from a leak at (B). (Fig. 383.) The latter is, of course, strictly a jejunal



Fig. 384.—On the tenth day after operation a serious fistula followed partial gastrectomy for a huge ulcer penetrating the pancreas. The measures detailed in the text were carried out. Bile-laden fluid from the fistula was collected in the bottle and periodically the contents of the bottle were gravitated into the jejunum. Excoriation of the abdominal wall was insignificant.

fistula, but there is no means of distinguishing (A) and (B) from an inspection of the discharge. A fistula at (B) should be suspected when there was no difficulty in closing the duodenum, but when the ulcer was high in the stomach and the blood-supply to the lesser curve may have been jeopardized. From the practical standpoint the treatment is the same. Perform jejunostomy under local anæsthesia by the technique described on page 523, at the very earliest opportunity. The patient is then nursed in Fowler's position and after taking full precautions to protect the skin about the fistula from becoming excoriated (see Chapter XLVII) and abdominal wall from disrupting (see p. 172), suction drainage is instituted (Fig. 384). By exercising a little ingenuity in the manner of applying the suction in each individual case the fistula can be kept under control. Jejunal feeding (Fig. 385) is carried out in accordance with the instructions given on page 524.

Aetiology and Prophylaxis.—Much investigation has been carried out as to why a duodenal fistula sometimes follows closure of the duodenum in subtotal and other forms of gastrectomy. The presence of a drainage tube impinging upon the closed duodenum has been incriminated, but if the drainage tube is soft, or if the drain is of corrugated rubber,

it is impossible for it to cause pressure necrosis. Moreover, there is no need for the drain to touch the duodenum.

There is little doubt that leakage from the duodenal stump is due to one or more of three causes:—

1. Mobilization of even $\frac{3}{4}$ in. (2 cm.) of the duodenum is liable to imperil the blood-supply of the stump, and so lead to necrosis and leakage.

2. Anæmia, hypoproteinæmia, avitaminosis, and dehydration all predispose to failure of intestinal lines of suture to heal.

3. Probably the most important factor is that there is obstruction to the exit of the blind afferent loop, and the increased pressure therein leads to a 'blow-out' (R. W. McNealy et al.).

RETROGRADE JEJUNOGASTRIC INTUSSUSCEPTION

Retrograde jejuno-gastric intussusception can occur after gastrojejunostomy or partial gastrectomy:—

1. The afferent limb may intussuscept into the stomach.

2. The efferent limb may undergo retrograde intussusception which either stops short of the stoma, or passes through it into the stomach (Fig. 386).

3. Both afferent and efferent limbs together may intussuscept into the stomach.



Fig. 385.—This photograph was taken fifteen days after jejunostomy had been performed. By this time the fistula had almost closed, but to be on the safe side the patient is still receiving all his nourishment through the jejunostomy tube. The fistula healed within eighteen days.

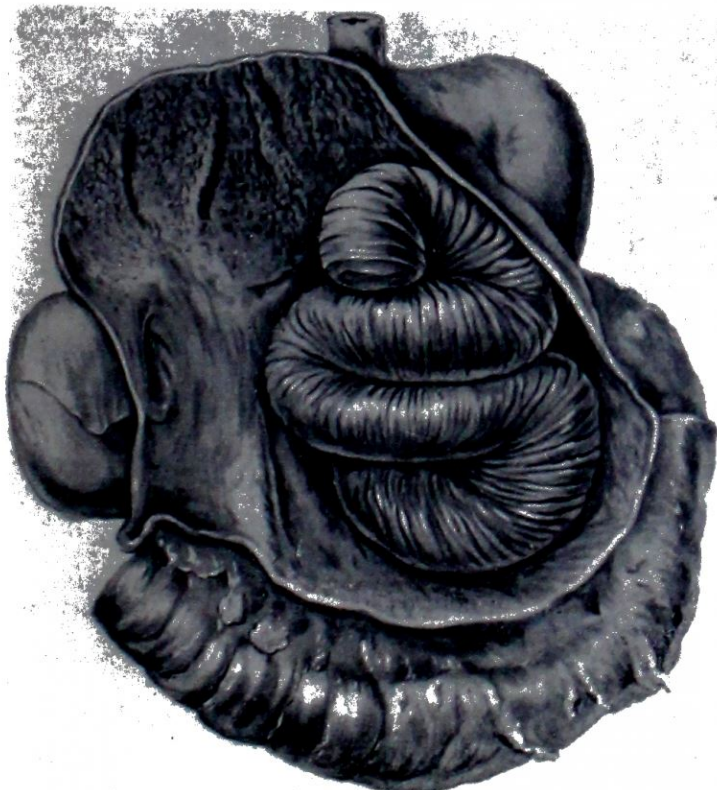


Fig. 386.—Retrograde intussusception of the small intestine after gastrojejunostomy.

All are very uncommon. Women are affected more often than men, and in two cases the patient was pregnant at the time. The intussusception has occurred between a few days to several years after the operation.

If the condition is borne in mind, it is not impossible to make a correct pre-operative diagnosis. Symptoms occur suddenly. The pain is gripping, epigastric, colicky. Vomiting soon occurs, and is frequently repeated. The vomitus at first is food, then bile, and then blood. If rigidity and tenderness are absent perforated gastrojejunal ulcer can be ruled out. Usually a lump can be felt in the epigastrium.

One of the most helpful diagnostic aids is a plain radiograph of the abdomen. This sometimes shows the typical step-ladder pattern of jejunal loops within the gastric outline (A. White).

Hamilton Drummond's Case.—

A platelayer, aged 35, on the previous day was seized with spasmodic epigastric pain after taking food. The pain, coming in spasms, had continued, and he had vomited many times, latterly almost pure blood. The patient looked ill. The pulse was 96 and the temperature 98° F. (36.6° C.). Whilst under observation he had several attacks of pain accompanied by small vomits of blood. Examination revealed a scar in the epigastrium. He had undergone gastro-jejunosomy sixteen years previously. There was no tenderness or rigidity. Two hours after admission laparotomy was performed. The proximal loop of the anastomosis was enormously dilated. About 6 ft. (1.8 m.) of small intestine from the distal loop had become intussuscepted into the stomach. This was reduced easily.

After the abdomen has been opened and the condition recognized, reduction is undertaken by squeezing the mass in the stomach towards the stoma.

When operation is undertaken at a late stage, reduction may be impossible. In such circumstances, an incision in the anterior wall of the stomach should be extended until the edge of the stoma is reached. Once the ring that imprisons the intussusception has been divided, reduction is possible. Should the gut be gangrenous resection must be undertaken. When time permits, stitching together the afferent and efferent limbs will help to prevent recurrence.

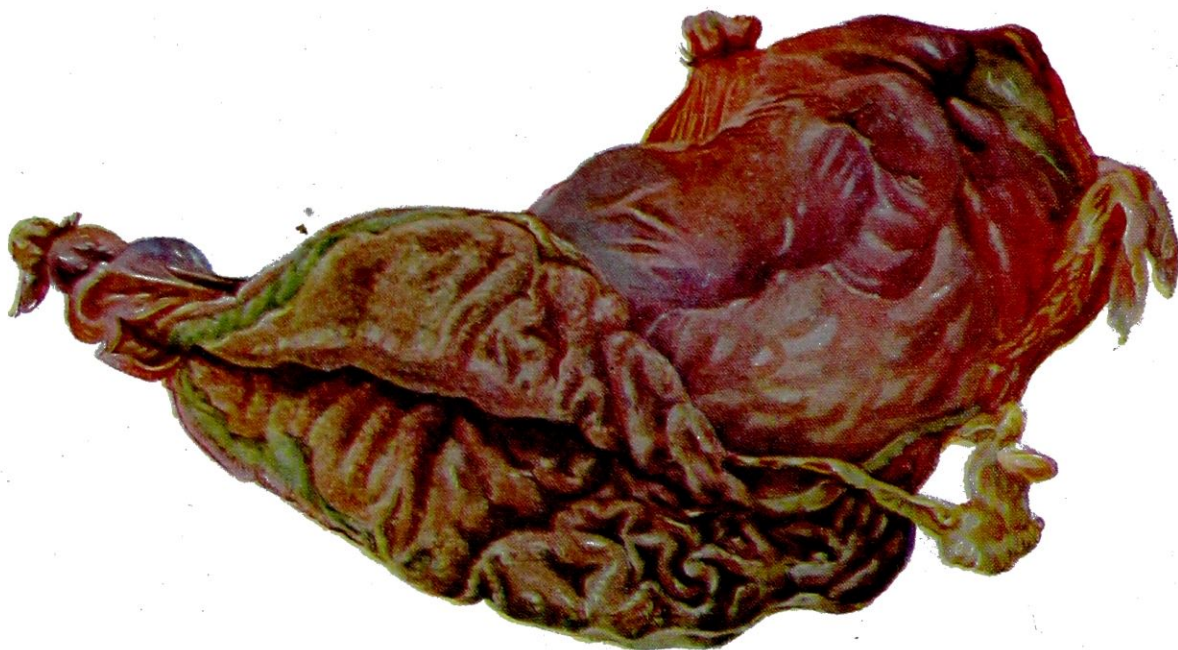


Fig. 387.—Lord Moynihan's case of phlegmonous gastritis.

ACUTE PHLEGMONOUS GASTRITIS

This condition was called by E. Rixford "acute suppurative cellulitis of the stomach", a name that conveys an accurate picture of its pathology. The stomach is swollen and angry, and pus is found in the submucosal layer (*Fig. 387*).

Lord Moynihan's Case.—

The patient, a boy aged 17, was taken ill a few hours after eating pork pie. He complained of acute abdominal pain, and there was exquisite epigastric tenderness. The epigastrium was distended.

The boy was very ill; the pulse was never less than 118; there were collapse, vomiting, and profound prostration, which ended in death about thirty-eight hours after the onset of symptoms. At the post-mortem a typical and most acute phlegmonous gastritis was found. No lesion of the mucous membrane of the stomach could be seen.

When the stomach has been examined after death, the mucosa has been found to be intact and comparatively normal in all but a few instances. In these exceptions a carcinoma or a chronic gastric ulcer has been present.

The offending organism is nearly always a streptococcus. Exceptionally, a pneumococcus is the cause.

Jennings Marshall's Case.—

A man of 54, during convalescence from pneumonia complicated by empyema, commenced to vomit. He continued to vomit copious bright-red jelly. There was rigidity in the upper abdomen, but little tenderness or other symptoms. Laparotomy revealed an œdematous stomach with the gastric wall $\frac{1}{2}$ in. (8.5 mm.) thick. The abdomen was closed and the patient recovered.

In its most acute form acute phlegmonous gastritis invades both walls of the stomach from the cardia to the pylorus. There is a localized type that, when situated near the pylorus, has been treated successfully by partial gastrectomy, as in Gerster's cases. There is also a variety mainly confined to the duodenum.

The absence of characteristic signs and the rarity of the condition make pre-operative diagnosis impossible. Probably some cases resolve and the true condition never comes to light. In the very acute generalized forms, acute pancreatitis, perforated gastric ulcer, and pneumonia enter the clinical picture; while in the variety confined to the pylorus, acute cholecystitis appears to be the most likely pre-operative diagnosis.

Recognition at Laparotomy.—On opening the abdomen (usually on a diagnosis of perforated peptic ulcer) some perigastric peritonitis is likely to be found. The stomach is infiltrated and inflamed, its walls being likened to wet blotting paper. If doubt exists as to the nature of the condition, insert a hypodermic syringe into the stomach wall. Thick muddy pus is withdrawn into the syringe from the submucosa. If pus is aspirated a small incision should be made down to the submucous layer. In either event drainage leading to the anterior surface of the stomach and also to the lesser sac must be provided. If the stomach wall has been incised the greater omentum should be stitched to the lower part of the incision so as to form an omental barrier. If pus has been aspirated it should be sent for culture and antibiotic sensitivity.

Drainage should be maintained until the pulse-rate and temperature reach normal.

Antibiotic therapy is of course the mainstay of treatment.

GASTROSTOMY

There are occasions when gastrostomy to relieve starvation from œsophageal obstruction is a semi-emergency (*Fig. 388*). The operation can easily be carried out under local infiltration. A short incision is made a little to the left of the midline. The rectus muscle is split,



Fig. 388.—Patient about to undergo gastrostomy. He has only been able to keep down a little water during the past week. Carcinoma of the œsophagus.

the peritoneum opened, and the stomach, which is often small and retracted, is found and drawn to the surface. A portion of the anterior wall about the middle of the body of the stomach is selected and held up by two Lane's forceps. With a narrow-bladed scalpel, a stab is made into the lumen of the stomach; this is followed by a hæmostat, the jaws of which are opened to make quite sure that the stab has passed through all coats of the stomach. The scalpel and the hæmostat, being infected, are discarded. A suitable

rubber catheter (not too small) is selected and an extra eye is cut near the tip. About 3 in. (7.5 cm.) of the catheter are passed into the stomach, and the catheter is transfixed by a catgut stitch that anchors it to the stomach wall. A second catgut stitch may be necessary, to make a snug junction. Three rows

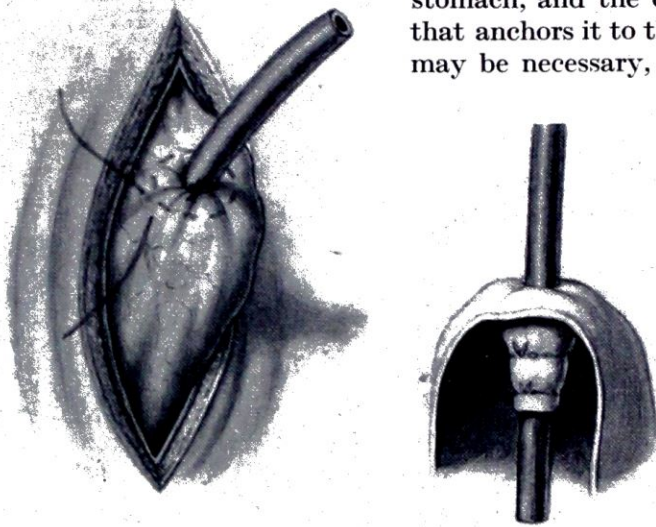


Fig. 389.—The Abbé-Kader-Senn-Stamm operation of gastrostomy.

of *unabsorbable* purse-string sutures are employed to invaginate the stomach wall, producing the well-known unspillable ink-bottle effect (Fig. 389). The stomach in the immediate vicinity of the exit of the catheter is firmly sutured to the peritoneum, and the wound is closed. At the conclusion of the operation it is customary to give a feed while the patient is still on the operating table, in order to be certain that the tube does, in fact, lie within the lumen of the stomach. As soon as the patient has been returned to bed drip feeding can commence.

HYPERTROPHIC STENOSIS OF THE PYLORUS

Hypertrophic pyloric stenosis of infants is seldom an emergency condition. Occasions arise when it becomes really urgent to relieve the pyloric obstruction. Dehydration is corrected by the administration of dextrose-saline solution given either intravenously or subcutaneously with hyaluronidase. The stomach is kept empty during this period by gastric aspiration. If it has not been tried already Eumydrin (atropine methylnitrate) 1–10,000 freshly-made, can be given by mouth, commencing with 0.5–1 ml. half an hour before each feed, and if the pylorus relaxes, increasing to 2.5–3 ml. Small hourly feeds of milk—if possible, mother's milk—diluted with 5 per cent dextrose, are tried, but if the greater part does not pass through the pylorus, it is unwise to persevere for more than six hours.

Rammstedt's Operation.—The operation can be conducted under local anæsthesia (Fig. 390). The abdomen is opened by an incision over the pylorus, the rectus muscle being either retracted outwards or split vertically. The greatly hypertrophied pylorus is held in the finger and thumb and rotated somewhat so that the upper surface comes to look forward. The muscle coats are incised down to the mucosa (Fig. 391), great care being exercised not to perforate the mucous membrane, an accident especially

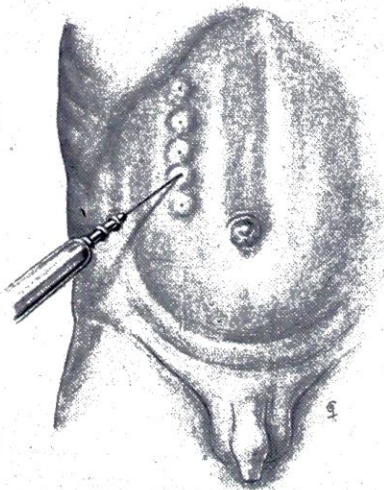


Fig. 390.—Infiltrating the abdominal wall with local anæsthetic.



Fig. 391.—Hypertrophic stenosis of infants—incising the pylorus.

liable to occur where the hypertrophied pylorus terminates abruptly to join the comparatively thin duodenum. Using a blunt dissector, the thickened muscle, which cuts like an unripe pear, is eased from the mucosa at the bottom of the wound and the mucosa bulges into the incision. It is a good practice to place a tiny piece of muscle from the rectus in the pyloric incision—this helps to arrest oozing. If the mucosa is opened accidentally (this will become evident if air is squeezed gently from the stomach into the duodenum) it should be closed with a catgut stitch, and a corrugated rubber drain inserted through the incision. The abdomen is closed. The feeding of the patient after the operation requires strict supervision. Very small feeds are the order of the day, especially during the first three days.

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CHAPTER XXX

THE GALL-BLADDER AND BILE-DUCTS

GALL-STONE COLIC

MORPHINE and its derivatives, so long the standard treatment of gall-stone colic, do not relieve the pain as often as would be expected. If enough of the narcotic is given to render the patient stuporous, it is liable to increase the damage of a liver already damaged. What should be given is a drug which relaxes spasm of involuntary muscle (morphine causes such musculature to contract). A drug fulfilling these requirements is pethidine¹ (B.P.C.), 2 ml. (100 mg.) intravenously. In severe cases the dose can be repeated in one hour.

As soon as the acute pain has passed off is the time to apply heat in some form to the right upper abdomen. It is often impracticable to expect the patient to tolerate hot applications while rolling in agony.

When an attack of biliary colic is followed by jaundice, it is almost certain that a stone has entered the common bile-duct. Even when the jaundice is unmistakable, good results often follow expectant treatment. It should be an unwavering rule never to be in a hurry to operate upon a patient who has recently had an attack of gall-stone colic. Even in cases of moderately deep jaundice, by waiting patiently for a week or more frequently we can spare the patient undergoing an operation at an unfavourable time, for so often the jaundice clears, even though at the subsequent operation a stone or stones are found in the common bile-duct. Jaundice means depressed liver function. To operate upon patients with a depressed function will result in a percentage of unexpected deaths in the post-operative period, fatalities which are often unexplained by morbid anatomy (the hepatorenal syndrome).

Three or four days after the symptoms have passed off and the jaundice, if present, has cleared, cholecystography should be carried out. In most cases the examination will prove that the gall-bladder is diseased. If so (and possibly in the absence of radiological confirmation) an elective operation should be undertaken within the next few days.

While the above instructions apply in cases of gall-stone colic with or without mild obstructive jaundice, from time to time cases will be encountered where the jaundice becomes deeper and the patient's temperature suggests that cholangitis is likely to supervene. In such circumstances, to delay unduly is a surgical misdemeanour. The operative treatment of obstructive jaundice is discussed on p. 323.

CHOLECYSTOSTOMY

At the present time it is fashionable to regard cholecystostomy with considerable condescension, but with the proviso that it is desirable only in cases of the direst urgency or when the surgeon is too timorous or inexperienced to perform cholecystectomy. This patronizing attitude is unwarranted; cholecystostomy is an excellent atraumatic procedure, which can be carried out readily under local anæsthesia. The surgeon should never feel ashamed of performing cholecystostomy in cases of emergency. He should recall that the incidence of accidental ligation of the hepatic artery, and especially injuries to the common bile-duct, have increased in frequency (H. K. Gray) as a result of cholecystectomy being performed for acute cholecystitis. The main reason for this is that, especially after 48 hours' duration, œdema often makes the bile-ducts and their associated blood-vessels difficult of clear recognition.

The indications for urgent cholecystostomy are:—

1. Fulminating cholecystitis.
2. Acute obstructive cholecystitis. Failure of regression of symptoms and signs within 48 hours.

¹ Known in the U.S.A. as Demerol.

3. Mucocele of the gall-bladder.¹
4. Empyema of the gall-bladder.
5. Diagnosis uncertain. Acute inflammation of the gall-bladder found.
6. Perforation of the gall-bladder.
7. Stone impacted in the common bile-duct, and cholangitis and cholæmia threatening life.

Operations on the gall-bladder are made easier by having a sandbag under the back about the level of the 11th dorsal vertebra. Most operating tables are provided with a movable bridge (*Fig. 392*), which is much more convenient. It is important to see that



Fig. 392.—The gall-bladder position showing the 'bridge' of the operating table elevated.

the patient is in the correct position for this bridge to function *before* the operation is commenced. The adoption of this position is seldom required for cholecystostomy. It is, however, a useful stand-by.

Cholecystostomy can be performed through the midline incision, sometimes readily, but no one would choose this incision if the pre-operative diagnosis was assured because, if the patient is fat, the gall-bladder small, and the anæsthetic troublesome, the operation can be distinctly difficult by this route. A vertical incision over the right rectus, splitting that muscle, provides excellent exposure of the gall-bladder. By this route the abdomen is more easily and more quickly opened, and certainly more readily closed, than by a paramedian incision, especially if the anæsthetic is not all that it should be. Another advantage of splitting the rectus muscle is that a direct path to the surface is available for the cholecystostomy tube.

The limited transverse incision (*Fig. 393*) is especially recommended for cholecystostomy when the diagnosis is certain. It gives good access to the gall-bladder and it does not disturb Nature's barriers around the seat of infection.

Local anæsthesia can be employed for this incision with perfect satisfaction.

The Transverse Incision.—The fundus of the gall-bladder may be surprisingly low. Always palpate the abdomen before making the incision. Directly over the fundus, if the gall-bladder is distended, or over the anatomical surface marking, an incision is made designed to transect at right angles the right rectus muscle. Towels are clipped to the skin edges. The rectus sheath is divided in the length of the incision and the fibres of the rectus are displayed.



Fig. 393.—Incision for draining the gall-bladder. In this case in addition to cholecystostomy the right kidney pouch was drained through a stab incision in the flank.

¹ Cholecystectomy usually to be preferred.

CHOLECYSTOSTOMY

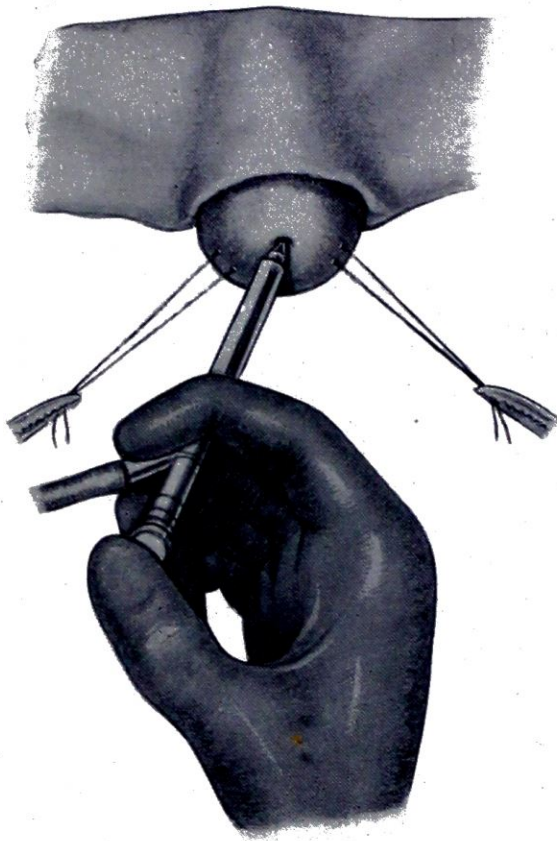


Fig. 394.—Cholecystostomy. Moynihan's method of isolating the fundus of the gall-bladder. A distended gall-bladder is first punctured with a trocar and cannula, and its fluid contents are permitted to escape.

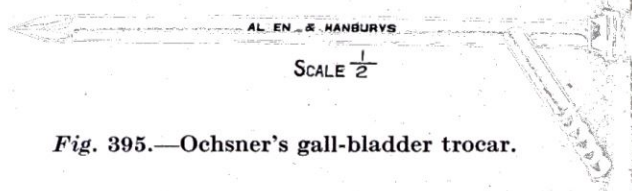


Fig. 395.—Ochsner's gall-bladder trocar.

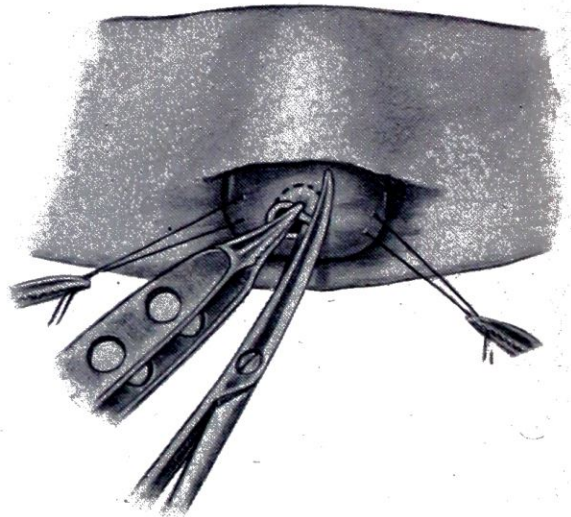


Fig. 396.—The puncture hole is enlarged by excising a crescentic portion of the fundus.

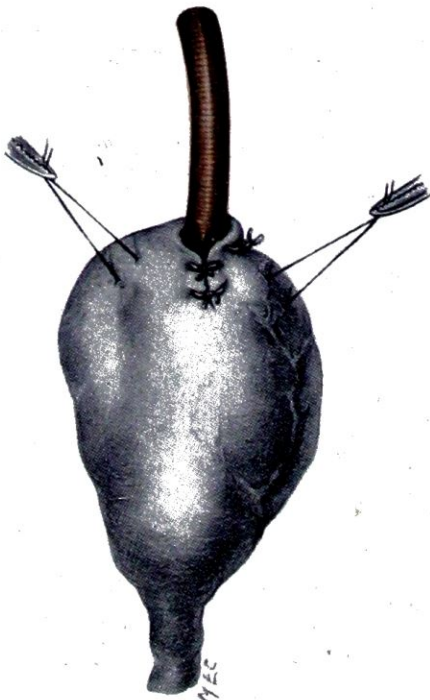


Fig. 397.—When the gall-bladder is thick and oedematous, the incision is closed about the tube by interrupted stitches.

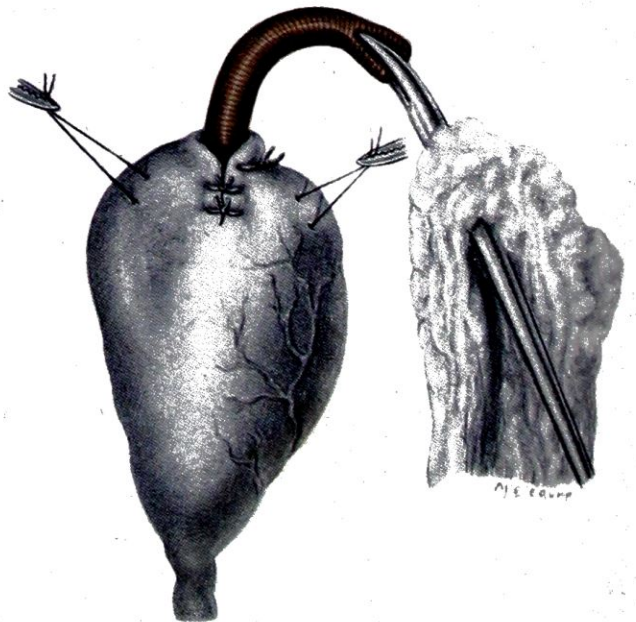


Fig. 398.—The tube is then brought through a convenient portion of the greater omentum, which reinforces the suture line.

With light touches of the scalpel or the diathermy needle the muscle-fibres are sectioned a few at a time, keeping strictly in the transverse plane. Sometimes there is hardly a vessel to ligate; usually the deep epigastric vessels require attention and a ligature on a needle is the best method of securing a bleeding vessel in muscle.

Having located the diseased gall-bladder, and freed any adhesions thereto, a moist abdominal pack is tucked below the gall-bladder. If the operating table is provided with a movable bridge, instructions can be given at this stage for it to be raised if necessary.

A small hole is cut in the centre of an abdominal pack, and through this hole the fundus of the gall-bladder is made to appear. The pad fits snugly around the organ, and when the viscus is opened, infected bile is prevented from running down and soiling the peritoneum. Puncture of the gall-bladder is the next step. Any attempt to grasp the tense and inflamed gall-bladder with instruments will result in tearing of its friable wall. Place two stay sutures through the fundus of the gall-bladder. They will steady the organ efficiently while the trocar and cannula (*Fig. 395*), with a sharp thrust, penetrates the fundus.

When the fluid contents have ceased to flow, the cannula is removed and the opening in the fundus is enlarged by excision of a crescentic portion of the wall (*Fig. 396*). The edges of the incision having been grasped by hæmostats, stones are removed from the interior (*Fig. 399*). Unless the calculi are very small, fenestrated forceps are better adapted to this work than a scoop. The fingers of the left hand beneath the pad may aid in the removal of the calculi by milking them from the region of Hartmann's pouch towards the open jaws of the forceps. After the gall-bladder has been emptied of stones, and if time permits, it is a good practice to pass strips of gauze into the interior of the organ until it is dry. Minute calculi are often dislodged by this means. A $\frac{1}{4}$ -in. (6-mm.) drainage tube with a lateral opening is then passed down into the body of the gall-bladder, and is retained in position by a single catgut stitch passing through the cut edge of the viscus. The gall-bladder is closed about the tube (*Fig. 397*). In large inflamed gall-bladders with thick friable walls a purse-string suture simply cuts out. In such cases the junction between the tube and

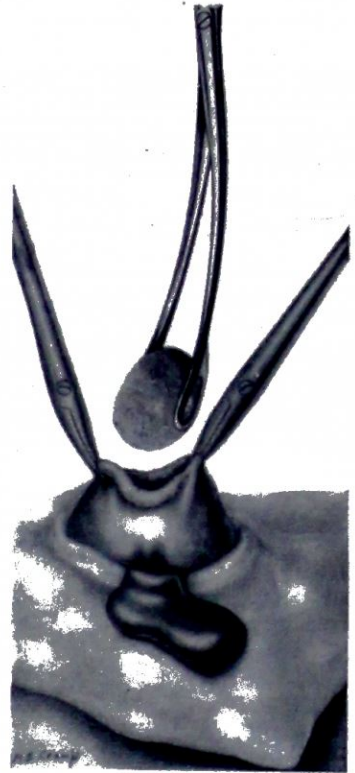


Fig. 399.—Cholecystostomy. Extracting a stone with fenestrated forceps. A scoop is also a useful instrument for this purpose.



Fig. 400.—A medicine bottle, a rubber teat, and adhesive plaster make a good sterile receptacle for bile. (After H. V. Cameron.)

the gall-bladder wall must be made as perfect as possible by the introduction of interrupted sutures, two of which usually suffice. The tube is then brought through a convenient piece of omentum (*Fig. 398*), which thus comes to rest upon and reinforces the suture line. The stay sutures referred to earlier in this description are brought through the omental covering and finally through the peritoneum before they are tied, thereby anchoring the fundus of the gall-bladder to the abdominal wall. If a midline or paramedian incision has been used, a stab incision is made over the gall-bladder and the tube is brought out through this. If the rectus has been split, or a transverse incision has been made, the tube is brought directly through the incision at a convenient spot, in which case the peritoneum must be carefully and independently approximated about the tube. After the abdomen has been closed, the tube is brought directly through the dressings, and, when the patient has been returned to bed, it is connected to a bottle for collecting the bile (*Fig. 400*).

CHOLECYSTECTOMY

A number of surgeons advocate early cholecystectomy for acute cholecystitis. By early cholecystectomy is meant 4–8 hours are expended in adjusting electrolytic balance, the administration of antibiotics, and carrying out other necessary pre-operative measures.

Provided the operation is carried out within 48 hours of the commencement of the attack, the technical difficulties and mortality of the operation, especially in patients under 50 years of age, is low. However, the general mortality figures are no better than, if as good as, those obtained by vigilant delayed treatment plus cholecystostomy in cases where that treatment fails to bring about resolution.

After a wave of enthusiasm for early cholecystectomy, some surgeons of experience in Great Britain, the U.S.A., Europe, and Soviet Russia are returning to the Ochsner-Sherren treatment, or to early cholecystostomy. Their reasons for this change are reviewed at some length in Chapter XCIV. In this chapter the opinion is expressed that when the surgeon is inexperienced in performing cholecystectomy, it is unwise to undertake this operation as an emergency measure if an alternative procedure is available. As a rule, when urgent operation on the gall-bladder is imperative, cholecystostomy will save life. There are, however, a few instances where urgent cholecystectomy is the method of choice, and they are set out in the pages that follow immediately. Eventually, 6–8 weeks after the termination of the acute attack, unless there is some definite contra-indication to a major operation, cholecystectomy is performed in the quiescent stage.

Technique.—Standard cholecystectomy and cholecystectomy by Thorek's method differ only in one essential particular. In standard cholecystectomy the gall-bladder is removed *in toto*: in Thorek's cholecystectomy that portion of the gall-bladder attached to the liver, and that portion only, is left attached and its mucosa destroyed by electro-coagulation. By allowing this strip of the gall-bladder to remain the integrity of the liver as an encapsulated organ is preserved.

The incision is a matter of individual choice. A transverse incision over both recti (*see* p. 162) gives excellent exposure. If there is uncertainty about the diagnosis, the paramedian

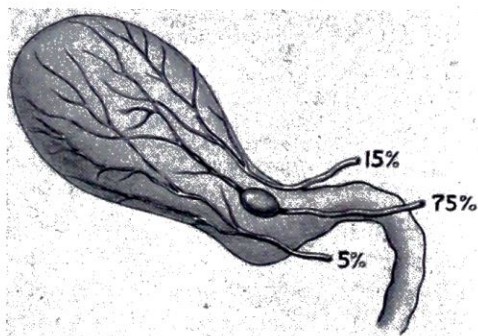


Fig. 401.—The relationship of the cystic artery to the cystic lymph-node. (After Ramirez-Flores.)

incision has much to offer. The gall-bladder is emptied by aspiration. The cystic duct and cystic artery are exposed by dissection, and divided between ligatures, as in the standard operation. A good guide by which to locate the cystic artery is the cystic lymph-node (*Fig. 401*). When the gall-bladder is in an acutely inflamed state, it is doubly necessary to dissect and demonstrate clearly the cystic, the common hepatic, and the common bile-ducts (*Fig. 402*) before dividing the duct. If, as is sometimes the case, œdema prevents this demonstration, it is safer to abandon the more radical treatment in favour of cholecystostomy.

The fluid content of the gall-bladder is aspirated. Having isolated the area with abdominal packs carefully, the gall-bladder is split longitudinally (*Fig. 403*). The stones are allowed to fall into Thorek's bile receptacle, or if this is not available, a tablespoon will answer the purpose. The redundant portion of the walls of the gall-bladder is excised with scissors or the diathermy knife. The posterior wall of the gall-bladder which remains attached to the liver is then treated by electrocoagulation (*Fig. 404*). The current should be turned on only when the ball electrode is firmly in contact with the tissues, so as to avoid fulguration. When the posterior wall of the gall-bladder has been electrocoagulated its edges are approximated with catgut sutures; the sewing needle should not penetrate the liver substance. A detached portion of the falciform ligament or a free omental graft is stitched over the sutured remnant of the gall-bladder (*Fig. 405*).

The advisability of exploring the common bile-duct.—If there is a history of jaundice, or if the common bile-duct appears dilated or feels thickened, or a stone or stones can be palpated therein, provided the condition of the patient is good, it is essential to explore the common bile-duct (*see* p. 323), after which this duct must be drained with a T-tube. After inspecting the area thoroughly to ensure that hæmostasis is perfect, the abdomen is closed with local corrugated rubber drainage. Some omit drainage altogether, but a soft drain does no harm, and in the rare event of post-operative hæmorrhage, the blood is directed externally.



Fig. 402.—The junction of the cystic, common hepatic, and common bile-ducts has been displayed; the cystic artery has been clamped and divided.



Fig. 403.—The gall-bladder is split open and the contents evacuated into Thorek's receptacle. Packs are omitted for the sake of clarity.

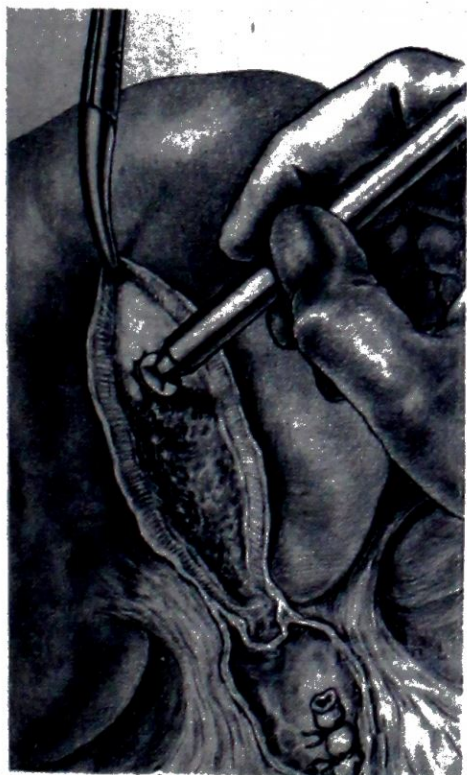


Fig. 404.—The redundant portion of the walls of the gall-bladder having been excised, that part of the gall-bladder which remains attached to the liver is electrocoagulated.



Fig. 405.—The detached falciform ligament of the liver, or a piece of omentum, is sutured over the gall-bladder bed.

THE CONTROL OF ACCIDENTAL HÆMORRHAGE FROM THE CYSTIC ARTERY

The principle involved is to control the cystic artery by compression of the hepatic artery (*Fig. 406*). This can be done by placing a finger through the foramen of Winslow and the thumb overlying the free edge of the gastrohepatic omentum. When the foramen of Winslow is non-existent, the free edge of the gastrohepatic omentum is grasped *en masse*, or the vessels are compressed against the vertebral column. If the hand occupies too much room, the incision can be enlarged whilst the hepatic artery is being compressed. After the field has been mopped dry, by momentarily relaxing pressure on the hepatic artery the bleeding cystic artery can be located accurately, caught in forceps, and ligatured.



Fig. 406.—Compressing the free edge of the gastrohepatic omentum in order to control hæmorrhage from the cystic artery. (*Hogarth Pringle's method.*)

drainage. Provided that hæmorrhage is severe and leaves no doubt that the vessel is spurting, it is necessary to reopen the abdomen. It is important to have the patient in the gall-bladder position (*see Fig. 392*). The cystic artery may be proved culpable or innocent by compressing the hepatic artery, and if the hæmorrhage continues in spite of this procedure, the bleeding point must be looked for elsewhere.

Post-operative Hæmorrhage.—If drainage has been employed, the hæmorrhage will be apparent, which is an argument in favour of

ACUTE CHOLECYSTITIS

Ninety-six per cent of patients with acute cholecystitis have stones in the gall-bladder. By far the commonest single cause of acute cholecystitis is obstruction by a stone impacted in the neck of the gall-bladder (*Fig. 407*) or in the cystic duct. Acute non-calculous cholecystitis occurs on rare occasions, sometimes in the course of an acute infectious disease such as pneumonia, typhoid, or virulent influenza.

Diagnosis.—The onset is often sudden and the pain is usually severe. After a variable period (usually two or three hours) biliary colic is superseded by a dull, throbbing pain localized in the right hypochondrium. Nausea, retching, and vomiting, together with belching of large quantities of gas, a rise of temperature (in 60 per cent of cases the temperature is above 100° F. (37.7° C.)) and an elevated pulse-rate are characteristic features. Tenderness and rigidity can be elicited in the right hypochondrium, and Murphy's sign is present. Jaundice occurs in about 25 per cent of cases. In the majority of cases it seems likely that jaundice in acute cholecystitis is due to hepatitis, because so often it can be proved later that the common bile-duct is free from obstruction; on the other hand a stone or stones will be found in the common bile-duct in 20 per cent of cases.

A palpable, tender gall-bladder, perhaps the clearest positive physical finding, becomes manifest at some time in the clinical course in 45 per cent of cases.

In many instances the diagnosis presents no particular difficulty. In others right-sided pyelonephritis must be excluded. High retrocæcal appendicitis not infrequently proves an insuperable stumbling block, and in cases of under 48 hours' duration laparotomy is advised.

Whenever possible a *serum-amylase estimation* should be undertaken, for the symptoms of acute pancreatitis and acute cholecystitis are often similar; indeed, the two conditions can be present concurrently.

The condition which is the most difficult to differentiate from acute cholecystitis is a myocardial infarct (coronary thrombosis). While electrocardiographic examination is most desirable whenever this differential diagnosis has to be made, in actual fact an abnormal



Fig. 407.—Acute obstructive cholecystitis.

electrocardiograph in an elderly patient who has had already severe cardiac disease is of little diagnostic value.

Radiography.—A plain radiograph is advisable; at any rate it will exclude gas beneath the diaphragm. In 14 per cent of cases, usually thin subjects, and especially in children, radio-opaque calculi are displayed in the gall-bladder. In rare instances gaseous cholecystitis (*see p. 315*) is revealed.

Treatment.—Acute cholecystitis is not an indication for immediate operation. As a rule intelligent inactivity during the attack, and cholecystectomy after the attack has subsided, is safer and better in every way. No one who has observed the regularity with which these cases respond to expectant treatment would wish to interfere with Nature's reparative process during the acute stage. Cholecystectomy performed after the attack has subsided carries a low mortality, and rids the patient of an organ which is almost certainly irreparably damaged and likely to give rise to further trouble.

If operation is performed between the third and ninth days, the mortality rises. In this respect acute cholecystitis is not unlike appendicitis in that there is a time at which the operation (cholecystectomy) is hazardous (Alton Ochsner).

Delayed Treatment.—In many respects the details of the treatment are similar to those of the Ochsner-Sherren treatment of appendicitis (*see p. 232*); constant vigil must be maintained for progression of symptoms and signs that foretell failure of the treatment. The patient is placed in Fowler's position, and for the first 24–48 hours continuous intravenous dextrose-saline solution is administered. During this period nothing is given by mouth. If vomiting has been in evidence, the stomach must be emptied, and kept empty, by means of an indwelling gastric aspiration tube. The local application of heat, in the form of an electric heating pad, is comforting. If the patient is even slightly jaundiced, vitamin K should be administered in addition to vitamins B and C, which are given as a routine. For the relief of pain pethidine 2 ml. (100 mg.) is given intravenously, and can be repeated four-hourly as necessary. If severe unrelenting pain, as opposed to tenderness, persists for more than 48 hours, operation should be advised.

Antibiotic Therapy.—It has been shown that antibiotics of the tetracycline group (aureomycin and terramycin) reach the interior of the gall-bladder via the blood-stream, even in the presence of occlusion of the cystic duct. For this reason Pulaski and Fusillo recommend that in cases of acute cholecystitis an antibiotic of the tetracycline group should be given from the commencement. In the initial stages doses of 1–1.5 G. are given intravenously *bis die* but, because of the liability of repeated injections to cause thrombophlebitis, oral administration should be commenced soon after the patient is permitted to take fluids by mouth.

Further Details of the Delayed Treatment.—When the rigidity has passed off *if a lump (the gall-bladder) is palpable* in the right hypochondrium its boundaries are marked on the skin. After the daily examination the fact as to whether the lump is stationary, or is decreasing or increasing in size, must be recorded in the notes. Increase in size is an indication for abandoning delayed treatment.

Often, after 24–48 hours, small dextrose drinks are allowed. When the pulse, temperature, and other physical signs show that the inflammation is subsiding, the parenteral administration of fluid can be stopped, and the oral intake increased. After the bowels have been opened by an enema, a milk diet can be commenced.

In the great majority of cases complete clinical resolution occurs within 10–14 days. After cholecystography has been performed the patient can be discharged home on a fat-poor diet, and instructed to return in 6–8 weeks for interval cholecystectomy. In cases where resolution occurs quickly, the interval can be shortened to three or four weeks, but this is not recommended because acute cholecystitis takes months to resolve, in spite of the fact that the patient is symptom-free. In those patients who have had previous attacks, and have refused operation, if consent is given, cholecystectomy should be performed before the patient is permitted to return home.

The delayed treatment of acute cholecystitis stipulates accurate and confident diagnosis. If we are sure that the case is one of acute cholecystitis, it is seldom necessary to open the abdomen for several weeks. If we cannot exclude perforated ulcer or high retrocaecal acute appendicitis of under forty-eight hours' duration, it is essential to operate. From time to time exploration is the only course, and if an acute cholecystitis is found, the gall-bladder must be drained or removed. Following this régime the number of cases submitted to immediate operation will be inversely proportional to our diagnostic ability.

Very occasionally, whilst undergoing expectant treatment, the patient will have a recrudescence of symptoms. A return of the pain, vomiting, and a rise in pulse-rate indicate failure of the treatment. Perforation of the gall-bladder from acute obstructive cholecystitis is not very rare, but perforation of the gall-bladder *while the patient is under delayed treatment* for acute cholecystitis is most exceptional. There is no denying that it is possible for perforation to occur under these conditions, but with the patient under the direct observation of the surgeon, who is able to operate without delay, even this exceedingly rare complication should seldom prove fatal.

To recapitulate: The danger of perforation whilst the patient is under a strict régime is an infinitely small one. Should it occur, it is by no means necessarily fatal if recognized promptly, which it should be with the patient under the conditions laid down here. To recommend immediate operation in acute cholecystitis on the ground of possible perforation is unjustifiable. No one would dream of recommending immediate operation during one of the acute exacerbations of a chronic duodenal ulcer on the ground that the ulcer might perforate. Uncertainty of diagnosis remains the chief indication for *very* urgent gall-bladder surgery.

Delayed Treatment is not Advised.—

1. When there is uncertainty about the diagnosis, e.g., early high retrocaecal appendicitis or a leaking duodenal ulcer cannot be excluded.
2. The presence of considerable diabetes is an indication for early operation.
3. Pregnancy makes operation necessary.
4. An uncompensated cardiac lesion and renal disease is further burdened by severe infection, and early operation is advised.

In the last three contingencies 3–6 hours are spent in getting the patient into the best possible condition for operation.

Delayed Treatment must be Abandoned.—

1. If, after a period of 24–36 hours, the pulse-rate and temperature are not falling, the pain persists, and the physical signs point to an *empyema of the gall-bladder*, operation should be undertaken forthwith, as also if there is a recrudescence of symptoms after a period of quiescence.
2. When the absence of pyrexia and the presence of a large piriform swelling in the right hypochondrium make the diagnosis of *mucocele of the gall-bladder* probable, after excretory pyelography has been performed to exclude a right hydronephrosis, operation is best carried out in a matter of hours.
3. When a gall-bladder *perforates into the general peritoneal cavity* urgent drainage of the peritoneal cavity and the gall-bladder is imperative; after such treatment 60 per cent of the patients recover; without immediate operation, the mortality approaches 100 per cent. As pointed out already, this complication is exceedingly rare in patients undergoing the delayed treatment of acute cholecystitis.
4. Typhoid fever is rare except in tropical countries. Because of the danger of perforation in *acute typhoid cholecystitis*, very early operation must always be advised.

Although this list of indications for abandoning delayed treatment may appear formidable, uneventful resolution occurs in 85 per cent of patients with acute cholecystitis.

Subsequent Cholecystectomy.—Six to eight weeks after the termination of an episode of acute cholecystitis treated either by the delayed method or by cholecystostomy, because of the high incidence of recurrence, cholecystectomy should, if possible, be insisted upon. In cases where cholecystostomy has been performed, the surrounding adhesions, although often considerable, are not greater than in many cases where a previous operation has not been performed, especially if a barrier of easily divided greater omentum has been placed over the fundus of the gall-bladder, as recommended in this chapter.

ACUTE CHOLECYSTITIS FOLLOWING OPERATION FOR UNRELATED DISEASE

The recognition of acute cholecystitis occurring in the post-operative period is often difficult, and the symptoms are frequently mistaken for usual post-operative sequelæ. The first symptoms often occur within 48 hours of resumption of feeding. Even palpation at laparotomy of what seems to be a normal gall-bladder is no guarantee against its later acute inflammation. In only 6 of Glenn's 17 cases did the cholecystitis follow an intraperitoneal

operation. Clearly, surgeons should remember that acute cholecystitis is an uncommon, though none the less serious, complication following operations for completely unrelated diseases.

ACUTE FULMINATING CHOLECYSTITIS

Very few cases of acute cholecystitis fail to respond quickly to the non-operative régime described in this chapter.

The following case is an exception :—

After his evening repast a solicitor was seized with acute pain in the right hypochondrium. There was no particular difficulty about the diagnosis, for the rigidity was localized and his temperature was over 103° F. (40° C.). The hourly pulse-rate during the night showed a steady increase. In the early hours of the morning he had a rigor, and, contrary to most cases of acute cholecystitis, his facies was that of a very sick man. At 10 a.m., after he had had sufficient dextrose-saline solution intravenously the abdomen was opened, using the limited transverse incision. The gall-bladder, which was only moderately enlarged, was very tense and of a dusky mottled appearance. Momentarily I wondered if cholecystectomy would be the right course, for so virulent a focus might well lead to spreading peritonitis. The œdema about the cystic duct and the report from the anæsthetist that the patient's condition was poor negatived this course. On puncturing the gall-bladder thin blood-stained pus came out. There was a solitary calculus wedged in the entrance of the cystic duct; the stone was removed by the method shown in *Fig. 411*. Cholecystostomy was performed. The pulse-rate remained unduly fast for several days, but steady improvement in the general condition was maintained. Six months later cholecystectomy was performed.

ACUTE GASEOUS CHOLECYSTITIS

There is a gross accumulation of gas within the lumen and within the wall of the gall-bladder, frequently extending into the tissues around the gall-bladder. The patient is often a diabetic. The signs and symptoms are those of severe acute cholecystitis. After about 48 hours the radiograph discloses a dark pear-shaped shadow of gas outlining the usually distended gall-bladder, with its walls demarcated by contained gas as a darker circumferential shadow. The biliary ducts and radicles are usually not outlined. Gas-producing organisms, e.g., *Cl. perfringens*, may exist for a long time in the bile and the wall of the gall-bladder without producing symptoms. When obstruction of the cystic duct arises, they rapidly become pathogenic, producing gas infection. At operation crepitation can be elicited in the wall of the gall-bladder; gas and malodorous exudate is present within the gall-bladder; the mucosa is often partially or completely separated from the muscular layer and is gangrenous. If the patient is not extremely ill, in the presence of mucosal gangrene it would seem to be best to perform cholecystectomy, but cholecystostomy has saved lives in this condition.

MUCOCELE (HYDROPS) OF THE GALL-BLADDER

Without exception this is due to a stone becoming impacted in the cystic duct. As a rule, the condition is neither difficult to diagnose nor is it desperately urgent. On the other hand, it must be realized that it is impossible to define where a mucocele ends and an empyema of the gall-bladder begins. Furthermore, a palpable gall-bladder with a recent sudden onset of pain should be looked upon as a manifestation of *acute obstructive cholecystitis*, a condition in which 'tension' gangrene may proceed apace.

It is most unwise to allow a large, tender mass, presumably the gall-bladder that does not decrease in size, to remain unexplored for more than 24 hours. In such cases one should have in mind the following concept :—

ACUTE OBSTRUCTION TO THE CYSTIC DUCT + INFLAMMATION



INCREASED TENSION WITHIN THE GALL-BLADDER



DIMINISHED VASCULAR SUPPLY



TENSION GANGRENE



PERFORATION

A. Y., aged 54, had violent right-sided colic during the night. When seen at dawn the patient was sitting up in bed quite comfortably, and the result of my clinical findings are shown in *Fig. 408*. It was agreed that excretory pyelography would settle the diagnosis. The pyelogram showed a normal kidney outline, with the exception of an opacity at the uretero-pelvic junction (*Fig. 409*). It was argued that this opacity must be an artefact, because the kidney was obviously functioning; if the swelling was the right kidney a normal outline of the renal pelvis and calices was impossible. That evening the patient said he felt quite well, but the lump was

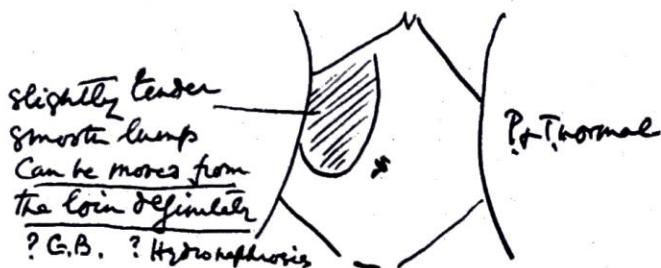


Fig. 408.—Facsimile of the diagram which accompanied the notes of A. Y.

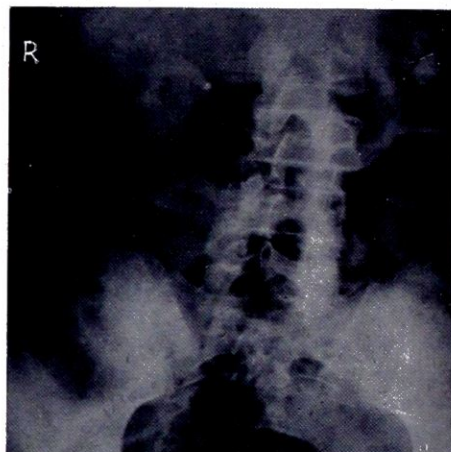


Fig. 409.—Excretory pyelogram of patient A. Y., showing the artefact at the pelvi-ureteric junction.

still in evidence, and his temperature was now 99° F. (37° C.). Early the following morning laparotomy was performed. On puncturing the enormous gall-bladder thick mucopus slowly exuded. A hand was passed beneath the towel, in order to palpate the neck of the gall-bladder and by compression to speed up the flow.

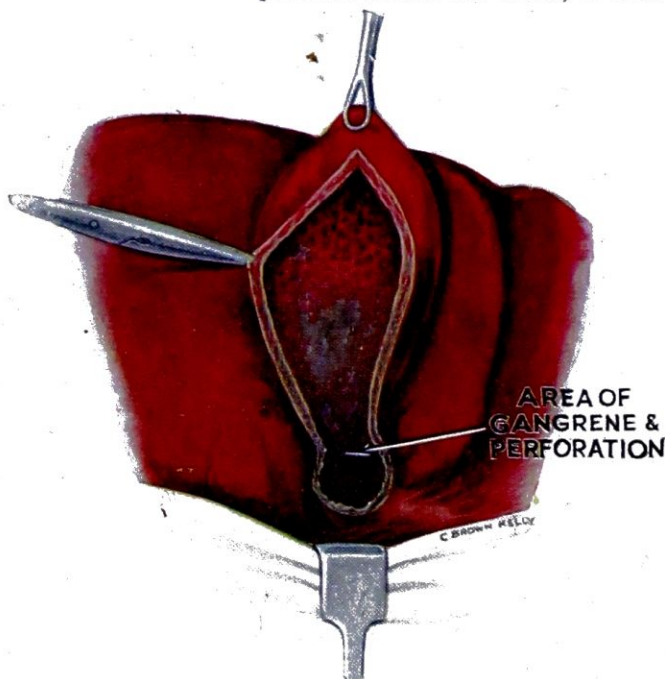


Fig. 410.—The gall-bladder was slit up from the perforation in Hartmann's pouch to the fundus. Showing the gangrenous interior.

The manipulation was of the gentlest character, but it caused the gall-bladder to burst at Hartmann's pouch. Fully three-quarters of a pint of mucopus was liberated, but the surrounding area was well packed off. The fluid was too thick to be aspirated with a sucker, and it was mopped up with abdominal packs. It was then seen that a large stone had come through the perforation. The gall-bladder was slit from the perforation to the fundus. The mucous membrane was of a dusky hue and in the region of the perforation it was green and gangrenous (*Fig. 410*). On palpating the cystic duct it was ascertained that there was a stone the size of a pea tightly impacted therein; this was removed with a small Volkmann's spoon, breaking the stone in the process. Desjardins' forceps were passed down the cystic duct into the common bile-duct and clear bile flowed from the open mouth of the cystic duct. The cystic duct was ligated and cholecystectomy performed by Thorek's technique. A small drainage tube was left in position because of the

local soiling of the peritoneum referred to. The patient recovered uneventfully.

EMPHYEMA OF THE GALL-BLADDER

The temperature is a notoriously unreliable guide in many of these cases, and although there is no desperate hurry, the sooner the pus is evacuated the better. In general, it can be stated that it is usually in the patient's interests to spend 12–24 hours in getting her into the best possible condition for the operation, a high dextrose intake being an important consideration in this respect. Should the pulse advance even a few points during this interval, the performance of the operation must be expedited.

The limited transverse incision is particularly valuable in this instance, for the area of the gall-bladder can be well packed off, which is so desirable. After the pus has been

evacuated, almost without exception, a stone will be felt impacted in the commencement of the cystic duct; occasionally this is the only stone present. By judicious upward pressure with the finger and thumb (*Fig. 411*) the stone can often be expressed into the more commodious region of the neck of the gall-bladder, where it can be retrieved and removed. Disimpaction of this, the keystone of the trouble, is desirable, though not vital. If this stone remains the patient usually recovers, but a persistent mucopurulent fistula remains until at a second operation cholecystectomy is performed.

There are occasions when the diagnosis of empyema of the gall-bladder is difficult, for the gall-bladder is so embedded in adhesions as to make it impalpable. For the same reason, it is sometimes extremely difficult to find the gall-bladder at operation, even with adequate exposure.

A. L., aged 72, had had a successful operation for strangulated left inguinal hernia performed six months previously.

During convalescence he complained of pain in the right loin but nothing was found to account for it. He returned home and the pain became worse; he always had pain in his back, but it was more in evidence on some days than others. For the last six weeks the pain had been very severe and continuous. The signs seemed to point to right renal pain and

although he was tender in the hypochondrium, his doctor stated that during the time he was under observation his temperature had never been elevated more than 99° F. (37° C.). After he had been removed to hospital, excretory pyelography showed that the right kidney was functioning. It was

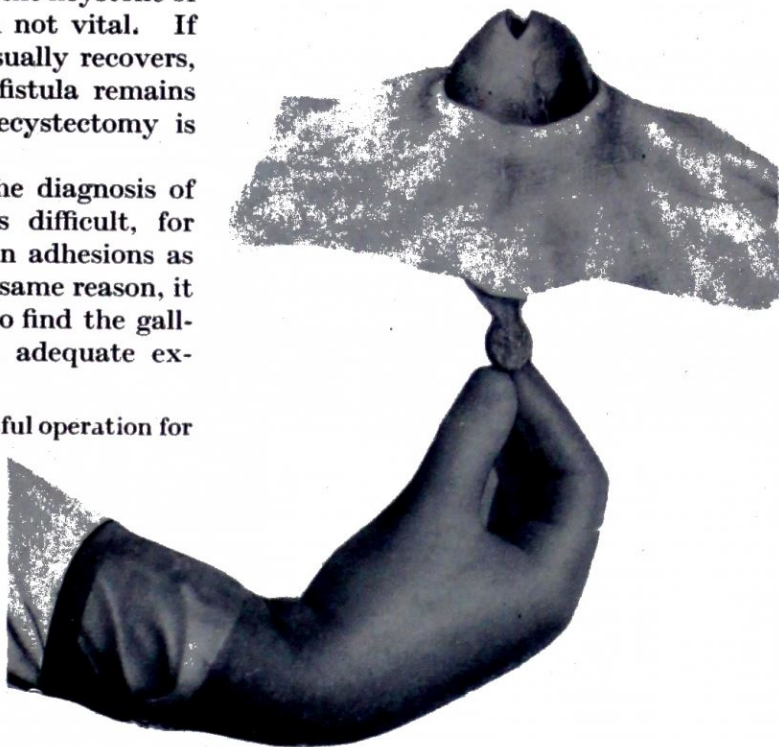


Fig. 411.—Squeezing a stone impacted in the cystic duct into the neck of the gall-bladder.



Fig. 412.—When in doubt whether a structure is the gall-bladder, aspirate some of the contents. (This advice also holds good for the common bile-duct.)

therefore decided to explore the gall-bladder, allowing two days to get the patient as fit as possible. Under local anaesthesia the abdomen was opened through a transverse incision. Where the fundus of the gall-bladder should have been there was a segment of small intestine adherent to the liver. This was dissected free with difficulty, but there was still no sign of the fundus of the gall-bladder.

Continuing to dissect omentum from the free edges of the liver at length a small portion of some hollow viscus was displayed. In order to ascertain whether this was the fundus of the gall-bladder, a hollow needle was inserted (*Fig. 412*) and thick pus was withdrawn. Cholecystostomy was then performed and about a quarter of a pint of stinking pus was evacuated. A stone was expressed from the neck of the gall-bladder and other calculi removed. The operation was completed in the manner described on page 309. After a rather stormy convalescence the patient made a good recovery.

TORSION OF A FLOATING GALL-BLADDER

A prerequisite of this condition is an unusual anatomical arrangement whereby the gall-bladder is suspended by a mesentery long enough to allow the gall-bladder to hang free in the peritoneal cavity. Torsion of the gall-bladder is a rare condition; about 100 cases have been reported.

Should a greatly enlarged gall-bladder be palpable within a few hours of the onset of an attack of biliary colic the possibility of torsion of the gall-bladder should come to mind. In such circumstances it is important not to delay operation on the supposition that the symptoms and signs are due to cholecystitis. The statistical studies of Rendle Short and Paul showed that patients with this condition, even though they are advanced in years, recover if operation is undertaken within 48 hours.

Most of the cases reported have occurred in elderly women.

A. H. Barber's Case.—

A warehouseman, aged 46, was seized with very severe abdominal pain in the upper right abdomen on the previous day. Vomiting was persistent. The physical signs pointed to a perforated peptic ulcer. On opening the abdomen a considerable amount of blood-stained fluid was found and the gall-bladder was distended to about the size of an orange,

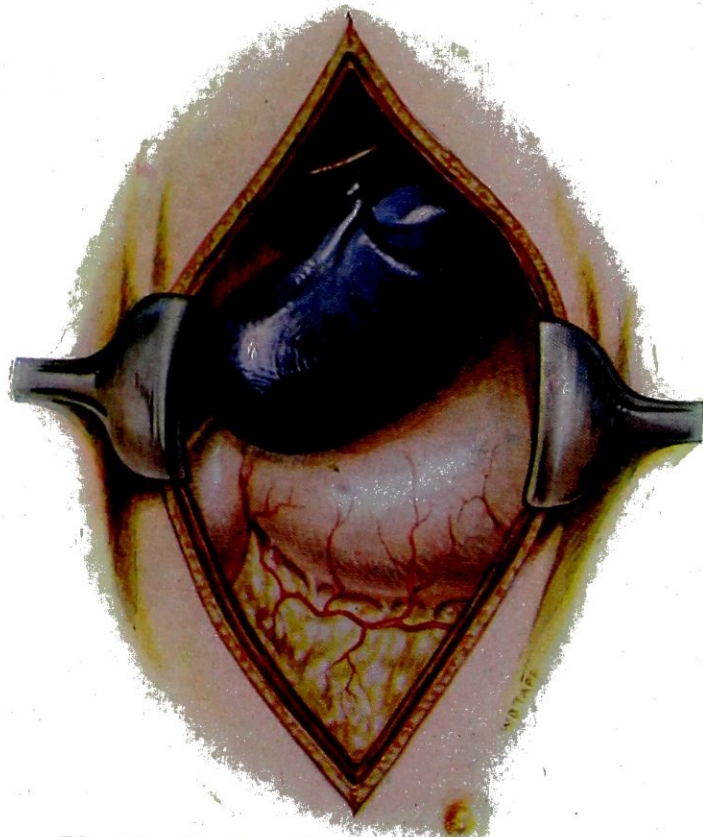


Fig. 413.—Torsion of the gall-bladder. Cholecystectomy is extremely simple as will be appreciated by observing this typical pedicle. (*Rendle Short and Paul, "British Journal of Surgery"*.)

and was of a deep blue-black hue. The whole gall-bladder was completely covered with peritoneum and suspended from the anterior border of the liver by the cystic duct and vessels. Cholecystectomy was therefore extremely simple; all that was necessary was to ligate the pedicle below the twist before severing the gall-bladder from its only attachment.

Owing to the anatomical arrangement which allows torsion of the gall-bladder to occur (*Fig. 413*), cholecystectomy is a procedure of simplicity.

EXTRAVASATION OF BILE (BILE PERITONITIS)

If on opening the peritoneum pure bile is found, the following four conditions must be thought of:—

1. Perforation of the gall-bladder.
2. Perforation of the bile-ducts.
3. Perforated duodenal ulcer (second part of the duodenum).
4. 'Spontaneous' biliary peritonitis.

It is therefore necessary to examine the gall-bladder, the bile-ducts, and the first and second parts of the duodenum. In the event of a perforation remaining undiscovered after searching for a reasonable time (in accordance with the condition of the patient) the possibility of (4) should be assumed.

When bile is found in the peritoneal cavity following an abdominal accident the following three conditions must be borne in mind :—

1. Rupture of the gall-bladder (*see p. 388*).
2. Rupture of the common bile-duct or hepatic duct (*see p. 389*).
3. Rupture of the duodenum (*see p. 381*).

Post-operative bile peritonitis is discussed on p. 214.

Bile peritonitis causes rapid and profound toxæmia—general symptoms of peritonitis out of all proportion to what one would expect. If the bile is drained from the peritoneal cavity early enough dramatic improvement often occurs.

FREE PERFORATION OF THE GALL-BLADDER

Further evidence that while widespread bile peritonitis is very lethal it is also a condition which responds to prompt surgical treatment, is afforded by C. A. McWilliams's study of 48 cases of free perforation of the gall-bladder.

Of 7 cases operated on within 12 hours	6 recovered	(14 per cent mortality)
Of 15 " " " 24 " "	10 " "	(33 per cent ")
Of 16 " " " 3 days	8 " "	(50 per cent ")
Of 10 " " " 4 " "	4 " "	(60 per cent ")

Difficulties in Diagnosis.—Unless we know that the patient has suffered recently with gall-stones or cholecystitis, the diagnosis is almost impossible. In the absence of such data the nearest approach to a correct pre-operative diagnosis will be that perforation of a duodenal ulcer has occurred. On the other hand, with a lead, the problem is not by any means insuperable.

A. H., aged 42, was admitted with a large tender swelling coming from beneath the right costal margin. The symptoms had been present for five days, but after the first few hours the pain had not been severe. Excretory pyelography showed a normal pelvis of the right kidney, which heightened the suggestion that the swelling was a greatly distended gall-bladder. Two days later, while his abdomen was being prepared for laparotomy he experienced a severe attack of pain which soon passed off. The pulse-rate, which had been normal, began to rise. On examining his perfectly flaccid abdomen I was astounded to find that the large lump had disappeared completely. On opening the abdomen free bile was found in the peritoneal cavity. There was a large perforation in the gall-bladder just above Hartmann's pouch, and beneath this two gall-stones lay free. Cholecystectomy with local and suprapubic drainage was carried out. Convalescence was uneventful.

Operation.—When the organ is examined, the perforation is not difficult to find. Its situation varies; it may be at the fundus, or at Hartmann's pouch, or between the two (*Fig. 414*). If the opening is at the fundus, it should be enlarged, the stones removed, and cholecystostomy performed. If the perforation is further down, the gall-bladder may be slit up towards the fundus. After clearing the interior of stones and debris the gall-bladder may be reconstructed around a drainage tube. Alternatively, if the patient's general condition permits and the operator is experienced in the technique, cholecystectomy is permissible.

Drainage of the peritoneum should always be carried out by: (1) Local drainage by a stab wound in the mid-axillary line, about 1½ in. (3·8 cm.) below the costal margin in order to drain Rutherford Morison's pouch; and (2) Suprapubic drainage in all but very early cases.

Localized Abscess Formation after Perforation of the Gall-bladder.—In over 80 per cent of cases the perforation is well localized. The frequency with which localization occurs results from adhesions developing during previous attacks of cholecystitis. Unless the collection of purulent bile is considerable, the diagnosis is indistinguishable from that of empyema of the gall-bladder.

F. C., aged 66, had been ill for five days. There was a large tender mass beneath the right costal margin, but the overlying rigidity made it impossible to define its limits accurately. The temperature was 103° F. (40° C.), although he did not appear to be gravely ill. For forty-eight hours he was treated by the delayed method. As the temperature remained at this high level and he was rather worse than better, operation was decided upon, the diagnosis being empyema of the

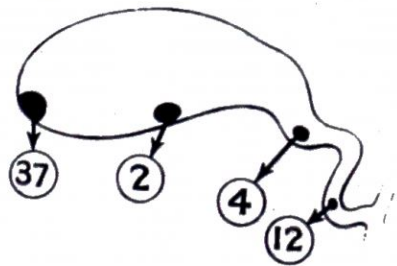


Fig. 414.—The site of the perforation in 59 cases. In 4 of these there was more than one perforation. (*Pines and Rabinovitch's statistics.*)

gall-bladder. The abdomen was opened by the limited transverse incision described already. As soon as the peritoneum was incised, bile and purulent gelatinous material escaped. A perforation was found in the gall-bladder near the fundus. A solitary calculus impacted in Hartmann's pouch was expressed (*see Fig. 411*). Utilizing the perforation, which admitted the little finger, cholecystostomy was performed and the abscess cavity was drained. Free drainage of bile through the cholecystostomy tube continued for seventeen days; the tube was then removed. Convalescence was delayed by retention of urine, but a good recovery followed.

It is important to refrain from tearing Nature's barriers, which are usually the great omentum and the transverse colon. If the perforation is inaccessible or other circumstances make it difficult to deal directly with the gall-bladder, reliance can be placed on simple drainage of the abscess cavity. Seven out of eight patients so treated recovered (L. R. Fifield).

PATHOLOGICAL PERFORATION OF THE COMMON BILE-DUCT

A man of 45, whilst walking home from work, was seized with abdominal pain. With difficulty he managed to reach his destination, a quarter of a mile distant, unaided. Twenty-two hours later he was brought to hospital. The temperature was 97° F. (35° C.), the pulse 72, and he appeared very shocked and ill. The physical signs were typical of a perforated duodenal ulcer, and as he was a very thin man, shifting dullness could be demonstrated easily.

The abdomen was opened by a supra-umbilical midline incision. Pints of bile were found in the peritoneal cavity. Bile was also present in the lesser sac and *behind* the peritoneum, which was floated up. The gall-bladder looked normal, but on palpation many tiny calculi were felt within. The stomach and duodenum were examined, with a negative result. The cystic duct and supraduodenal portion of the common duct were examined with a seeker, but no perforation was demonstrable; indeed, these structures appeared quite normal. It was concluded that there was a perforation of some part of the hepatic or common bile-duct. Cholecystostomy and drainage of the peritoneum was performed. Throughout the operation the patient received saline infusion, and he was returned to bed in good condition. Next morning his pulse was good and he stated that he felt better. It was remarked that it was curious that he showed no signs of jaundice. Twelve hours later he collapsed and died. At the necropsy a perforation at the back of the junction of the cystic and common ducts was demonstrated.

I encountered a similar case; again I was unable to find the perforation and the case ended fatally. If the perforation can be found, it should be enlarged sufficiently to insert a T-tube. When the perforation cannot be found, provided the patient is in good condition the duodenum and the head of the pancreas should be mobilized (*see p. 382*) in the endeavour to find a perforation in the retroduodenal portion of the common bile-duct. In any case choledochostomy, cholecystostomy, and peritoneal drainage should be performed.

To drain the common bile-duct with a T-tube is absolutely essential; without this step the patient nearly always dies. Antibiotic therapy should be commenced at the earliest possible moment.

SPONTANEOUS PERFORATION OF THE COMMON BILE-DUCT AS A SEQUEL OF CHOLEDOCHOSTOMY

Wolfson and Levine have encountered three cases of spontaneous perforation of the common bile-duct following choledochostomy. The train of events is as follows: The T-tube draining the common duct is removed at the appropriate time. The patient makes a satisfactory recovery, and returns home, but at a period varying from four days to six weeks is re-admitted because of a sudden onset of peritonitis. The abdominal cavity is reopened and found to contain a tremendous quantity of bile. Acute pancreatitis is the condition most likely to be confused with this syndrome. It is important to know that spontaneous rupture of the common bile-duct may follow choledochostomy. Armed with this knowledge, immediate laparotomy will be performed, instead of instituting expectant treatment.

'SPONTANEOUS' BILE PERITONITIS

Numbers of examples of bile peritonitis, i.e., free bile in the peritoneal cavity without a demonstrable perforation of the biliary tract, have been recorded, mostly in the Continental literature. Sir Zachary Cope, reporting six personal cases, concluded that the most logical explanation for this remarkable phenomenon was that an acute ulcer in some part of the biliary tree resulted in a minute perforation, through which bile was forced by the normal muscular contractions of the gall-bladder. The truth of this hypothesis was substantiated by a case reported by Small who, having

concluded a fruitless search for a perforation, noticed a small area of discoloration in the sulcus between the gall-bladder and the liver. In the centre of this area was a minute perforation. Immediately following the perforation, like that of the intestine, there is cessation of peristalsis and the patient may have but few symptoms. Intestinal activity returns after the stimulation caused by the ingestion of food. Bile is then forced through the perforation, and signs of peritonitis become obvious.

'Spontaneous' bile peritonitis cannot be diagnosed before laparotomy; even then it gives rise to considerable confusion, if the surgeon is unaware of the existence of this rare clinical entity. Early cases simulate a perforated peptic ulcer, although the symptoms are not so acute (S. Power). Late cases present the features of diffuse peritonitis.

From a practical standpoint, the position is this. The abdomen is opened; pure bile is discovered therein. The gall-bladder appears and feels normal; no stones can be palpated in the biliary tree. It is ascertained that there is not a perforation of the duodenum. In such circumstances suck out the bile, if a sucker is available, and perform cholecystostomy. Drain Rutherford Morison's pouch, and when there is a considerable quantity of bile in the general peritoneal cavity, insert a tube into the rectovesical pouch through a suprapubic incision. Close the abdomen as quickly as possible. In all cases give dextrose-saline, dextran, or plasma and, when available, blood transfusion, according to the needs of the patient.

The mortality is very high; at least 60 per cent of patients with this condition die. Probably, with gentle, swift surgery, the mortality could be lowered. The trouble is that because the condition is so rare, few surgeons are aware of its existence. Consequently, a great deal of time is wasted in searching for a perforation, and the resulting operative trauma is not inconsiderable.

'Spontaneous' Bile Peritonitis in Infancy.—Owing largely to delay in diagnosis, the prognosis of bile peritonitis in infancy is very poor. A pre-operative diagnosis can sometimes be made with assurance by paracentesis. In three cases reported recently simple drainage proved successful.

In Davies and Elliot-Smith's case bile was seen issuing from a perforation in a greatly distended common bile-duct: the cause of the distension was congenital atresia of the duct. The perforation was enlarged, and the opening was anastomosed to the duodenum. The peritoneum was drained. Recovery followed.

Post-operative Bile Peritonitis.—(See p. 214.)

Traumatic Bile Peritonitis.—(See p. 389.)

OBSTRUCTIVE JAUNDICE

Most of the conditions dealt with in this work are urgent in the sense that there are but hours—sometimes, indeed, only minutes—in which to act. Obstructive jaundice can hardly be placed in this category, yet it cannot be omitted.

When the jaundice is not deep, the question of early operation does not arise; the patient is observed from day to day. If the jaundice is clearing and the cause is probably, or definitely, gall-stones, operation should be postponed for at least a week or until the jaundice has cleared completely. If the jaundice is getting deeper; if, when the patient is first seen, it is already of an olive hue; and particularly if the jaundice has been progressive and the onset painless, operation should be arranged for in two or three days' time. During the interval active preparations (*see below*) are made.

Causes of Obstructive Jaundice.—

1. Gall-stone in the common bile-duct.
2. Carcinoma of the head of the pancreas.
3. Subacute or chronic pancreatitis obstructing the ampulla of Vater.
4. Simple stricture of the bile-ducts.
5. Malignant stricture of the common duct.
6. Metastatic carcinomatous deposits obstructing some part of the biliary system.

It is not proposed to enter into the differential diagnosis of these various types of obstructive jaundice, the salient features of which are well known. In spite of better understanding of the principles which govern this differential diagnosis, there are many surprises in this branch of surgery—happily, sometimes pleasant surprises. Take, for instance, the patient illustrated in *Fig. 415*. The enlarged, somewhat irregular liver, combined with deep progressive jaundice, caused a competent observer to diagnose malignant disease, in spite of the fact that the trouble started with an acute attack of pain. Unwisely, the patient was ordered cholecystography. As might be expected, the cholecystogram showed nothing, but the additional strain on the liver in endeavouring to excrete the dye caused him to pass into a semi-comatose condition. After a blood transfusion,

laparotomy was performed. There was swelling of the whole pancreas, which was considered undoubtedly inflammatory. The much enlarged gall-bladder was drained. Drainage of the bile-ducts via the gall-bladder together with intravenous dextrose-saline produced a remarkable improvement. Within forty-eight hours the dark jaundice had almost gone, and he has remained well.

There are occasions where doubt exists as to whether jaundice, particularly increasing jaundice, is due to infective hepatitis or to mechanical obstruction of the common bile-duct. In no circumstance whatsoever

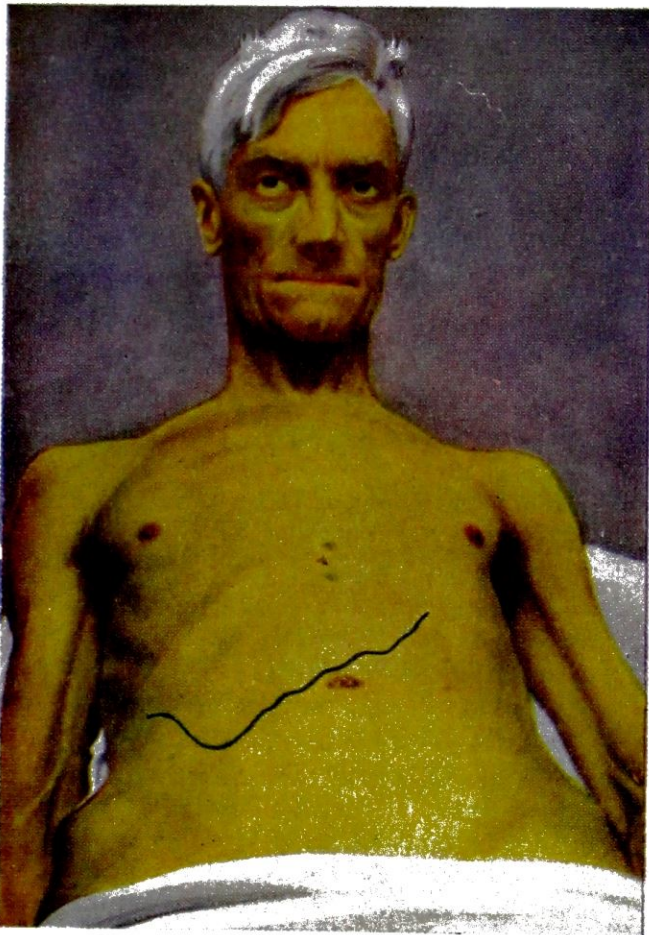


Fig. 415.—Patient with greatly enlarged, somewhat irregular liver, profound jaundice, and cachexia. One of the many surprises in this branch of surgery. Recovered completely after cholecystostomy followed by cholecyst-gastrostomy.

Thymol turbidity test. A saturated solution of thymol buffered at pH 7.8 (3 ml.) is added to serum (0.05 ml.). A turbidity usually develops in cases of hepatitis, but results are mainly negative in biliary obstruction. Normal value 0–4 units (Maclagan).

Aspiration liver biopsy is a method of confirming the presence or absence of hepatic cirrhosis. Failure to aspirate a cylinder of liver occurs in about 5–10 per cent of cases; moreover, the procedure is not without danger of internal hæmorrhage. When performed at laparotomy, this danger is eliminated.

Suppurative Cholangitis is a grave complication, usually of stone impacted in the common bile-duct. With the exception that the patient is more deeply jaundiced, the symptoms are similar to those of pylephlebitis (*see p. 349*), and if suppurative cholangitis is not treated by early choledochostomy multiple abscesses of the liver occur, a state of affairs similar to that found in pylephlebitis.

No patient with obstructive jaundice should be abandoned as hopeless without exploration.

Preparation for Operation includes a diet containing a high proportion of carbohydrates and animal protein, reinforced by lipotropic¹ amino-acids.

¹ Lipotropic—increasing bodily fat.

suggest an exploratory laparotomy to ascertain this point without first endeavouring to make the differential diagnosis by laboratory methods. In cases of infective hepatitis or other form of hepatogenous jaundice any operation only increases already existing liver damage.

Among a number of laboratory tests designed to assist in distinguishing obstructive from non-obstructive jaundice, the following are the most useful:—

Serum alkaline phosphatase. Normal value: 3–13 King-Armstrong (K-A) units. Values below 20 favour hepatogenous jaundice; those above 35 obstructive jaundice.

Urobilinogen in the urine (normal approximately 0.5 mg. in 100 ml.) is absent in complete obstruction to the common bile-duct and in hepatogenous jaundice at its height. Calculus in the common bile-duct results, usually, in a fluctuating level.

Serum-prothrombin coagulation time is estimated on two days before and two days after the administration of vitamin K. If the initial value is low, this is an indication for pre-operative vitamin-K therapy. When there is little or no response to vitamin K, extensive hepatocellular damage is almost certain. Owing to large reserves, a satisfactory response does not exclude considerable liver damage.

The patient should receive 4-8-9 mg. per day of synthetic vitamin K by intramuscular injection. Vitamins A and B are also given, because jaundiced patients are often deficient in this respect. The electrolytic balance, particularly the serum-chloride, should be ascertained and restored to normal limits before the operation. Blood transfusion is often required. This régime should be followed for several days before and continued for several days after the operation. Definite improvement in the general condition is usually noted after the blood transfusion.

Test for Bleeding Time.—Apply a sphygmomanometer, raising the pressure to 40 mm. of mercury. After one minute make a 2-mm. incision on the forearm. With the pressure maintained at 40 mm. of mercury the maximum time of bleeding in a normal individual is 4 minutes (Roscoe R. Graham).

Anæsthesia.—Patients with impaired liver function tolerate general anæsthesia badly. On this account local anæsthesia is advisable, and is effective for cholecystostomy and/or straightforward choledochostomy.

The incision is a matter of considerable importance. The *midline* incision (p. 159) has certain advantages. It is particularly satisfactory for use with local infiltration; it is an avascular route, and it gives excellent access to the common bile-duct. The midline incision is as good as any, and better than most, for a set operation of choledochostomy. The *paramedian* is a very good incision. It is a little more difficult to infiltrate satisfactorily, and when this incision is employed more time is expended in opening and closing. This is the best incision to employ when the cause of the obstructive jaundice is doubtful, for it gives fair access to both the gall-bladder and the common bile-duct. The *limited transverse* incision (p. 162) is excellent for cholecystostomy or cholecystjejunostomy.

The Operation.—As to the proper procedure to adopt in a given case, much judgement is required. Throughout the operation the surgeon must have his objective like a beacon light shining brightly before him. Primarily, it is to relieve the obstruction; secondarily, and far less important, it is, if possible, to remove the cause of the obstruction.

As soon as the abdomen has been opened, examine the gall-bladder.

The gall-bladder is large and tense; the patient is old, and jaundice is profound. Aspirate the fluid contents of the gall-bladder. If green bile is recovered in considerable quantities, one knows that the obstruction will be relieved by drainage of the gall-bladder. Under such circumstances rest content in performing cholecystostomy. When the flow from the gall-bladder is light-coloured mucoid material, after satisfying yourself that there is no obstruction to the cystic duct, assume that this is white bile. 'White bile' is an accompaniment of the last stages of biliary obstruction. Drainage of the biliary passages via the gall-bladder will give the patient a fighting chance.

The gall-bladder is large and tense; the condition of the patient is fair. Palpate the pancreas. If there is a hard, irregular mass in the head, the case is probably one of carcinoma of the head of the pancreas, but not irrefutably so. If the *whole* pancreas is enlarged, it is more likely a case of chronic or subacute pancreatitis. In either case, cholecystjejunostomy (Fig. 416) can be performed. Should the patient's general condition be such that speed is essential, cholecystostomy is the better immediate procedure. Cholecystjejunostomy can then be performed six weeks later, but the operation is more difficult when the gall-bladder is small and contracted, as it will be after prolonged drainage.

The gall-bladder is not enlarged; indeed, it is thick-walled and may be fibrotic, small, or full of stones. Proceed at once to palpate the common bile-duct. A stone of fair dimensions is felt in the common bile-duct. Grasp the stone between finger and thumb (Fig. 417) and do not let go, for the stone may slip out of reach. Let the assistant retract



Fig. 416.—Cholecystjejunostomy.



Fig. 417.—Stone impacted in the supraduodenal portion of the common bile-duct. Incision of the duct overlying the stone.

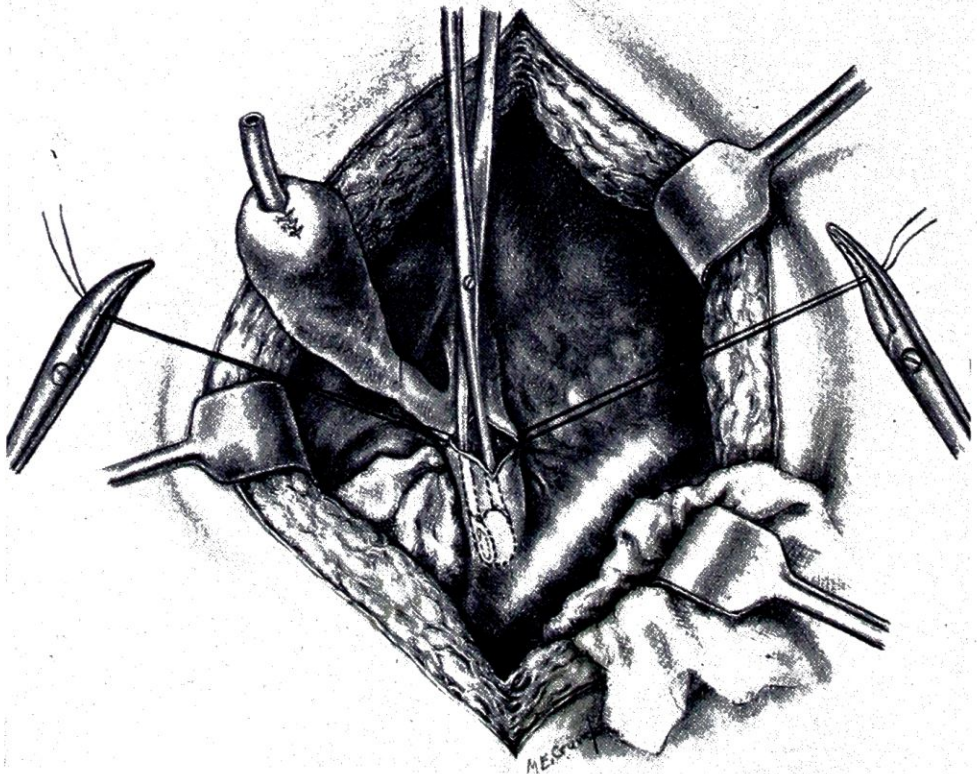


Fig. 418.—Extracting a calculus from the common bile-duct.

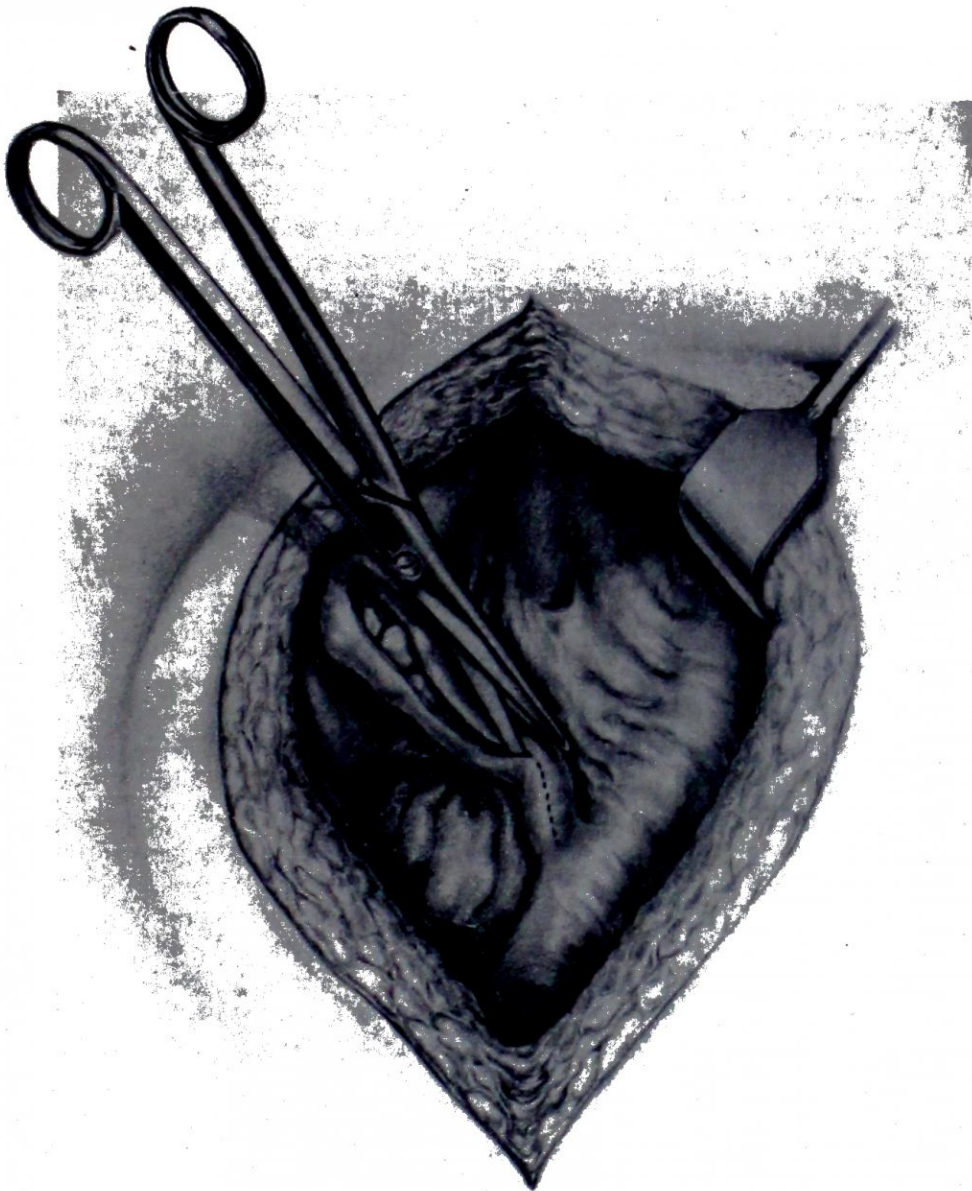


Fig. 419.—Entering the common bile-duct by way of slitting the gall-bladder and the cystic duct.



Fig. 420.—T-tube for drainage of the common bile-duct.

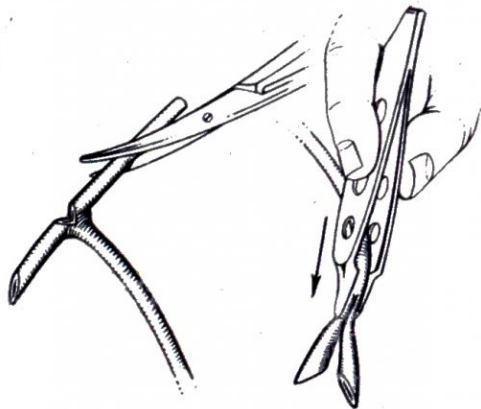


Fig. 421.—Orr's method of modifying a T-tube which facilitates introduction and withdrawal.



Fig. 422.—T-tube in situ.

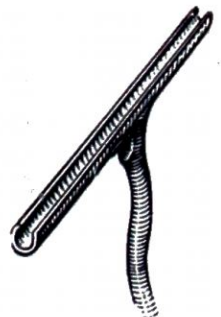


Fig. 423.—Maingot's T-tube.

as necessary, until you can see what you are holding. Incise the common duct longitudinally on to the stone, and remove it. Delicately pick up the cut edges of the common duct. Employ suction or mop up the bile which continues to flow. If circumstances permit, pass Desjardins' forceps upwards and downwards within the lumen of the duct, and make sure that no other stones are within. Close the opening in the common duct about a drainage tube (*see below*).

The cause of the obstruction is doubtful. A calculus cannot be palpated in the common duct. Open the gall-bladder and remove calculi, if present. Unless there is a copious free flow of bile from the gall-bladder, cholecystostomy will not remedy the obstruction. Focus your attention upon the common bile-duct. When the common duct is obstructed it is enlarged, perhaps to the size of a finger, sometimes even larger. If doubt arises whether the structure under observation is the common bile-duct, take a hypodermic syringe, puncture the structure, and aspirate. Bile is unmistakable. 'White bile' looks like mucus. In either case, the presence of bile or mucus in the syringe is conclusive evidence that the doubtful structure is none other than that which we seek.

Being now entirely satisfied that we are dealing with an enlarged common bile-duct, choledochostomy can be performed through a longitudinal incision about $\frac{1}{2}$ in. (12 mm.) long. The interior of the duct is explored deftly with Desjardins' forceps (*Fig. 418*), remembering that a likely place for an elusive obstructing calculus is near the ampulla of Vater. If the patient is standing the operation poorly, the only wise course is to conclude with drainage of the common duct (*see below*). Before leaving this subject it will be helpful to describe a method of entering the common bile-duct which at times proves most useful. The method is applicable only to one type of case, which is fairly common—the gall-bladder is small, the cystic duct is short and opens into the common duct without convolutions. The gall-bladder and cystic duct are slit down as shown in *Fig. 419*, until the common duct has been entered. After extracting calculi from the bile-passages, the common bile-duct and the gall-bladder are drained, the slit in the cystic duct and the neck and body of the gall-bladder being refashioned by a continuous suture.

Drainage of the Common Bile-duct.—The T-tube¹ (*Fig. 420*), if available, is very useful. Usually the transverse limbs of the T as supplied by the makers are unnecessarily long; they should be pruned, and if the tube is cut in the manner shown in *Fig. 421* its introduction into the common duct is facilitated. Maingot's T-tube (the floor of the horizontal limb is lacking) (*Fig. 423*) is more readily introduced and removed than the ordinary pattern. *Fig. 422* will make the technique of closing the common duct about a T-tube clear.

When the T-tube is not available, an ordinary drainage tube of suitable dimensions must be employed. It is valuable to have the tube armed with a stitch of fine catgut with a small round needle ready threaded on each end (*Fig. 424*). The tube is passed into the common duct in an upward direction, and it is anchored into place. The opening in the duct is closed about the tube with interrupted stitches. After a drainage tube has been inserted into the common bile-duct, omentum should be so arranged about the tube as to favour the formation of a track from the opening of the common bile-duct to the surface. It is usual to bring a tube draining the common duct out through the abdominal incision, but the first consideration should be that the tube makes a straight line to the anterior abdominal wall, and a stab incision for the exit of the tube may better suit a particular case.

After-treatment.—Following the relief of the obstruction, the slow administration of dextrose-saline has a remarkably beneficial effect. By its use I have seen the skin of deeply jaundiced patients assume an almost normal tinge in forty-eight hours.

Intravenous therapy should never be employed in these cases unless it is certain that the obstruction has been relieved, as evidenced by a free flow of bile through the tube. If intravenous fluid is administered to a patient suffering from unrelieved obstructive jaundice, retained bile in the blood-stream and tissues is swept to the kidneys in quantities sufficient to interfere seriously with their function.

Gradual Decompression of the Obstructed Biliary Tree.—Often scant attention is paid to this important detail. When complete obstruction to the common bile-duct is released

¹ Latex T-tubes, which are moulded in one piece, are preferable to red rubber T-tubes, which are made in two sections fused together; the latter have been known to come apart at the junction.

suddenly the intrahepatic ducts collapse. This leads to a sudden inflow of blood into the liver. The resulting intense hyperæmia is liable to cause additional damage to the liver cells. Therefore, in cases of severe jaundice, as soon as the tube has been sutured into place in either the gall-bladder or the common bile-duct, the tube should be clamped with a hæmostat. When the patient has been returned to bed the clamp is removed, the tube is connected to a saline dripper, and, by means of another tube, to a bedside bottle. The bile-ducts are decompressed in exactly the same way as the bladder is decompressed in

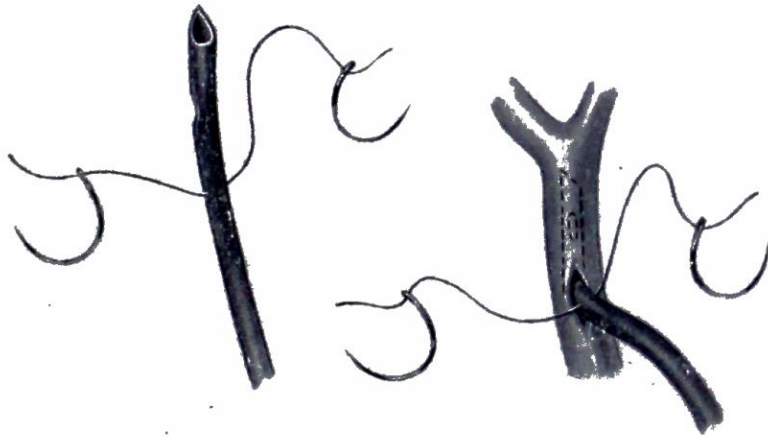


Fig. 424.—Drainage of the common bile-duct when a suitable T-tube is not available.

acute retention of urine (*see p. 638*). The rate of flow is set at 40 drops a minute for the first 18 hours. After that time the screw clamp can be released, but the dripper is retained, as it is an excellent means of preventing retrograde infection. If the obstruction has been relieved, it is good practice to tighten the screw clamp gradually with the object of forcing bile into the duodenum, the prevention of loss of bile to the exterior being of great value.

The following case illustrates several points in the management of obstructive jaundice due to impaction of a stone in the common bile-duct:—



Fig. 425.—Mrs. M. W., showing the transverse incision and the T-tube issuing from the common bile-duct.

Mrs. M. W., aged 69, was jaundiced to an olive hue; even her conjunctivæ were green rather than yellow, and her body was covered with scratch marks. A month previously she had had an attack of abdominal pain, which had passed off within 48 hours. Tenderness was elicited beneath the right costal margin where a swelling could be felt.

She entered hospital the next day. Vitamin K was given intramuscularly and she was encouraged to imbibe dextrose solutions. On the evening of the second day she received a blood transfusion. On the following morning $\frac{1}{2}$ gr. (16 mg.) morphine was given, and the patient was brought to the theatre, blindfolded. The abdomen was opened through a transverse incision under local anæsthesia. There were so many adhesions to the liver that the gall-bladder could neither be seen nor felt. Attention was directed towards the common bile-duct. It was soon evident that there was a stone therein, for a hard object could be felt behind the duodenum. The stone, which was about the size of a lump of sugar, was grasped between

the finger and thumb and squeezed upwards. This manipulation must have been painful, but the patient co-operated by relaxing her abdomen. After two or three attempts the stone was loosened from its bed, and it could be pushed up for about an inch. By dissection immediately above the duodenum and retracting the duodenum downwards, that portion of the duct containing the stone

was displayed, and the fingers, which had never remitted their grasp of the stone, were able to get a new grasp, this time without the intervention of the duodenum. The stone, now obviously under control, could be seen beneath the thin covering of the common duct. With a sucker in position to remove the flow of bile which was expected, a vertical incision was made on to the stone, which was removed easily. A copious discharge of mucoid material (white bile) containing flakes of what appeared to be purulent material followed—there was not even a tinge of yellow in this 'bile'. A T-tube was introduced into the commodious common bile-duct and the incision in the duct was closed about the tube. A soft drainage tube was inserted down to this junction, and the abdomen was closed. The patient stood the operation well and the pulse was of good volume and under 100 when the operation had been completed.

There was very little drainage for three or four days, but on the fifth day, rather suddenly, a copious discharge of green bile indicated that the liver had resumed its function (*Fig. 425*). On the twelfth day lipiodol was injected down the T-tube and radiographically it was demonstrated that there was a free communication with the duodenum. The T-tube was, therefore, removed. Convalescence was uneventful.

MANAGEMENT OF DRAINAGE TUBES AFTER OPERATIONS ON THE GALL-BLADDER AND BILE-DUCTS

After *cholecystectomy*, if there is little or no discharge, the corrugated rubber drain can be removed at the end of 48 hours. In the case of *cholecystostomy*, the tube placed in Morison's pouch can likewise be removed at the end of 48 hours. The cholecystostomy tube itself usually becomes loose in 8–12 days. Before this time 20 ml. of diodone, or other radio-opaque material, is injected, the tube is clipped, and a radiograph is taken in order to ascertain if any part of the biliary tree is blocked. If there is no obstruction, the tube can be removed.

The T-tube: After a week, if the stools are coloured and if the bile is crystal-clear, a T-tube in the common bile-duct should be clipped progressively for half, one, and two hours on three consecutive days. If this causes no pain or backache, and no leakage of bile takes place around the tube, it can be removed. Should the bile be muddy or malodorous, if the stools are clay-coloured, if clipping the tube brings on pain or pyrexia, or leakage of bile around the tube, it is almost certain that the common bile-duct is obstructed. In order to ascertain the site of the obstruction, as soon as the patient is symptom-free, retrograde cholangiography should be undertaken by injecting diodone down the tube prior to radiography. In the presence of obstruction the T-tube must be retained until the patient is fit to undergo further operation for the removal of the obstruction. In the case of drainage of the common bile-duct for suppurative cholangitis the T-tube should be left in place for 3–6 months.

STONE IMPACTED IN THE COMMON BILE-DUCT—PRIBRAM'S METHOD

Retroduodenal and transduodenal choledochostomy carry a mortality of 20 per cent. Pribram's method, it is claimed, reduces the mortality to 5 per cent.

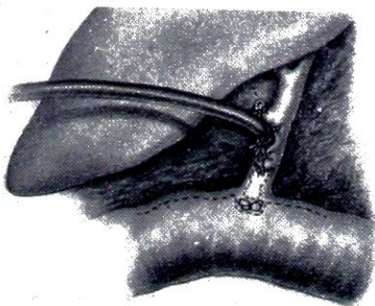


Fig. 426.—Pribram's method. In this case the tube has been passed to a group of stones near the ampulla of Vater. The opening in the common duct is closed meticulously and the tube is held in place by binding one of the catgut sutures around it.

Ether dissolves cholesterol. Many gall-stones are composed of this substance. In cases where a stone cannot be removed from the common duct expeditiously, or when there is uncertainty if all the stones have been removed, Pribram advises the following procedure:—

A rubber drainage tube without lateral fenestrations is insinuated through the opening in the common duct down to the calculus, care being taken that the tube does not kink. The tube should be of such a size that there is ample room in the common duct for bile to flow alongside it. The common duct is closed accurately about the tube so as to make a watertight junction. The tube is held in place by binding around the tube one or more of the sutures which close the upper part of the opening in the duct (*Fig. 426*). About six days later diodone is injected down the tube and a radiograph (*Fig. 427*) is taken. The first treatment with ether is carried out after the diodone has been evacuated; usually a few hours later. The amount of ether used depends on the diameter of

the common duct. In a large duct 0.5 ml. or even more can be injected, whereas in a small duct only a few drops are used. First the bile is sucked out with a syringe. The syringe is then filled with ether, which is injected drop by drop. Directly the patient feels any pressure suction is applied. The injection is repeated several times in this way. Finally, 1 ml. of



Fig. 427.—Gall-stones impacted near the ampulla.



Fig. 428.—Ampulla freed after four weeks' treatment. (B. O. C. Pribram.)

liquid paraffin is injected and the tube is closed with a hæmostat. The hæmostat remains in place until the patient feels pressure, when it is removed. The procedure is repeated several times a day. After a week's treatment a new cholangiogram is obtained. The treatment continues until it is proved that bile is passing freely from the common duct into the duodenum (Fig. 428).

JAUNDICE IN INFANCY

Icterus Neonatorum is noticed in more than half of all newly-born infants. The jaundice appears between the second and fifth day after birth, reaches its zenith in three or four days, and then fades gradually. The liver is not enlarged; neither are the stools

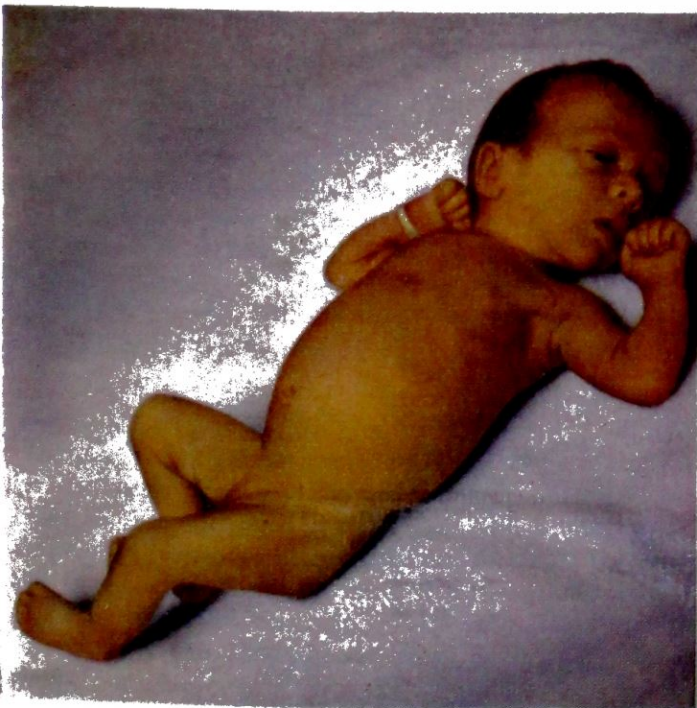


Fig. 429.—Congenital atresia of the common bile-duct.



Fig. 430.—Incision for exploring the bile-ducts.

clay-coloured, nor is the urine deeply bile-stained. The condition does not require any treatment.

Erythroblastosis foetalis et infantium (syn. icterus gravis neonatorum).—(See p. 60.)

Congenital Atresia of the Bile-ducts.—Too often this condition is allowed to pass on to a fatal termination without any attempt being made to explore the abdomen and see if the condition is remediable.

When the common bile-duct or the common hepatic duct is congenitally occluded the infant becomes increasingly jaundiced and the liver enlarged (*Fig. 429*). Life is usually prolonged for three or four weeks, sometimes longer, but towards the end of this period the chances of a successful operation become slender. The time to operate is before the fourteenth day. This gives ample time for the diagnosis to be firmly established.

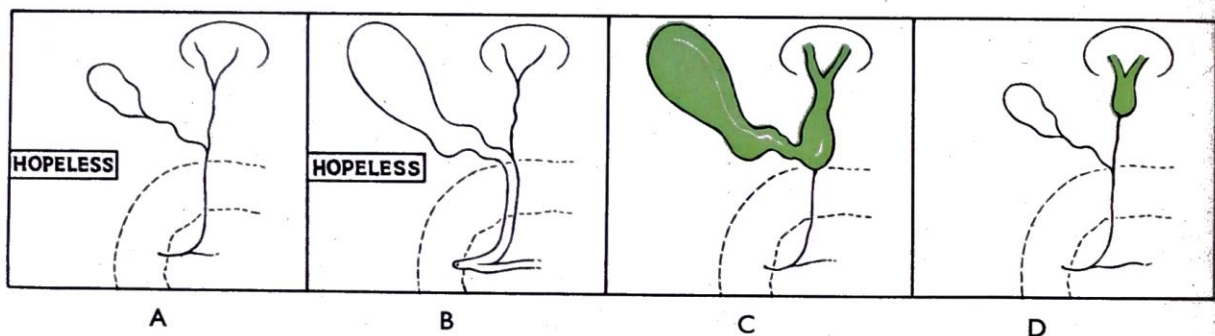


Fig. 431.—Symposium of the various types of congenital obstruction to the bile-ducts, remediable and irremediable. In the remainder the ducts are blocked with epithelial debris. A, 61 per cent. B, 14 per cent. C, 4 per cent. D, 8 per cent.

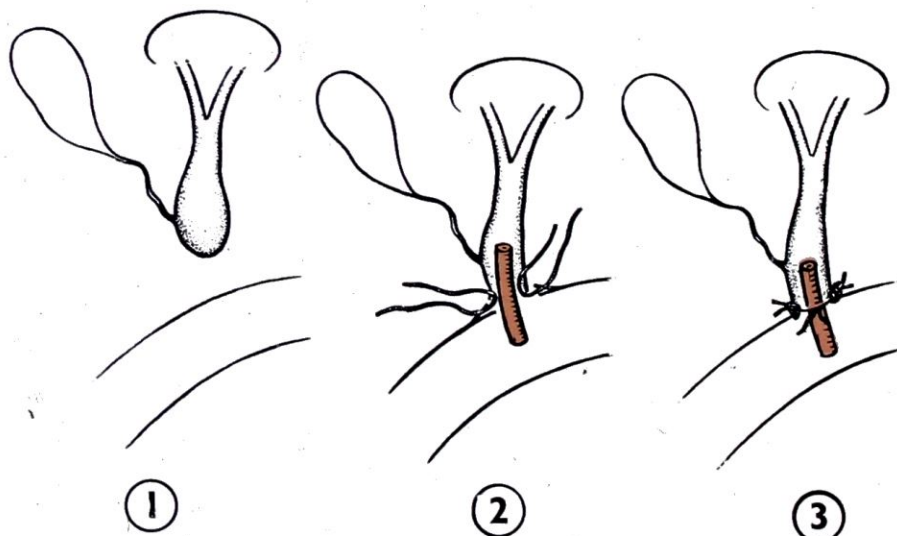


Fig. 432.—The only treatment other than simple drainage to the exterior for the variety of congenital obstruction shown in (1) is to perform hepatico-duodenostomy. After mobilizing the duodenum the anastomosis is made about a piece of rubber tubing (2). Fine cotton stitches complete the anastomosis (3).

Diagnosis.—The infant is usually a male. Sometimes a slight icteric tinge is present at birth, more usually jaundice appears within two or three days thereof; occasionally it is delayed for up to several weeks. Unless the atresia (*Fig. 431*) can be remedied the jaundice becomes deeper and deeper; even tears and the saliva are yellow. From birth the stools are white or clay-coloured; after two weeks they may become faintly yellow; the clinician must be aware of the fact that in profound jaundice a small amount of bile-pigments from the blood is excreted by the intestines. The only method of ascertaining that no bile is entering the duodenum from the liver is by an analysis of the duodenal contents withdrawn by an indwelling duodenal tube. Nutrition is fairly well maintained, especially if the baby is given feeds containing but little fat. Even with medical treatment, if the obstruction is unrelieved, death results in three to six months.

Differential Diagnosis.—The condition is distinguished from erythroblastosis foetalis et infantium (icterus gravis neonatorum, see p. 60) by examination of the blood and (in congenital atresia of the bile-ducts) by the presence of white faeces.

Treatment.—

a. Medical treatment is occasionally successful when the ducts are blocked by epithelial debris. Cholagogues are given; orally 250 mg. of desiccated bile-salts with each feed, and intravenously 5 ml. of 20 per cent dehydrocholic acid three times a week.

b. Operative.—Should the patient be anæmic pre-operative blood transfusion is given. Vitamin K is always necessary to combat the tendency of a jaundiced patient to bleed. At laparotomy (*Fig. 430*) one of the conditions shown in *Fig. 431* will be displayed. While (A) and (B), if fibrous cords, are beyond surgical aid, it is always well worth ascertaining if a tiny lumen is present in the main duct. Syringeing has sometimes proved successful in freeing

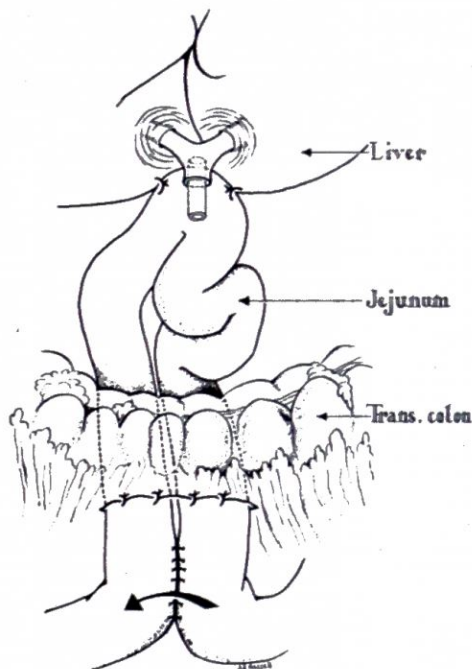


Fig. 433.—Hepatico-jejunostomy. (After Peterson and Cole.)
The anastomosis need not necessarily be retrocolic.

such ducts of inspissated material. In (C) often the only method of constructing a channel for the bile to flow into the intestine is anastomosis of the common bile-duct with the duodenum (choledochoduodenostomy, *Fig. 432*); if, however, the cystic duct is indubitably patent, as is shown in *Fig. 431* (C), cholecystjejunostomy will suffice. In (D) the stump of the common hepatic duct can often be joined to the mobilized duodenum. If this is not possible, reconstruction of the common hepatic duct (hepatico-jejunostomy) should be attempted (*Fig. 433*). In these anastomoses one layer of interrupted sutures is sufficient. It is necessary to place a piece of catheter through the anastomosis. In successful cases eventually it will be passed *per via naturalis*. After a successful operation the enlargement of the liver abates slowly.

SOME POINTS TO BEAR IN MIND IN CONNEXION WITH OBSTRUCTIVE JAUNDICE

1. There is seldom much hurry to operate upon these patients; on the other hand, they are frequently left unrelieved too long.
2. Operation for the relief of obstructive jaundice should be the simplest possible, but it must be adequate.
3. Cholecystectomy in addition to the relief of the obstruction is uncalled for, and if attempted in the presence of jaundice the life of the patient is being endangered unnecessarily.
4. The essential aim of the operation is to relieve the obstruction. A worthy objective is at the same time to remove the cause of that obstruction should it be possible.

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CHAPTER XXXI

ACUTE PANCREATITIS

IN the days before the serum-amylase test for the confirmation of the diagnosis, acute pancreatitis was encountered rarely; and then often either at laparotomy or necropsy and, unfortunately, too often at both. At the present time acute pancreatitis is certainly not a very uncommon disease.

DIAGNOSIS

In its more severe forms acute pancreatitis comes on very suddenly and typically soon after a heavy meal. In these respects it simulates a perforated peptic ulcer. In 50 per cent of cases there is a history of one or more previous attacks of similar, though often less severe, upper abdominal pain.

Pain is the most prominent single symptom of acute pancreatitis. The pain is agonizing, and commences relatively suddenly in the mid-epigastrium, or occasionally in the right hypochondrium, and radiates to the back. When it originates in the right hypochondrium the pain suggests acute cholecystitis, but if it spreads to the left flank, this symptom points to pancreatitis, and in particular to irritation of the peritoneum of the lesser sac. Less commonly the abdominal pain becomes generalized. The severity of the pain is a rough index of the degree of pancreatic involvement. Characteristically the pain is unrelenting and unaffected by vomiting; in the endeavour to gain some measure of relief, often the patient sits up in bed and leans forward.

Vomiting usually follows the pain. Bouts of retching and repeated vomiting exhaust and dehydrate the patient.

Cyanosis is a fairly common accompaniment of the most acute forms of acute pancreatitis. It is due to the profundity of the toxæmia, though perhaps anoxæmia due to the inflamed pancreas preventing full excursions of the diaphragm plays a part.

The pulse-rate is nearly always quickened from the commencement of the attack (cf. PERFORATED PEPTIC ULCER).

The temperature is at first subnormal. Later, if the patient rallies, it rises to 99° F. (37·2° C.). Seldom at this stage is it higher.

Shock: In the past much emphasis has been placed on the dramatic development of shock. Some degree of shock is found in 25 per cent of cases; in very severe cases it is pronounced. When the shock had passed off, it was found that in a series of patients with acute pancreatitis the blood-pressure, both systolic and diastolic, was significantly higher than in a comparable series of patients with perforated peptic ulcer (I. Heinz).

Rigidity in ultra-severe cases is absent, because the patient is collapsed. However, considerable rigidity is to be expected when the initial shock has passed off, but it is not board-like.

Tenderness is conspicuous in the epigastrium, and may be present in the loins, particularly the left.

Ileus is not present in the early stages. After twelve hours peristalsis diminishes and, unless it is prevented by gastro-intestinal aspiration, abdominal distension supervenes.

Leucocytosis is present (early in the attack) in less than half the cases.

Glycosuria is found in about 7 per cent of cases. It is of little diagnostic significance unless it is known that the glycosuria was not present previously. Glycosuria due to acute pancreatitis adds considerably to the gravity of the situation, for it indicates gross pancreatic destruction.

Later Manifestations of Acute Pancreatitis.

A tender mass in the epigastrium, due to entrapped fluid in the lesser sac, can often be felt on or about the fourth to the sixth day. This is of great importance from the standpoint of treatment.

Faint jaundice is discernible in 15 per cent of cases at some time during the attack, usually not until the seventh or eighth day. It is probably obstructive, and due to œdema of the head of the pancreas.

Discoloration of the skin is a most exceptional manifestation, seen only in severe cases of several days' standing. Grey Turner described it in the loins, and likened it in appearance to that of late extravasation of urine. Other observers have described similar discoloration around the umbilicus. The cause of the phenomenon is the action upon the subcutaneous fat of pancreatic ferments that have escaped from the retroperitoneal tissues, in the first instance directly, and in the second instance via the round ligament of the liver.

BIOCHEMICAL CONFIRMATORY TESTS

The Serum-amylase Estimation is one of the pillars upon which rests the modern concrete diagnosis of acute pancreatitis. Without this test exploratory laparotomy is often necessary, and in its wake a greatly increased mortality. The normal value is 80–150 Somogyi units; 200 units is pathological. In acute pancreatitis the serum-amylase level often rises to 1000 units or more (in a few cases it reaches 3000 units), the highest level being attained in less than one hour after the onset of symptoms. Consecutive specimens of blood show a fairly progressive decline, so that the normal level is frequently re-established within 24–48 hours.

Seeing that during laboratory working hours the result can be available within an hour after the blood has been taken for the test, the determination of the serum-amylase can usually be employed as an emergency procedure. One can make a diagnosis of acute pancreatitis with assurance in a patient with severe abdominal pain and a serum-amylase of over 1500 units. In the presence of abdominal pain and a serum-amylase between 500 and 1500 units the diagnosis of acute pancreatitis can still be made if other causes are eliminated. The facts being what they are, good practice requires that any patient with severe abdominal pain should have a serum-amylase estimation performed, and preferably repeated. The reliability of this test depends, to a large extent, on the time during the clinical course of the disease that the specimen is obtained.

Under what Circumstances, and for what Reasons, can the Serum-amylase Level be raised in a Patient with a Normal Pancreas? Apart from the presence of obvious parotitis, several conditions are associated with a raised serum-amylase level:—

1. *Perforated peptic ulcer*, due to the escape of pancreatic juice and absorption of its ferments. It must be emphasized that a raised serum-amylase level in perforated peptic ulcer is exceptional.
2. *Intestinal strangulation*: Again the phenomenon of a raised serum-amylase level is unusual. The reason for it is obscure. This is the most difficult and dangerous condition with which to confuse acute pancreatitis.
3. *The injection of an opiate*, by evoking spasm of Oddi's sphincter, will of itself induce an increased, sometimes pronounced, level in the serum-amylase (H. Wapshaw).
4. *Renal failure*: A probably less frequently encountered factor is the possibility that a serum-amylase elevation is due to retention of the enzymes because of transient anuria and/or renal failure.¹ In oliguria and anuria the serum-amylase level often reaches 1000 units.
5. *A mistake in technique of the determination*: It takes only a tiny contamination with saliva to give a falsely high amylase value.

In view of these possible sources of error, it is wise to repeat the test, especially until the effects of an opiate have subsided, before drawing a definite diagnostic conclusion. It should be noted that increase of serum-amylase from extrapancreatic causes seldom reaches the high levels often found in early acute pancreatitis.

Under what Circumstances can a Patient suffering from Acute Pancreatitis have a Normal,¹ or a Very Slightly Raised, Amylase Level?

1. When there is such extensive damage to the acinar cells of the pancreas that they are rendered incapable of elaborating the enzyme.
2. Idiopathically, the anomaly has been attributed to lack of obstruction to the pancreatic ducts, which seems an important factor in the production of a positive test.
3. After one to four days following the attack.

Summarizing: In making a diagnosis of acute pancreatitis all facts must be taken into consideration. One must guard against the tendency to rely solely on a serum-amylase reading given over the telephone, or entered on a slip of paper.

¹ A normal serum-amylase level in acute pancreatitis is usually a bad prognostic sign (Professor Francis D. Moore).

The **Diastatic Index of the Urine** is normal¹ during the early hours of the attack. After twelve to twenty-four hours it often rises to 100 units or more. Sometimes it is as high as 500 or, rarely, 1000 units. It remains elevated after the serum-amylase has returned to normal; after that it, too, declines, usually to reach normality between the third and the fifth days.

Serum-lipase Estimation cannot be used for an urgent diagnosis, since the result does not become available for twenty-four hours after the blood has been received by the laboratory. However, the serum-lipase remains elevated for a longer time than does the serum-amylase. Hence, in a patient admitted late in the course of the attack, the nature of the condition can sometimes be determined by an elevated serum-lipase, though the serum-amylase has returned to normal levels.

Antithrombin Titre.—A remarkable and consistent rise in the antithrombin level of the blood is present in acute pancreatitis. In 50 of 55 cases a strongly positive result was obtained, and persisted for as long as five days after the onset of symptoms. No elevation was observed in a control group of 150 patients (I. Innerfield). The test is easy to perform, the result can be obtained within 20 minutes, and there are but few negative readings in acute pancreatitis. In many respects this laboratory test has an advantage over the serum-amylase estimation.

Serum-calcium.—Owing to free fatty acids combining with serum-calcium to form soaps in the areas of fat necrosis, the amount of calcium in the blood is reduced. This reduction is not appreciable until about forty-eight hours after the commencement of the attack, and becomes most apparent between the fourth and tenth days. Levels below 7 mg. per cent have sometimes been noted, but this usually reflects neglect in detailed diagnosis, and in the administration of calcium salts. Tetany rarely occurs in the presence of a low blood calcium in acute pancreatitis. It has been suggested that the stimulating effects on the neuromuscular system of a low calcium level is counteracted by the inhibiting effect of a concomitant lowered potassium level. The serum-calcium is a diagnostic help when the patient is first seen late in the disease, and in those rare, ultra-acute cases where the serum-amylase is normal, or only slightly raised.

Plasma-potassium.—A low plasma-potassium sometimes occurs, although less frequently. The use of gastric suction and a low potassium intake both contribute to the fall in potassium (H. A. Edmondson).

RADIOLOGY

In the early hours of the attack a plain film of the abdomen often shows excessive gas in the stomach and the first part of the duodenum (*Fig. 434*). In many cases a radio-lucent area can be seen in the second, and sometimes the third, parts of the duodenum.



Fig. 434.—Acute pancreatitis. Radiograph two hours after onset, showing gas in the duodenum and a little in the stomach. (S. Olivier, "Radio-Diagnostic des Occlusions Intestinales Aiguës", Paris.)



Fig. 435.—Acute pancreatitis. Isolated loop of distended jejunum seen in plain X-ray film.

Commonly, the colon is shown to be filled with gas. In the event of the stomach and the colon being visualized by the presence of gas within them, in acute pancreatitis the stomach and transverse colon are separated by an opaque zone corresponding to the pancreas, whereas in peritonitis the colon and stomach, although frequently distended, remain in contact. Later in the course of an attack of acute pancreatitis there is a sentinel loop of distended jejunum (*Fig. 435*) visible on the film in 50 per cent of cases.

¹ Normal—in a 24-hour collection up to 35 units; in a casual specimen up to 50 units.

The left side of the diaphragm is often elevated and a slight pleural effusion at the left base, though not necessarily pathognomonic, aids in the diagnosis.

DIFFERENTIAL DIAGNOSIS

Difficulties in diagnosis arise because acute pancreatitis can closely imitate other abdominal and thoracic emergencies and, as has been shown, entire reliance cannot be placed in a moderately high serum-amylase test or on radiology.

1. Acute Cholecystitis.—The differential diagnosis between acute cholecystitis and acute pancreatitis is often very difficult; indeed, in 26 per cent of cases of acute pancreatitis the patient is suffering from acute cholecystitis in addition to acute pancreatitis. When it is possible, the differential diagnosis between these two conditions is highly desirable, but failure to make it does not endanger life; the delayed treatment of each is unsurpassed.

2. Perforated Peptic Ulcer.—The rigidity of acute pancreatitis is seldom board-like. Moreover, in perforated peptic ulcer the plain X-ray film often shows air beneath the diaphragm. In the presence of an only moderately raised serum-amylase test, if diagnostic aspiration is not conclusive, an exploratory incision under local anæsthesia is the best course.

3. High Intestinal Obstruction with or without Strangulation is a most onerous differential diagnosis, for the penalty of withholding early operation in the case of strangulated intestine is certain death. As has been described, a moderate rise in the serum-amylase level does not rule out intestinal strangulation. In both conditions the abdomen may be distended, and in both conditions radiology can show gas-filled jejunum. The presence of colicky pains that come and go, and the presence of turbulent bowel-sounds, overwhelmingly favour the diagnosis of intestinal obstruction. The bathing of an upper loop of jejunum in the enzyme-laden peritoneal exudate of acute pancreatitis can result in local paralytic ileus with symptoms and radiological signs identical with those of high intestinal obstruction. The absence of an obvious cause for the obstruction, with tenderness in the flanks, should make one suspicious of acute pancreatitis. In such cases, proceed as in (2).

4. Diffusing Peritonitis (perforated appendicitis; perforated diverticulitis; etc.).—Here the serum-amylase and prothrombin tests are invaluable.

5. A Coronary Thrombosis.—In the more severe type of acute pancreatitis the sudden onset, the cyanosis, lowered blood-pressure, and rapid pulse may suggest coronary thrombosis.

6. Diaphragmatic Pleurisy.

In a number of instances cases belonging to categories (5) and (6) have been proved by the amylase test to be examples of acute pancreatitis with the pain higher than usual.

DIAGNOSTIC ASPIRATION

If shifting dullness is present, and it is imperative to know the nature of the fluid, diagnostic aspiration employing a fine needle attached to a syringe is permissible (for technique, see p. 362). The peritoneal effusion of acute pancreatitis is typically coloured a prune-juice shade by hæmolysed blood. In very acute cases the blood-stained fluid is brighter red. The amylase level of this peritoneal fluid is higher than that found in the blood-serum, and it remains higher for a longer period of time.

LIMITED EXPLORATORY LAPAROTOMY

It is again emphasized that operation should be avoided unless it is impossible to rule out some other condition requiring urgent laparotomy. Such contingencies arise more often when the surgeon has not full laboratory and radiological facilities. When needed, the following method can be recommended with confidence: after premedication with pethidine, under local infiltration anæsthesia an incision 2 in. (5 cm.) long is made in the middle line two fingerbreadths above the umbilicus. If the case is one of acute pancreatitis, prune-juice coloured or blood-stained peritoneal fluid is observed, and tell-tale areas of fat necroses (*Fig. 436*) will be present. In order to find fat necroses occasionally it is necessary to open the lesser sac. When the diagnosis of acute pancreatitis is substantiated, after aspirating as much of the peritoneal exudate as possible (a sample can be sent for a

serum-amylase test) the incision is closed with through-and-through sutures of stainless-steel wire. No drainage is advised at this stage. When some other intra-abdominal catastrophe is revealed, the patient must be anaesthetized more fully, according to circumstances, and the incision extended as necessary.



Fig. 436.—Fat necroses.

DELAYED TREATMENT

The success of the delayed treatment of acute pancreatitis depends upon the care bestowed upon its application. It also demands repeated appraisal of the patient's clinical and biochemical states. Without question this treatment offers the patient the best chance of survival. The patient is nursed mainly in the sitting position, which he finds comfortable, and in many respects the treatment is similar to the Ochsner-Sherren treatment of acute appendicitis (see p. 232).

Transnasal Gastric Aspiration should be started as soon as possible. In addition to the comfort from the relief of vomiting and retching that it brings, it helps to alleviate pain in no uncertain measure. Furthermore, aspiration of gastric juice as soon as it is secreted inhibits the normal hormonal stimulation of the pancreas; thus physiological rest is afforded to the pancreas as well as to the stomach. It is a sound practice to punctuate continuous gastric suction with brief periods of non-suction, during which antacids are instilled into the stomach, thereby still further depressing hormonal stimulation of the pancreas.

The Relief of Pain.—Morphine, and other opiates, induce spasm of the duodenal papilla, thus increasing the pain. They should, therefore, be eschewed rigorously.

Pethidine (Demerol) 2 ml. (100 mg.) intravenously should be the standard analgesic for acute pancreatitis. If necessary, this dose can be repeated in from 1 to 4 hours.

Intravenous Procaine: In cases of exceptionally severe pain 0.5 G. procaine in 500 ml. of saline solution can be administered by the drip method twice daily. The action is similar to that of paravertebral anaesthesia without the latter's unpleasant injection, possible fall of blood-pressure, and short-lived effect. Intravenous procaine relieves pain by continued local anaesthetic, vasodilating, and smooth muscle-relaxing effects.

Everything by mouth is withheld for at least four days.

Intravenous Fluid Therapy.—Usually *intravenous drip dextrose-saline* suffices, and is commenced early and continued for at least four days. In no other intra-abdominal catastrophe is the replacement of lost water and electrolytes more needed than in acute pancreatitis. A daily Fantus test or flame photometric urinary chloride estimation is imperative, to guard against hypochloræmia. In these cases it is especially important

not to overload the circulation. The administration of *whole blood and/or plasma* is necessary in the treatment of severe cases, in order to combat diminution of blood-volume due to loss into the peritoneal cavity of fluids rich in proteins. In severe cases the associated circulatory hypotension can often be rectified by infusion of plasma which, in addition to combating shock, is alleged to contain sufficient antitryptic activity to neutralize some of the released trypsin. In severe cases with hypotension the intravenous administration of noradrenaline (*see p. 77*) has proved valuable.

If prolonged gastric aspiration is required, the use of protein hydrolysate intravenously helps to spare body proteins.

Antibiotic Therapy to combat intraperitoneal and retroperitoneal infection. Aureomycin (or terramycin) is the drug of choice, because it is concentrated in the bile. On account of the accompanying ileus, the antibiotic must be administered parenterally.

Calcium Therapy.—In ultra-acute cases, because of extensive fat necroses and concomitant hypocalcaemia, calcium gluconate 10 ml. of a 10 per cent solution should be given intravenously, and repeated once in 48 hours, if deemed necessary.

Oxygen Therapy does not appear to remedy the cyanosis as quickly as would be expected from experience in other conditions. Nevertheless efficient oxygen therapy should be given as long as the patient exhibits cyanosis.

Hydrocortisone Therapy.—In a number of instances where it has been used, hydrocortisone has quickly brought about a remarkable change for the better in patients with ultra-acute hæmorrhagic pancreatitis who seemed likely to die. The dose is 20–50 mg. intramuscularly, followed by prednisone¹ 25 mg. daily in divided doses by mouth for 5 days, after which the dose is diminished slowly. This form of therapy should be used only in desperate cases.

The Care of the Mouth.—Post-operative parotitis is a rather frequent complication; consequently the nursing staff should be especially vigilant in the disinfection of the patient's mouth.

Pancreatic Asthenia, characterized by great muscular weakness and other signs identical with hypopotasæmia (which is, no doubt, the cause), sometimes develops about the third to the fifth day. If the diagnosis of hypopotasæmia is confirmed by a lowered serum potassium level or by electro-cardiography, the administration of potassium (*see p. 35*) is essential.

As a rule, patients suffering from acute pancreatitis respond to conservative treatment, and within 48 hours there is gradual and steady improvement. Nothing is allowed by mouth for at least four days, and after that time it depends upon whether or not the patient has paralytic ileus. Those patients who become progressively worse fall into the category of acute hæmorrhagic or suppurative pancreatitis.

Summarizing: It is of paramount importance to search for, and correct, dehydration, electrolytic imbalance, hypotension, and insulin deficiency. Special attention must be given to calcium and potassium deficiencies of the circulation.

ANCILLARY METHODS OF TREATMENT

Intravenous Drip Infusion of Serum-albumin.—There is agreement that extensive necrosis and hæmorrhage observed in the pancreas result from the action of pancreatic enzymes liberated into its tissues. Serum albumin has an antitryptic factor. With a view to giving the freed enzymes a protein on which to expend their activity, Kenwell and Wells treated 11 consecutive patients suffering from acute pancreatitis with salt-free serum albumin, the amount given being 300–500 ml. (by slow drip) daily for three to five days. In all patients the course of the disease was influenced favourably by the albumin, and no untoward reactions occurred. The temperature and leucocyte count returned to normal rapidly, and the general condition of the patient improved. When these results were compared with 19 similar cases not given albumin, it was appreciated that the beneficial effect of this treatment is striking, and may indeed be life-saving.

Ganglion-blocking Drugs, which depress pancreatic secretion, are now widely prescribed. When the pain is severe it is best relieved by giving propantheline bromide (pro-banthine)² 30 to 45 mg. six-hourly via the indwelling gastric tube, or 15 mg. intramuscularly. If required, the drug, which reduces pancreatic secretion and lowers the concentration of enzymes in the juice, can be continued for several days.

¹ Roussel Laboratories Ltd., 847, Harrow Road, London, N.W.10.

² Pro-Banthine (G. D. Searle & Co. Ltd., 83, Crawford Street, London, W.1).

TREATMENT OF A COLLECTION OF (SEMIPURULENT) FLUID IN THE LESSER SAC

A sharp watch must be kept for the development of a tender mass in the epigastrium, which not infrequently can be felt about the fourth to the sixth day of the disease. It is due to the foramen of Winslow becoming sealed by inflammatory exudate. The entrapped fluid distends the lesser sac to such an extent that a tender mass can be felt in the epigastrium. It is sometimes accompanied by a hectic temperature and a daily leucocyte count is advisable.

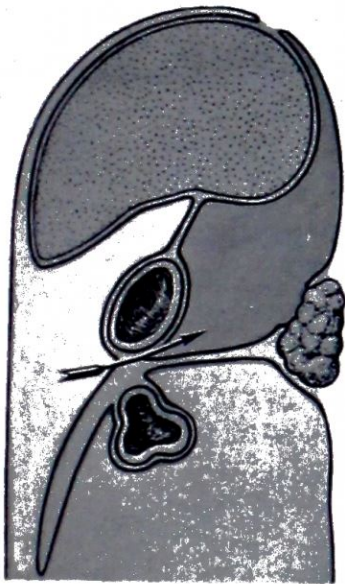


Fig. 437.—Route for draining the lesser sac.

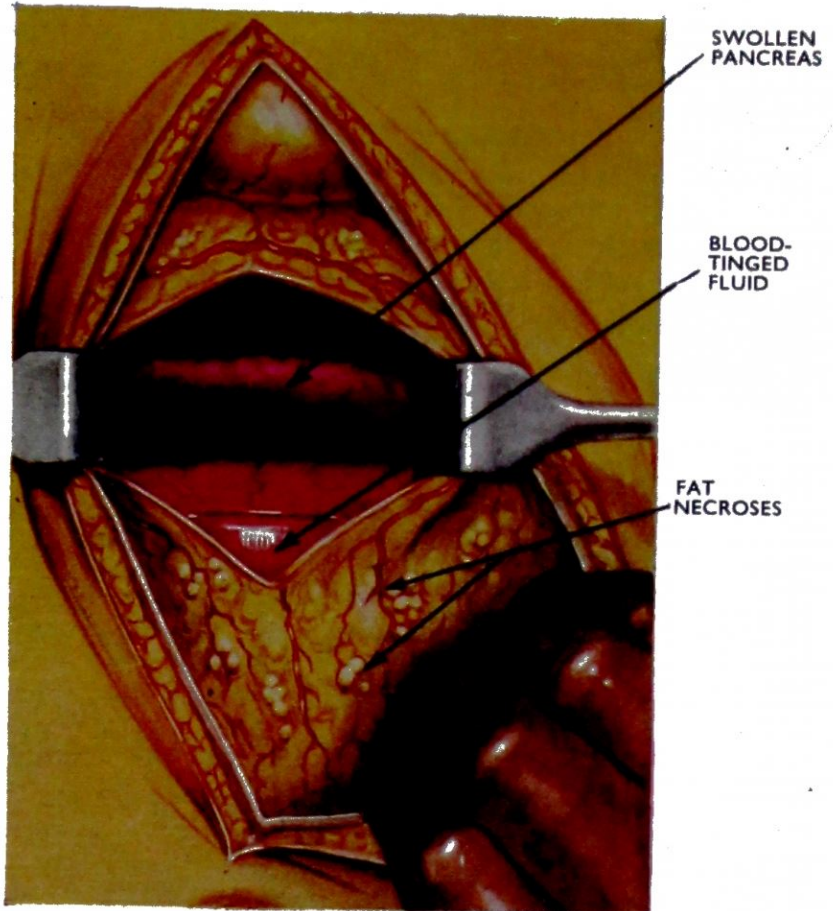


Fig. 438.—The lesser sac has been opened between the stomach and the colon.



Fig. 439.—Drainage of the lesser sac was performed in this very severe case of acute pancreatitis.

The sooner this semipurulent collection of fluid is drained, the better. Local anaesthesia is strongly advised, and nothing more than opening (Figs. 437, 438) and draining the lesser sac through the short midline incision described already is required (Fig. 439).

Post-operative Treatment.—Escaping pancreatic juices tend to digest the abdominal wall and the sutures contained therein. It is advisable to forestall the possibility of a burst abdomen by applying an abdominal corset forty-eight hours after the operation. Digestion of the skin around the wound can be prevented to a large extent by smearing it with paraffin ointment containing 0.2 per cent of hydrochloric acid, which renders the ferments impotent, or aluminium paste can be used. Sump drainage is an excellent additional prophylactic measure.

In the early stages feeds should be pancreatized, and fats should be withheld as far as possible.

PERIPANCREATIC ABSCESS BURROWING POSTERIORLY

During the conservative management of acute pancreatitis it must not be forgotten to make frequent examinations of the lumbar region for tenderness. In the rare event of persistent tenderness and the development of overlying cutaneous œdema of the left loin—signs that indicate that a peripancreatic abscess is burrowing posteriorly—the abscess should be drained through a vertical incision beneath the 12th rib. By burrowing with the finger towards the head of the pancreas, pus is likely to gush forth with minimum disturbance to the gravely ill patient.

SEVERE HÆMORRHAGE AS A CAUSE OF DEATH

The hæmorrhage is characteristically preceded by the development of pyrexia, usually fourteen to twenty-one days after the onset of the attack. Since 1946 hæmorrhage has become one of the chief causes of death in cases of acute pancreatitis. It is believed that antibiotics prevent early death from infection, and that hæmorrhage is the result of necrosis of a large peripancreatic blood-vessel, e.g., the splenic vein. The hæmorrhage occurs into the peritoneum and/or through a drainage tube. More rarely it has occurred per rectum and through the mouth. In most of the reported cases the patient has not rallied with blood transfusion. In a few the abdomen has been opened or reopened, but the bleeding vessel could not be identified and packing has been inserted without success. It is highly important to drain a collection of fluid in the lesser sac in order to prevent this source of erosive fluid causing dissolution of the walls of a large blood-vessel (C. K. Kirby et al.).

INVESTIGATION OF THE BILIARY TRACT

Two weeks after an attack of acute pancreatitis has subsided, cholecystography with visualization of the bile-ducts is undertaken. As a result of this investigation about 70 per cent of patients will prove to be suffering from coexistent biliary tract disease.

TREATMENT AFTER ACUTE PANCREATITIS HAS SUBSIDED

Medical Treatment.—Operation on the biliary tract is hardly to be considered in cases where there are no clinical symptoms of cholecystitis, and above all when there is no radiological evidence of cholecystitis or obstruction to the duodenal papilla. Cholecystectomy in such cases (which is too often performed) only brings discredit on an extraordinarily good operation. Medical supervision should include a strict dietetic régime and abstinence from alcohol, in the endeavour to prevent a relapse.

Interim Operation.—In those cases where it is indicated, laparotomy can be undertaken safely within two weeks of subsidence of all symptoms. On opening the abdomen it is likely that some evidence of fat necrosis will still be present, and the pancreas will feel enlarged. Attention is directed to the gall-bladder. The course to be followed will vary according to whether the gall-bladder is thin-walled and comparatively normal, or thickened and fibrotic. If the elasticity of the wall of the gall-bladder is not appreciably impaired, undoubtedly the operation of choice for an obese, poor-risk patient is to proceed at once to perform cholecyst-jejunostomy, with the objective of by-passing the bile. In other circumstances cholangiography is helpful in determining whether obstruction to the ampulla of Vater is present. In any case, when the gall-bladder is small, fibrotic, and contains calculi, cholecystectomy is indicated. Nevertheless, unless the patient is fit enough to undergo sphincterotomy¹ in addition, it is unlikely that cholecystectomy *per se* will prevent further attacks of acute pancreatitis, or stay the progress to chronic pancreatitis. In spite of a well-chosen and well-executed interim operation, relapses occur in no less than one-third of these patients.

ACUTE POST-OPERATIVE PANCREATITIS

Acute pancreatitis occasionally follows gastric resection or partial pancreatectomy. It is manifested by severe epigastric pain passing to the back, restlessness, followed by shock in varying degrees, within a few days of the operation. Jaundice may supervene. The diagnosis is made by the serum-amylase test.

¹ A description of this operation is beyond the scope of this work.

In 14 cases where the onset of acute pancreatitis followed an upper abdominal operation, the pancreas had been manipulated or incised in each instance. The operations were :—

Subtotal gastrectomy	..	..	..	6
Subtotal pancreatectomy	..	..	..	5
Biopsy of pancreas	..	..	..	2
Right colectomy with partial pancreatectomy	..	..	..	1

All the patients had relatively severe pancreatitis. The mortality is much higher than that of idiopathic acute pancreatitis. Seven of the patients died of hæmorrhage, and one of infection (C. K. Kirby et al.).

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CHAPTER XXXII

OTHER EMERGENCY CONDITIONS IN THE UPPER ABDOMEN
SUBDIAPHRAGMATIC ABSCESS

Signs of pus somewhere, signs of pus nowhere else, signs of pus there. (Harold Barnard.)

SUBDIAPHRAGMATIC suppuration is sufficiently common to make it imperative for the emergency surgeon to study the subject closely, and endeavour to master it. At the outset he must face the fact that, if unreported cases and those which die without the abscess being drained are taken into the assessment, subdiaphragmatic abscess is linked with the formidable mortality of about 40 per cent. The chief obstacle to overcome is 'too late': the diagnosis, always difficult, so often becomes confused because of the concomitant signs in the base of a lung.

Subphrenitis may give rise to all the constitutional and local symptoms and signs produced by a subdiaphragmatic abscess except, of course, those of a space-occupying lesion.

An important consideration, and one which is not generally appreciated, is that in a high percentage of cases subdiaphragmatic *infection* resolves, consequently many examples of infection of the space pass through our hands, perhaps suspected, but never diagnosed concretely; Alton Ochsner places the number of cases falling into this category as high as 70 per cent. It is only when suppuration occurs that failure to diagnose the condition spells disaster, for unless the abscess bursts into the bronchial tree, the patient is doomed.

Antibiotic therapy will doubtless be commenced at an early stage of the subphrenitis. It should be remembered that the infection is often mixed; it is therefore advisable to administer streptomycin in addition to penicillin, or aureomycin can be substituted. If the constitutional symptoms subside and do not recur, the condition is one of subphrenitis, and antibiotic therapy should be continued until one is certain that resolution is complete. On the other hand, antibiotic therapy will have but little effect on a formed abscess. It should, however, be given pre-operatively and post-operatively. In the latter case, when the sensitivity of the organisms present to antibiotics has been ascertained, the most suitable antibiotic can be given with precision.

A Space-occupying Lesion is present.—To most surgeons subdiaphragmatic abscess means right subdiaphragmatic abscess. Consequently subdiaphragmatic abscesses on the left side, which should be expected once in every four or five cases, are missed or delayed unduly even more than those on the right side. In a series reported from the Mayo Clinic by Berners et al. the location of the abscess was as follows:—

On the right side	114
On the left side	36
Bilateral	4
	—
	154 cases
	—

The average duration of the symptoms before the subdiaphragmatic abscess was diagnosed and drained was 150 days.

THE SEVEN SUBDIAPHRAGMATIC SPACES

The subdiaphragmatic region is bounded above by the diaphragm and below by the transverse colon and the transverse mesocolon. It includes five intraperitoneal and two extraperitoneal spaces. Of the intraperitoneal spaces, two are situated on the right and three on the left side.

The right suprahepatic space lies between the right dome of the diaphragm and the anterior superior and right surfaces of the right lobe of the liver (*Fig. 440 A*).

The right infrahepatic space is better known as Rutherford Morison's pouch (*Fig. 440 B*).

The **left suprahepatic space** is situated between the left lobe of the liver and the left dome of the diaphragm, and it is separated from its fellow on the right side by the falciform ligament.

The **left infrahepatic space** is divided by the stomach into (a) an anterior and (b) a posterior space (*Fig. 441*). It should be noted that the left postero-inferior space is the lesser sac.

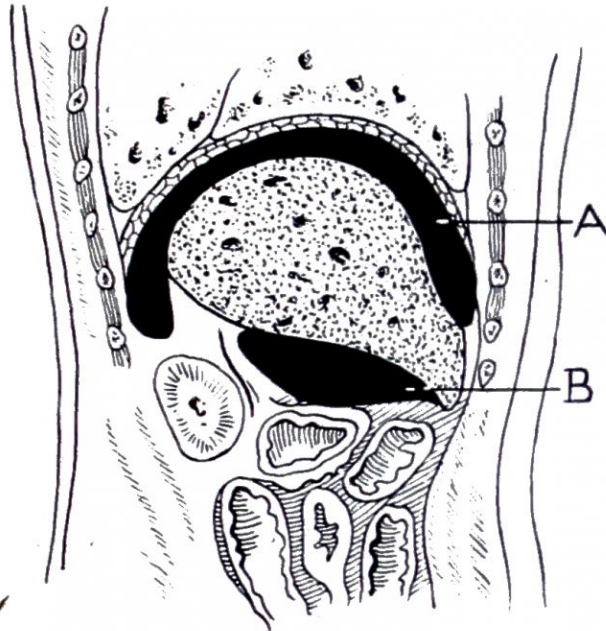


Fig. 440.—Sagittal section through the right side of the body showing : (A) Right suprahepatic space ; (B) Right infrahepatic space.

The **right extraperitoneal space** is comparatively large. It is situated between the bare area of the liver (which is situated on the back of the right lobe) and the diaphragm.

The **left extraperitoneal space** occupies the cellular tissue between the left kidney and its suprarenal gland posteriorly, and the pancreas anteriorly (*Fig. 441*).

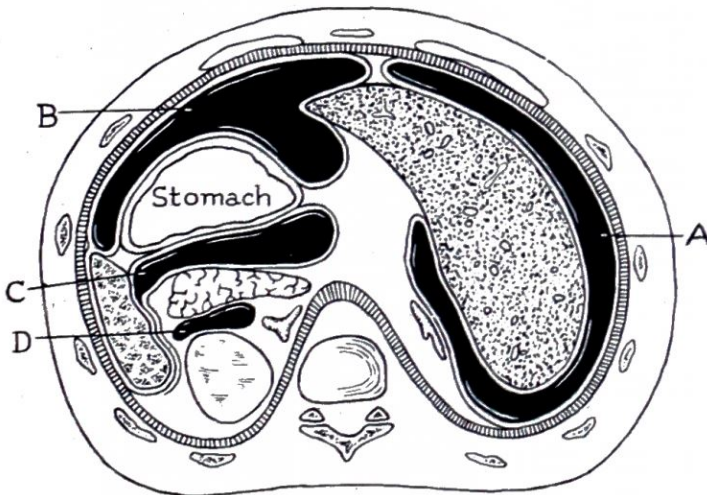


Fig. 441.—Cross-section of the body showing : (A) Right suprahepatic space ; (B) Left anterior infrahepatic space ; (C) Left posterior infrahepatic space ; (D) Left extraperitoneal space. (*Modified from Berners et al.*)

An abscess in either the right or the left *suprahepatic space* seldom occupies the whole space ; it is limited by adhesions to a portion of the space. Such an abscess is often situated mainly anteriorly or mainly posteriorly—more often mainly anteriorly. Likewise an abscess of the *right infrahepatic space* may manifest itself in front or behind. An abscess of the *left anterior infrahepatic space* is limited to the left hypochondrium, while an abscess of the *left posterior infrahepatic space* (lesser sac), like a pseudopancreatic cyst, presents in the middle line.

Aetiology.—Nearly all subdiaphragmatic abscesses follow a known intraperitoneal lesion. The commonest causes of subdiaphragmatic abscesses are:—

1. Perforated peptic ulcer 33 per cent
2. Acute appendicitis (usually retrocaecal) 20 per cent
3. As a complication of an abdominal operation other than for the above . . 16 per cent

Then follows a miscellaneous collection of intra-abdominal inflammatory conditions, on the relative frequency of which it is unprofitable to linger, save to mention that post-partum cases (*Fig. 442*) are not very uncommon.

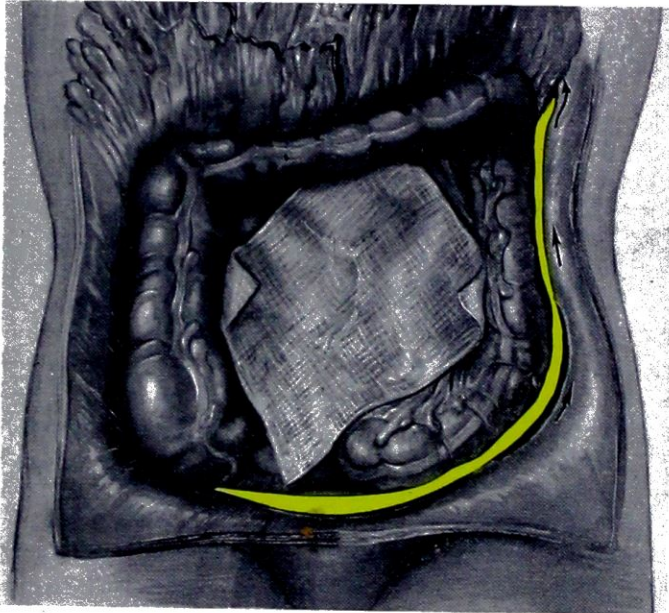


Fig. 442.—The trail of pus from the pelvis to the left subphrenic space. Pelvic suppuration, particularly post-partum, is a frequent source.

In cases of subdiaphragmatic abscess following a perforated duodenal ulcer a suprahepatic abscess is frequently an extension of a subhepatic abscess. This suggests that if in late cases of perforated duodenal ulcer and in perforations that are difficult to close, Rutherford Morison's pouch was drained more often, we should be spared quite a number of subdiaphragmatic abscesses. The same is true for the Polya type of partial gastrectomy especially in cases when difficulty is experienced in closing the duodenal stump.

Regarding the third group, the operation in question is most frequently cholecystectomy, and secondly, and nearly as frequently, partial gastrectomy with leakage of the duodenal stump. These two operations

account for three-quarters of all cases of subdiaphragmatic abscess attributable to an abdominal operation, but excluding those performed for (1) and (2).

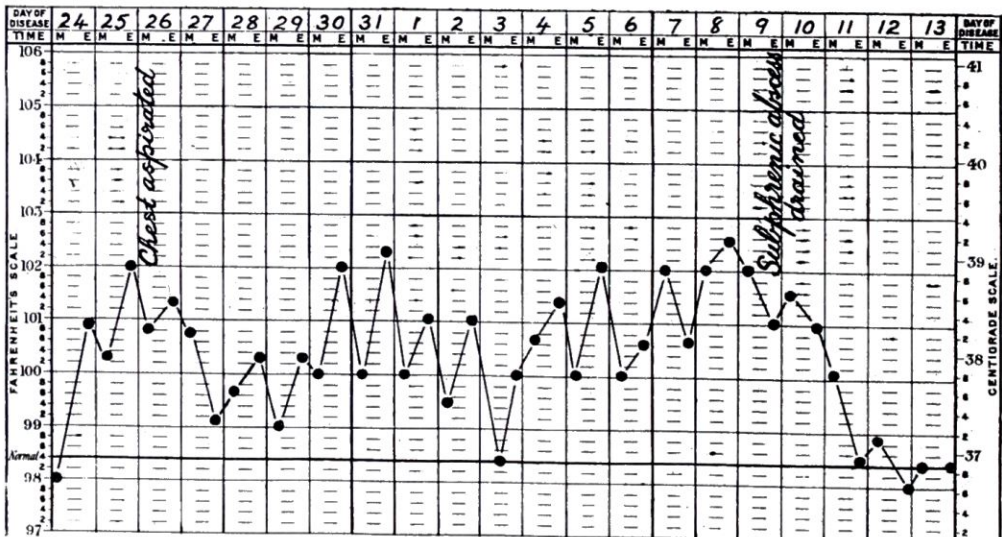


Fig. 443.—The temperature chart of A. H. B. after the third week following cholecystectomy. Note the hectic temperature and the termination of pyrexia following drainage of the subphrenic abscess.

Bacteriology.—The predominant organisms are streptococci, *Esch. coli*, and staphylococci. A mixed infection is present frequently.

Diagnosis.—The majority of patients with a subdiaphragmatic abscess feel ill. In addition to pain, they complain of anorexia and nausea. The complexion is frequently muddy.

The temperature nearly always fluctuates between 100° and 102° F. (37.8° and 38.9° C.) or more (Fig. 443). In a few cases it alternates, remaining lower, but rarely normal, for a few days, and then rising again. Exceptionally the patient is apyrexial; in these cases the prognosis is extremely bad.

Rigors are uncommon, and usually occur in patients with concomitant pylephlebitis or a liver abscess.

The pulse-rate is less than 100 in a third of cases, between 100 and 120 in a third of cases, and more than 120 in a third of cases (H. R. S. Harley).

The respiratory-rate is usually raised and corresponds to the extent and nature of the thoracic complications.

Pain is felt on the side of the lesion, or in the middle line. It is often localized in the hypochondrium, although nearly as frequently it is experienced in the lower part of the thorax of the corresponding side. In a much smaller percentage of cases the pain is located in the lumbar region or in the neighbourhood of the 11th and 12th ribs. Referred pain to the corresponding shoulder is not infrequent, but special inquiries must be made concerning it.

Swelling is present in 25 per cent of cases. It is situated very much more frequently in the right or left hypochondrium than posteriorly.

Tenderness is present in 40 per cent of cases, always on the side of the lesion and more commonly anteriorly (Fig. 444) than posteriorly.

Discharge: When the primary lesion is or was situated in the right upper abdomen, nearly always there is a persistent purulent discharge from the operation wound.

Downward displacement of the liver is uncommon, and in one-third of cases in which such displacement occurs it is due to a concomitant abscess of the liver.

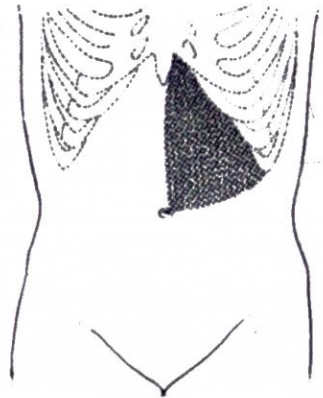


Fig. 444.—Area of tenderness and fullness in left anterior infrahepatic abscess.



Fig. 445.—Subdiaphragmatic abscess, showing elevation of the diaphragm. (A. L. d'Abreu.)

Jaundice is most unusual in subdiaphragmatic abscess. When it is present it is nearly always due to coexisting obstruction to the common bile-duct by a calculus, or to suppurative pylephlebitis.

Persistent hiccup is rare, and in this condition is of grave omen.

Examination of the blood: Leucocytosis is nearly always much in evidence; secondary anaemia is common.

Thoracic symptoms and signs: As emphasized already, there is a high incidence of symptoms, and especially signs, in the corresponding base of the thorax. These include cough with sputum, dullness to percussion, and diminished air entry.

Radiology.—In spite of the fact that in about 10 per cent of cases of subdiaphragmatic abscess radiological signs are absent, in most cases X-ray examination is an invaluable method of confirming the diagnosis and of localizing the site of the abscess. Films should be taken in the

postero-anterior and the lateral positions, with the patient upright. Whenever the patient is well enough, he should also be screened, if necessary in the recumbent position. The particular value of screening is that the movements of the diaphragm can be observed. Positive radiological signs are as follows:—

1. Diminution or abolishment of diaphragmatic movement on the affected side.
2. Elevation of the diaphragm (Fig. 445), also a most valuable sign, is more likely to be present on the right, than the left, side.
3. Increase in thickness of the diaphragm, with loss of sharp definition of its upper border.

4. Radiological signs in the pleural cavity of the corresponding side, by far the commonest being a pleural effusion. In addition collapse of the lung, or pneumonitis, may be present.

5. Gas in the abscess cavity is most illuminating, but it is present in only 25 per cent of cases. The presence of gas indicates that the abscess has been in communication with the alimentary tract, a bronchus, or the exterior. In rare cases gas is a product of gas-forming organisms; it must also be remembered that air which gained entrance at the time of laparotomy sometimes takes 10–14 days to become absorbed. To give the patient a Seidlitz powder before the examination, and so to distend the stomach, is most helpful in distinguishing subdiaphragmatic gas from a bubble in the fundus of the stomach. Alternatively a small amount of barium emulsion and screening the patient in Trendelenburg's position can be employed.

Needling for a Subdiaphragmatic Abscess should be forbidden absolutely. It may be quite justifiable to pass a needle into the pleural cavity (*see p. 708*) to ascertain whether fluid is present and the nature of that fluid, but to pass the needle onwards in the endeavour to locate pus beneath the diaphragm is the quintessence of impropriety. In no circumstances, whoever advises it, should the surgeon weaken in his resolve to refrain from attempting to confirm the diagnosis by this expedient, for if he passes the needle through the pleural cavity and a subdiaphragmatic abscess is present, inevitably the pleural cavity will become seriously infected.

DRAINAGE OF A SUBDIAPHRAGMATIC ABSCESS

Transthoracic drainage should be avoided absolutely, for the mortality of drainage by this route is nearly $2\frac{1}{2}$ times as great as that of extraserous¹ drainage. According to the site of maximum tenderness and the X-ray appearances, one of two routes is chosen—

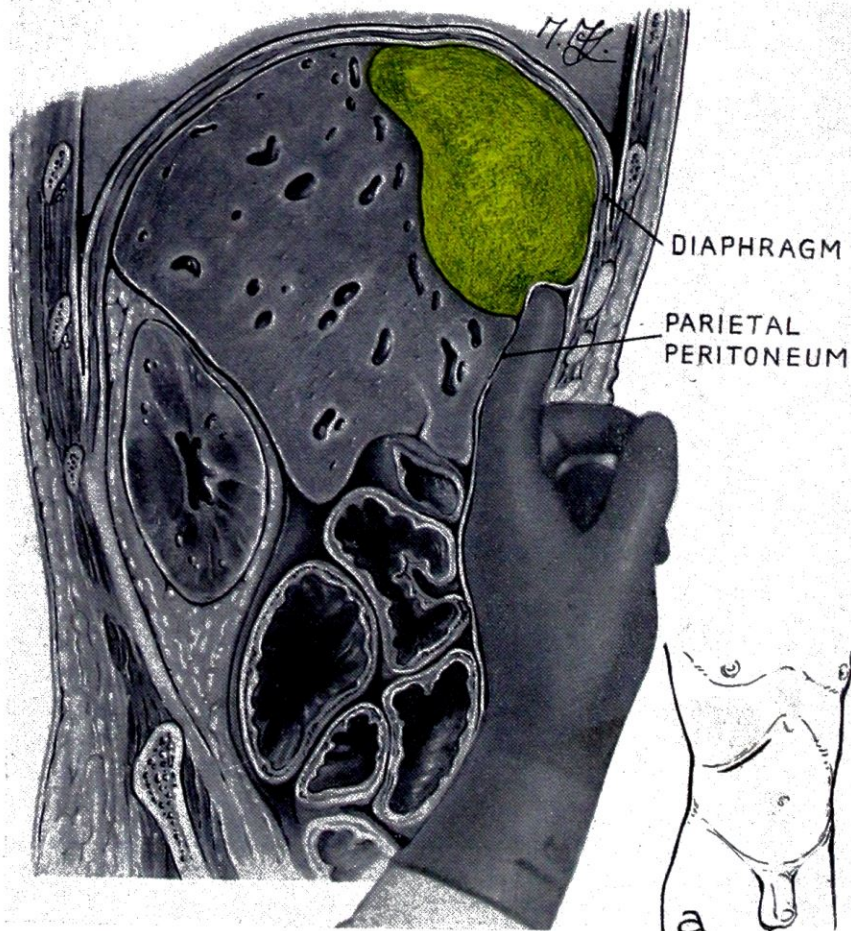


Fig. 446.—Drainage of a right suprahepatic subdiaphragmatic abscess.

¹ Extraserous—The line of section must traverse neither the pleural cavity (whether the layers are adherent or not) nor an *uninvolved* portion of the peritoneal cavity.

the anterior or the posterior. In both the approach is meticulously extraserosus. Anæsthesia can be accomplished by a paravertebral block of the lower six thoracic nerves, combined with local infiltration. Of course endotracheal general anæsthesia makes the operation less arduous for the surgeon, but whether it is harmless to a patient who has in all probability at least some pulmonary involvement is extremely doubtful.

THE ANTERIOR EXTRASEROUS OPERATION

An incision is made 1 in. (2.5 cm.) below and parallel to the costal margin, from the middle of the rectus abdominis, extending laterally sufficiently to provide an opening large enough to accommodate the hand (*Fig. 446*, inset). The external oblique, the internal oblique, and the transversalis muscles are divided in the line of the incision. Unless it is absolutely necessary in order to gain sufficient room, the rectus sheath is not incised, the reason being that it is advisable to avoid soiling the interior of the sheath with pus. The incision exposes the peritoneum: attention is focused on the extraperitoneal areolar tissue. In order to expose the suprahepatic space the finger burrows upwards in the extraperitoneal areolar tissue between the peritoneum and the diaphragm. With the finger, the peritoneum is peeled off the diaphragm. Especially when inflammatory œdema is present, this peeling is accomplished easily. The abscess (*Fig. 446*) is recognized by induration, and is opened by forcing the finger through its wall. The left anterior infrahepatic space is opened by inserting the finger upwards and backwards between the upper border of the stomach and the under surface of the left lobe of the liver (*Fig. 447*).

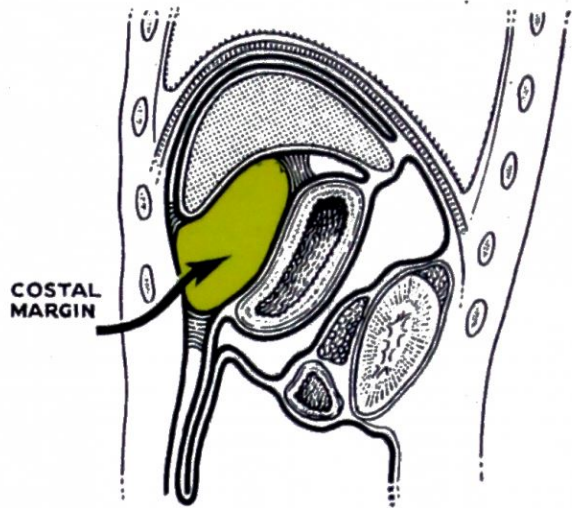


Fig. 447.—The anterior extraserosus approach to an abscess of the left infrahepatic space located anteriorly. (After H. R. S. Harley.)

THE POSTERIOR EXTRASEROUS OPERATION

The patient is placed on his sound side, the sandbag or bridge elevating the lumbar region. The skin incision is made over the 12th rib, commencing 1 in. (2.5 cm.) from the middle line and extending to beyond its tip. The incision

must be long enough to accommodate the hand. The 12th rib is exposed and its periosteum incised along the length of the rib, and, after freeing the periosteum with suitable rougines, the sacrospinalis is retracted so as to gain access to the posterior end of the rib. The whole length of the shaft of the rib is then excised subperiosteally. The next step is to incise the bed of the 12th rib transversely at the level of the first lumbar vertebra (*Fig. 448*). If a higher level than this is chosen, the pleura will be endangered. This incision passes through the bed of the 12th



Fig. 448.—Showing the transverse incision made through the bed of the resected twelfth rib. (After Ochsner and Graves.)

rib, dividing the periosteum and the muscles attached to the rib. Deep to these the diaphragm is severed. The diaphragm at this site may be well or poorly developed. Beneath the diaphragm will be found the perinephric fat. Blunt dissection in it will reveal the posterior layer of the renal fascia, through which the perirenal fat can be seen. The

renal fascia is not divided. By dissection with the finger the upper pole of the kidney and the suprarenal gland is sought. The finger passes over the suprarenal gland, and on the right side it is easy to explore the right suprahepatic and right infrahepatic (*Fig. 449*) as well as the right extraperitoneal space, provided the incision is large enough to accommodate the hand. To explore the right infrahepatic space the finger is thrust below the right lobe of the liver.

On the left side the left suprahepatic space (*Fig. 450*) and the left extraperitoneal space can be examined.

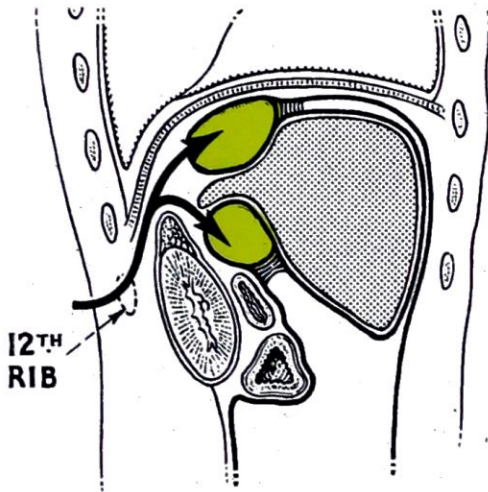


Fig. 449.—The path taken by the fingers in draining a right suprahepatic and a right infrahepatic abscess by the posterior route. (After H. R. S. Harley.)

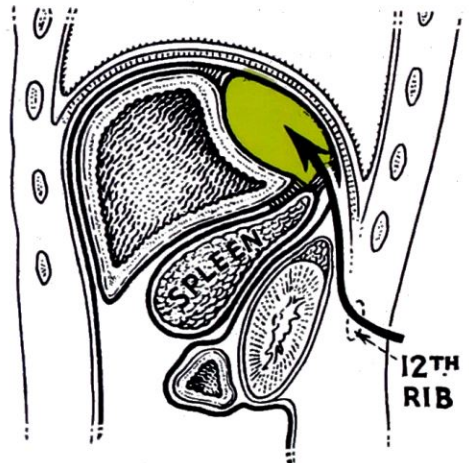


Fig. 450.—The posterior extra-serous approach to a left-sided suprahepatic abscess. (After H. R. S. Harley.)

A MIDLINE INCISION

This is used when tenderness and swelling are situated in the epigastrium, which is sometimes the case when a right extraperitoneal abscess tracks forwards between the layers of the falciform ligament.

An abscess of the left posterior infrahepatic space (lesser sac) is the one exception where the peritoneum must be opened in order to effect drainage of the abscess. The abscess is approached by entering the lesser sac between the colon and the stomach via a midline incision.

POST-OPERATIVE TREATMENT

This should include a nourishing diet with added vitamins. Transfusion with *fresh* blood is most beneficial when the patient is anæmic. Respiratory exercises to encourage full function of the diaphragm are essential.

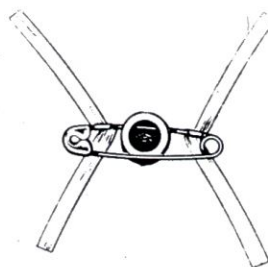


Fig. 451.—Method of anchoring the tube draining a subdiaphragmatic abscess.

Management of the Drainage Tube.—The drainage tube should be a fairly large one ($\frac{3}{4}$ in. in diameter). Its end is bevelled, but no side holes are cut; side holes render that portion of the tube beyond the holes ineffective, and granulations are prone to grow into the holes (Harley). The tube should project very little above skin level, and is kept in place by a safety-pin and adhesive tape (*Fig. 451*). The dressings are maintained by corsetage.

In the early stages of drainage of a large abscess the tube can be connected to a water-seal bottle. When the discharge is reduced to 1 oz. (28.5 G.) per day, closed drainage is abandoned in favour of dressings. The drainage tube must not be shortened until it has been shown by a series of radiographs in two planes at right angles to one another, taken after injecting lipiodol through a catheter inserted down the tube, that the abscess cavity has become obliterated. The lipiodol must not be allowed to escape. This is achieved by plugging the end of the tube with gauze, and keeping the patient in such a position that the medium will not run out. If any is spilled on the skin, it must be wiped away with gauze dampened with methylated ether.

before the radiographs are taken. When the radiographs show that the abscess cavity has filled in, and only the tube track remains, the tube is shortened tardily, and finally removed.

COMPLICATIONS

Complications attributable to subdiaphragmatic infection occur in about two-thirds of all cases. The most common complications are :—

Pleural effusion	55 per cent of cases
Pneumonitis	39 " " " "
Empyema	23 " " " "
Bronchopleural fistula ..	11 " " " "
Suppurative pericarditis ..	2 " " " "

Except in cases of pleural effusion, often more than one of these complications occurs in the same patient.

The presence of complications, more especially suppurative complications, has a profound bearing on the prognosis. The death-rate for patients with complications is five times that of patients without complications.

Serous Pleural Effusion requires no treatment, unless it is causing mechanical respiratory embarrassment, when the fluid is withdrawn by aspiration. To ensure that the subdiaphragmatic abscess is not entered, the needle must be inserted well above the diaphragm. After drainage of a subdiaphragmatic abscess, a serous pleural effusion becomes absorbed.

The three most important causes of *intrathoracic suppuration* are rupture of the abscess through the diaphragm, transpleural drainage or needling of the abscess, and penetrating thoraco-abdominal wounds. The first is by far the most common.

Empyema is more commonly first recognized after, than before, drainage of a subdiaphragmatic abscess. When a subdiaphragmatic abscess and an empyema are present together, each must be drained separately with, if possible, an interval of 48 hours between operations.

Spontaneous Rupture of a Subdiaphragmatic Abscess into a Bronchus usually occurs via the pleural cavity. In other words, the subdiaphragmatic abscess ruptures into the pleural cavity, and later the resulting empyema ruptures into the bronchus. Although the patient's condition is improved by the latter happening, it does not provide satisfactory drainage of the original abscess, and drainage of the subdiaphragmatic abscess by operation should be undertaken as soon as possible.

Suppurative Pericarditis, which is always secondary to an empyema, is often overlooked, with fatal results. The pus should be aspirated, and if this is not soon effective, drainage of the pericardium should be carried out.

PYLEPHLEBITIS (PORTAL PYÆMIA)

Although pylephlebitis can follow suppurative disease in any part drained by the portal system, in more than 70 per cent of cases it arises as a complication of acute appendicitis, in which case the train of events is as follows: as a result of direct extension of infection from the lumen of an acutely inflamed obstructed appendix, thrombophlebitis of the appendicular veins occurs. The thrombophlebitis extends to the ileocolic vein and from thence to the superior mesenteric vein. At an early stage of the spreading intravascular clotting, pieces of thrombus become detached and are swept to the liver, where they lodge and form abscesses. Alternatively, if a gangrenous appendix occupying the splenic position lies in juxtaposition to the mesentery, radicles of the superior mesenteric vein can be infected directly.

The abscesses in the liver resulting from pylephlebitis are usually small and multiple (Fig. 452); little wonder that the prognosis is bad. Nevertheless, as long as the patient has a good hold on life, we should assume that he is to be an exception. Recovery is possible in one of two ways: (1) Resorption of small abscesses can occur, especially with the aid of antibiotic therapy; (2) Infrequently one or two large intrahepatic abscesses form, drainage of which is usually the prelude to a successful issue.

Pylephlebitis is less common than formerly; this is accounted for by the earlier diagnosis and treatment of appendicitis,¹ antibiotic therapy, and the wide appreciation of the fact that prolapsed or strangulated hæmorrhoids must never be excised while they are inflamed.

¹ The incidence of pylephlebitis in acute appendicitis is 0.03 per cent.

Diagnosis.—In as far as pylephlebitis arising as a complication of appendicitis is concerned, two clinical types are encountered :—

1. Rigors occur soon after the onset of an attack of appendicitis, and except for the rigors the signs and symptoms leave no doubt that the patient is suffering from acute appendicitis.

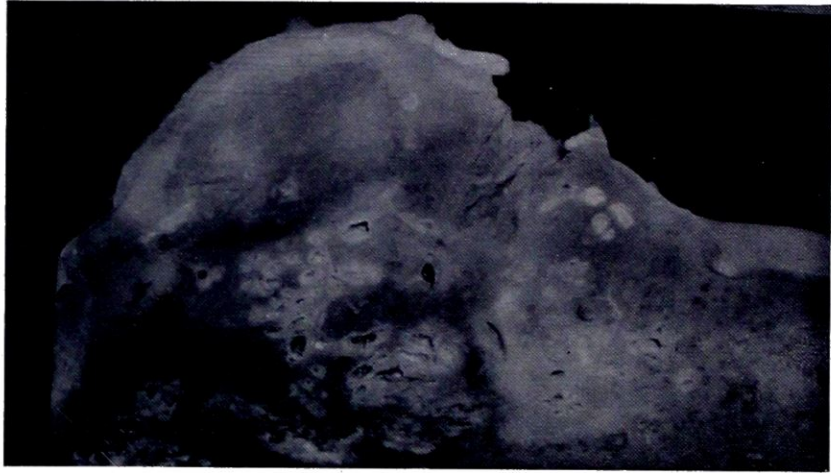


Fig. 452.—Pylephlebitis. Liver honeycombed with small abscesses.

2. The symptoms and signs of appendicitis are atypical, and the diagnosis is not made early, as is liable to occur when the appendix is high and retrocaecal. The absence of signs in the right iliac fossa and the presence of rigors mislead the clinician ; as a consequence much valuable time is lost. It is worth bearing in mind that in several reported cases a

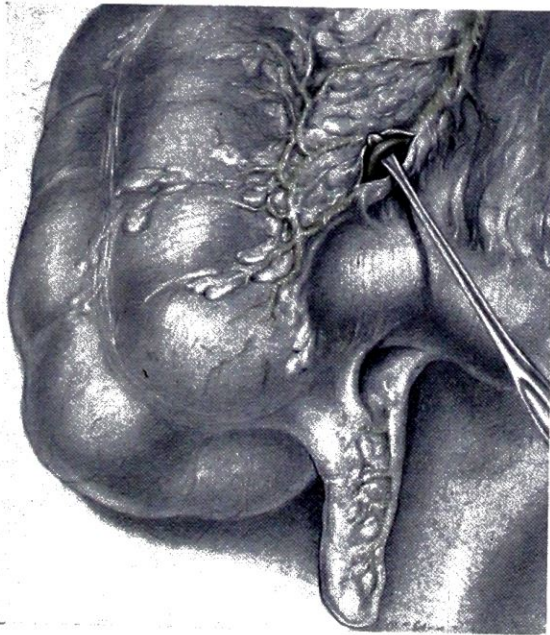


Fig. 453.—The prevention of pylephlebitis. Isolating the ileocolic vein preliminary to passing the ligature.

plain radiograph showing one or more faecoliths in the appendix has proved to be the turning point in arriving at the correct diagnosis. It is possible, though most unusual, for pylephlebitis to occur as a late complication of appendicitis, and this holds good for cases treated by appendicectomy as well as those treated by the Ochsner-Sherren method.

Pylephlebitis is characterized by a hectic temperature rising to 102° F. (38·9° C.) or more. *Recurring rigors are never absent*, and in relevant cases it is this symptom that helps to distinguish the condition from a subdiaphragmatic abscess but it does not exclude it. In one-third of cases the liver becomes palpably enlarged. In a somewhat higher proportion the patient is slightly jaundiced, i.e., there is an icteric tinge of the conjunctivæ when observed in daylight. If tested for, urobilin will be found in the urine *in every case*. Diarrhœa is a usual accompaniment. Moderate ascites occurs in a few cases. In a little more than half the cases the blood culture is positive ; *Esch. coli*, hæmolytic streptococcus, *Str. viridans*, and a mixed infection containing *Cl. perfringens* are the organisms most frequently cultured.

Treatment.—If a rigor occurs at the onset of an attack of acute appendicitis one should proceed as follows : withdraw a sample of blood, if possible during or directly after the rigor, and send it to the laboratory for culture and, if positive, for sensitivity of the organisms present to antibiotics. Commence antibiotic therapy forthwith by giving 500,000 units of penicillin and 0·5 G. of streptomycin, or a broad spectrum antibiotic. Perform appendicectomy urgently and, by clipping and cutting near the cæcal attachment, remove the

mesoappendix as completely as possible. If thrombophlebitis is found, ligation of the thrombosed vessel well above the thrombus should be undertaken.

Ligation of the Ileocolic Vein.—The cæcum is drawn well out of the wound and the superior ileocæcal angle sought. The vein is located and traced upwards about 2 in. (5 cm.), where it will be found to be joined by other cæcal branches. Using a Watson Cheyne dissector, the vein is isolated from its peritoneal covering (*Fig. 453*), and is divided between ligatures, taking care not to include the artery. I have practised the measure on a number of occasions. In each instance the patient had rigors prior to the operation. All made a smooth recovery. Possibly they were saved from portal pyæmia.

Antibiotic Therapy.—After operation a broad spectrum antibiotic is given and continued, unless sensitivity tests of organisms obtained from the blood-stream indicate otherwise. Antibiotic therapy should be maintained for at least 10 days after the temperature has been normal.

A man of 32 developed pylephlebitis as a complication of atypical appendicitis. After appendectomy and drainage of the associated abscess and ligation of the ileocolic vein had been performed, the patient received 1 G. of aureomycin four-hourly by mouth for 14 days. Recovery followed. (*Marson and Maynell.*)

Blood Transfusion is given when, as is often the case, the hæmoglobin estimation indicates that it is required.

Localized Abscess of the Liver is suspected.—If, in a protracted case, it is considered possible that a sizeable abscess lies within the liver, an exploratory operation should be performed (*see p. 1138*).

In a case operated upon successfully by the late Mr. Litler Jones, of Liverpool, witnessed by me, two abscesses in the right lobe of the liver were drained. These were a sequel of suppurating hæmorrhoids.

LOCALIZED PYOGENIC LIVER ABSCESS

A pyogenic liver abscess can develop without any obvious cause; indeed, in 77 cases analysed by W. A. Bourne no cause was found in 42, and in these unexplained cases the abscesses were twice as often single as multiple. The chief symptoms are a hectic temperature with rigors, upper abdominal pain, respiratory disturbance, nausea, pain in the loin, and diarrhœa—in that order. The local physical signs are downward enlargement of the liver and tenderness, but both these are absent in one-third of cases. Jaundice occurs in only one-quarter of cases. Radiological examination shows hepatic enlargement in three-fifths of the cases. Leucocytosis is almost invariable, but *a blood culture is sterile in three-quarters of the cases.*

A pyogenic liver abscess will often be missed unless the clinician is aware that it may be present in cases where no focus of origin is discoverable, and unless he relies on clinical and radiological examinations, rather than on pathological investigations.

Treatment.—The only treatment of a localized pyogenic liver abscess is drainage by open operation. **Operation.**—A transverse incision over the right rectus gives good access and is well suited for the erection of a barrier to prevent spread of infection to the general peritoneal cavity. Unless placed deeply, an abscess can be recognized by palpation; there is an elevation on the surface of the liver, and induration. After isolating the area most carefully with abdominal packs, an aspirating syringe fitted with a long wide-bore needle is used to confirm the presence of pus. If pus can be withdrawn freely the barrel of the syringe is disconnected, the needle being left in situ. To drain the abscess, sinus forceps are inserted along the track of the needle, which is then withdrawn. *The fingers should neither enlarge the opening nor attempt to break down loculi, as is done in abscesses in other situations, for this will cause tearing of the liver, and serious bleeding.* The jaws of the forceps are opened sufficiently for a drainage tube to be inserted. The tube is fixed in position by a stitch, which must be tied loosely, or it will cut out.

If, as is not infrequently the case, the surface of the liver is found to be studded with small abscesses, and no large collection is found on aspiration, it must be conceded that the outlook is practically hopeless.

When it has been possible to drain an abscess in the liver it is very necessary to erect a barrier of omentum to shut off the general peritoneal cavity. It must also be remembered that pus will ooze out alongside the tube and infect the space between the liver and the

costal wall. Drainage of this space must also be provided for. The patient should be nursed in the semi-Trendelenburg position for several days to ensure that pus does not gravitate downwards into the general peritoneal cavity. After this time adhesions will have formed, and he can be propped up gradually.

THE ABDOMINAL CRISES OF PERNICIOUS ANÆMIA

At the present time the mistake of operating upon a patient with a tabetic gastric crisis is unusual. The surgeon who makes a routine practice of testing the reaction of the pupils and the knee-jerks in every suspected case of gastroduodenal perforation never falls into this trap. Less attention has been paid to another medical condition that simulates very closely an acute abdominal catastrophe.

The later stages of pernicious anæmia are occasionally complicated with what may be termed abdominal crises. These resemble so closely one of the recognized acute abdominal conditions, such as perforated gastric ulcer or acute pancreatitis, that, when confronted with a case of this kind for the first time, even a most conscientious surgeon may stumble. The pallor, especially in artificial light, is mistaken for that of profound shock or internal hæmorrhage, and when this picture is combined with a history of sudden agonizing abdominal pain and vomiting, and is accompanied by abdominal rigidity, the difficulty in diagnosis is at times insurmountable, unless, of course, we are in possession of the knowledge that the patient is suffering from pernicious anæmia. The explanation of the sudden attacks of abdominal pain is clear. During the katabolism of large numbers of erythrocytes the liver is called upon to excrete a prodigious amount of bile-pigment. These pigments are too concentrated to be held in solution, and are precipitated in the form of 'bile mud', which gives rise to severe biliary colic. Furthermore, the subjects of these crises, being worn out by a long illness and an impoverished blood-supply, react very strongly to the painful stimuli.

Case 1.—A Jew, aged 55, was admitted at 2.30 a.m. as an 'acute abdomen'. He did not speak English, and the history was translated by a relative, who said that the patient was seized with sudden, very acute abdominal pain seven hours previously. The pain was at first in the epigastrium, but later became general. He had vomited several times. As far as could be gathered previously the patient had been quite well, except for indigestion. On examination the first observations were that he was exceedingly pale, and obviously he was in great pain. The abdomen did not move freely with respiration, and there was board-like general rigidity and tenderness, especially marked in the epigastrium and right hypochondrium. The liver, spleen, and kidneys could not be felt. The rectal examination and examination of urine were negative. The heart and lungs were clear. A diagnosis of perforated peptic ulcer was made, and laparotomy performed. The only abnormality found was a very distended gall-bladder. By cholecystostomy a large quantity of biliary mud was evacuated. Three days later the patient became comatose, and died shortly afterwards. It was at this time ascertained that he had received treatment a year previously for advanced pernicious anæmia.

Case 2.—A woman, aged 58, was admitted with a history extending over two years of frequent attacks of acute abdominal pain. The pain was always in the left hypochondrium and passed through to the back. The present attack began four hours before admission, and was considerably more severe than any of the previous ones; the patient had vomited. On examination in artificial light she appeared to be somewhat jaundiced. The tongue showed evidence of superficial glossitis. There was general abdominal tenderness and slight upper abdominal rigidity. The spleen and liver were enlarged, and the latter distinctly tender. A diagnosis of gall-stone colic was made. Next morning it was noticed that the patient was not jaundiced in the ordinary meaning of the term, but was of a bright lemon tinge. A colour index was carried out and gave a typical reading for pernicious anæmia. She was transferred to the medical side, where this diagnosis was confirmed.

THE ABDOMINAL CRISES OF PORPHYRIA

An increasing number of cases have been reported where the abdomen has been opened with negative findings, and the symptoms have been due to an abdominal crisis of porphyria. Porphyria is a hereditary error of katabolism of hæmoglobin in which porphyrinuria occurs. The abdominal crises are characterized by violent colic, which is liable to be precipitated by the administration of barbiturates. These symptoms are produced by areas of intestinal spasm causing short segments of gaseous distension of the small and large intestine, and especially of the cæcum. Serial X-ray films often provide the diagnosis (G. A. Calvy). In obscure cases of intestinal colic with constipation, it is well to try

and remember this condition, especially when these symptoms are associated with photosensitivity or mental or neurological symptoms. Almost invariably the spleen is enlarged. The urine of these patients may be normal in colour; more often it is orange (which is often dismissed as concentrated). If a specimen of urine is left exposed to daylight for a few hours it becomes amber coloured, particularly near the surface where it is in contact with the air. There are several conclusive laboratory tests for porphyrinuria. Another manifestation of acute porphyria is spasmodic abdominal pain, followed by jaundice. This is due to spasm of the common bile-duct and Oddi's sphincter (U. Ledingham).

Treatment.—Often there is a striking decrease in the serum-sodium level, and the patient is improved considerably by infusion of normal saline solution with careful control of electrolytic balance. To relieve the abdominal pain, pethidine is the best drug. If a sedative is required, paraldehyde should be given.

Acute porphyria is a serious, and often fatal, disease, and in every acute attack megrimide¹ (a barbiturate antidote) should also be given, irrespective of whether the attack is induced by barbiturates or not (T. K. With). Permanent remissions have been reported following splenectomy, which should be performed as an elective operation after a crisis has passed.

INTRAPERITONEAL RUPTURE OF A HYDATID CYST

In countries where hydatid cysts are rare, a correct pre-operative diagnosis of ruptured hydatid is improbable. In addition to symptoms of an acute abdominal catastrophe, fever and pruritus are frequently present. Eosinophilia in the circulating blood may be the means of clinching a tentative diagnosis.

Harold Dew's Case.—

E. B., a male of 45, was admitted in a state of severe shock, with a history that while he was lifting a weight he suddenly collapsed. The abdomen moved fairly well on respiration, but he was tender and rigid over the gall-bladder region. There was dullness in the flank as far medially as the umbilicus, and it moved with change of position. The diagnosis of visceral rupture was made, and the patient prepared for immediate operation.

The peritoneal cavity was found to contain much hydatid fluid and many daughter cysts of all sizes. A large multilocular cyst of the right lobe of the liver, adherent to the colon and gall-bladder, was found. This had a large opening on its postero-lateral aspect, at which point rupture had occurred. This cyst was evacuated and drained. The pelvis was then drained supra-pubically by a large tube, after removing fluid and cysts as far as possible. The patient, for ten days after the operation, had a temperature of 102.5° F. (39° C.), rapid pulse, cough, dyspnoeic attacks, and some delirium at night. It is probable that these symptoms were mainly anaphylactic in nature. For six weeks small cysts occasionally appeared through the suprapubic drainage track, but after being in hospital for two months, he was discharged, with instructions to report regularly and with a warning that probably secondary cysts would develop in a few years.

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CHAPTER XXXIII

FOREIGN BODIES IN THE FOOD-PASSAGES

REMOVAL OF A FOREIGN BODY FROM THE ŒSOPHAGUS
BY ŒSOPHAGOSCOPY

WHEN a foreign body is impacted in the upper food-passages, examination with a laryngeal mirror often shows a pool of saliva in one or both piriform fossæ of the pharynx. This is due to increased secretion of saliva, which is consequent upon the mechanical obstruction caused by the foreign body.

Whenever possible, the presence of the foreign body is confirmed by radiography (*Fig. 454*). If an operation is deemed necessary, a second radiograph should be taken just prior to the operation; thus we are armed with last-minute information concerning the foreign body, which is liable to change its location. Non-opaque foreign bodies present a more difficult problem, and it should be emphasized that swallowed bones rarely contain sufficient calcium salts to render them radio-opaque. In a proportion of cases where there is a history of swallowing some bone or other non-opaque body, the



Fig. 454.—Coin impacted in the upper part of the œsophagus.

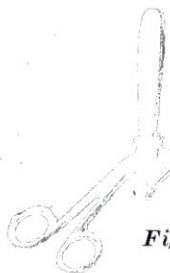


Fig. 455.—Œsophagoscope with œsophageal forceps in situ.

ingestion of a small quantity of barium emulsion prior to an X-ray examination may prove helpful. A typical radiological finding in such cases is as follows: there is a "residual barium flake, suggesting the presence of a foreign body" (F. G. Wrigley). It must be emphasized that the amount of barium ingested should not be more than half a teacupful. Even with this small amount in the stomach, a general anæsthetic should be postponed until the stomach is empty.

The Technique of Œsophagoscopy.—Before commencing œsophagoscopy, review the apparatus (*Fig. 455*). See that the lamp is working; examine the œsophageal forceps, noting especially if the points of their jaws engage; have a number of small pieces of gauze of a correct size to pass down the œsophagoscope in readiness—these are to mop up secretions, although they will be seldom required if a suction apparatus is available.

The patient is anæsthetized, endotracheal anæsthesia being most desirable.

Position of the Patient.—The position of the patient for œsophagoscopy is a most important consideration. The head-piece of the operating table is let down completely, and the patient's head and neck are supported entirely by the seated assistant. This allows the patient's head to be held firmly in any desired position. Note the following most carefully: *During the passage of the œsophagoscope the patient's head should not be extended; the assistant keeps the head well flexed.* It is only when the instrument is within the thoracic portion of the œsophagus that the head is lowered. Meticulous observation of this rule very materially aids in œsophagoscopy.

Passing the Œsophagoscope.—The mouth is opened and the tongue is drawn out by the anæsthetist. The exterior of the œsophagoscope is smeared with a little sterile paraffin.

The operator stands. With the handle of the instrument directed upwards, the œsophagoscope is passed along the right side of the tongue until the posterior pharyngeal wall is reached (*Fig. 456*). A lifting motion is imparted to the beak of the instrument, and this will bring the right arytenoid cartilage into view. The advancing tip of the œsophagoscope is lifted over this structure and the instrument directed to the right (usually) or the left piriform fossa, so as to imitate the mechanism of swallowing. It glides on for a short distance, then comes to a stop: this is the cricopharyngeal constriction (*Fig. 457*).



Fig. 456.—Introducing the œsophagoscope. First stage. Negus's œsophagoscope being used.

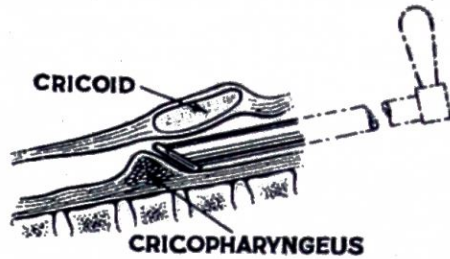
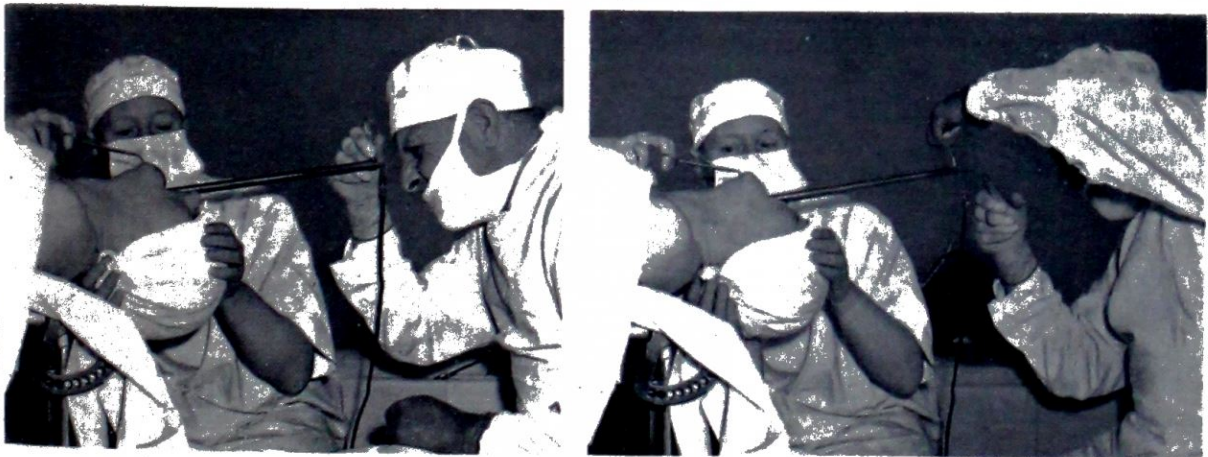


Fig. 457.—Passing the cricopharyngeal constriction, the most difficult part of œsophagoscopy. The importance of keeping the handle of the instrument uppermost during the manipulation can be seen.

overcomes the obstruction. The instrument is now within the thoracic portion of the œsophagus, along which it passes with comparative ease. Directly the cricopharyngeus has been passed the patient's head may be lowered somewhat, and the operator, who has been standing, takes a seat low enough to allow his eye to peer down the œsophagoscope without inconvenience (*Fig. 458 A*).

When radiographic evidence is available we will know where to expect the foreign body: on approaching this region the instrument is advanced slowly. A coin is sometimes

A little steady pressure with a lifting motion imparted to the distal end of the œsophagoscope by the left thumb within the mouth



A

B

Fig. 458.—A, The œsophagoscope is within the upper œsophagus and is being advanced slowly. B, The foreign body (a denture) has been visualized, and is being grasped with alligator forceps.

buried in food. When the object is seen (*Fig. 458 B*) it must be manoeuvred with the closed forceps, or by moving the œsophagoscope slightly backwards and forwards, until an edge suitable for grasping presents. The forceps then seizes the body (*Fig. 459*), and, still grasping it, the forceps, œsophagoscope, and foreign body are removed *en bloc*. In a small series of cases which include three dentures and more than a dozen coins, only the simple alligator forceps (*see Fig. 455*) were used, and were found to be perfectly satisfactory.

Some Difficulties of Œsophagoscopy.—

Light Anæsthesia.—If the patient starts gagging, anæsthesia is not deep enough, and it is dangerous to proceed. Remove the instrument, and when the patient is fully anæsthetized, start again. If the services of a skilled anæsthetist are available, the injection of curare-like drugs (e.g., scoline) so relaxes the cricopharyngeal sphincter that œsophagoscopy is considerably facilitated.

The Foreign Body is not Visible.—It is possible for a foreign body to be hidden by a fold of mucous membrane (Fig. 460), and this is most likely to occur just distal to the



Fig. 459.—A denture in the œsophagus as seen through an œsophagoscope.

cricopharyngeus. If, after an adequate search, the object cannot be seen, remove the œsophagoscope, and having reinserted the instrument, scrutinize the whole course of the œsophagus once more. On one occasion a second search failed to reveal a denture which had been swallowed. The patient had been radiographed elsewhere earlier in the day, and brought a film showing the denture in the mid-œsophagus. Still under the anæsthetic, the patient was moved to the X-ray room, and there screened. The teeth were in the stomach. On return to the theatre the denture was removed by gastrotomy. This emphasizes the wisdom of not accepting X-ray evidence unless it is of very recent origin.

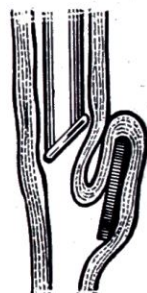


Fig. 460.—Coin hidden by a fold of mucous membrane.

The Problem of the Safety-pin.—An open safety-pin with the point downwards offers no particular difficulty. The coiled spring is seized, and the pin drawn into the open mouth of the tube (Fig. 461). In the case of a small safety-pin with the point upwards, version may be tried, but always, and only, in the direction which will cause the point to trail (Fig. 461). Once the coiled spring is uppermost it can be drawn into the œsophago-

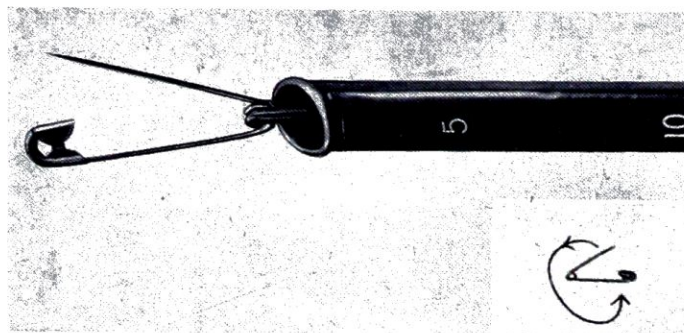


Fig. 461.—A safety-pin must always be withdrawn spring first. In the case of a small pin pointing in the wrong direction version may be attempted, but always in the direction shown in inset—i.e., the point must trail.

scope. The safety-pin *with the point upwards* is a more difficult problem. Intra-œsophageal version must not be attempted; the safety-pin should be pushed gently downwards into the stomach with alligator forceps. A skilled œsophagoscopist can perform gastric version and then remove the pin endoscopically. However, having guided the safety-pin into the stomach, most surgeons should be content with removing the open safety-pin by performing gastrotomy (see Fig. 464).

PERFORATION OF THE ŒSOPHAGUS BY A FOREIGN BODY

There is always the danger of a foreign body, particularly a pointed or jagged object, perforating the œsophagus. This is the chief reason for pressing that a foreign body in the œsophagus be removed by œsophagoscopy as soon as possible, rather than waiting

in the hope that it will pass into the stomach. Retrosternal or interscapular pain suggests perforation, and the great danger of perforation of the œsophagus is spreading mediastinitis.

Radiography.—A lateral radiograph is all-important. The demonstration of air in front of the spinal column, usually between the spine and the trachea, is pathognomonic. Thickness of the tissue layers between these structures suggests an inflammatory reaction. A small bubble of air is often displayed in the œsophageal lumen at the site of the foreign body, and is of no diagnostic significance. On the other hand, a large air bubble indicates a peri-œsophageal abscess, but does not exclude an abscess of the œsophageal wall. A rather long streak of interstitial emphysema is a sure sign of perforation. In cases of perforation of the lower third of the œsophagus a pneumothorax is sometimes present.

Treatment.—The foreign body should, of course, be removed as soon as possible. There is a great deal of evidence that antibiotic therapy, combined with drip feeding through an indwelling intragastric tube for a week, will prevent spreading infection and cure peri-œsophagitis. Perforation, therefore, does not necessarily indicate the need for immediate thoracotomy, although when an obvious perforation is found while performing œsophagoscopy, it is wise to open the thorax and suture the perforation. In most cases, when perforation is merely suspected, if the foreign body is removed early, antibiotic therapy and intragastric feeding usually render thoracotomy unnecessary. Late cases that have escaped spreading mediastinitis may require drainage of an abscess of the posterior mediastinum.

INGESTED FOREIGN BODIES IN THE INTESTINE AND STOMACH

A foreign body has been swallowed. The problem before us has been simplified by X rays, but there remains a considerable amount of judgment to be exercised in deciding whether the foreign body should be left, to see if it will be voided, or be removed by operation. At this juncture it is well to know that F. H. Kemp cites two instances where a foreign body in the œsophagus was missed owing to X-ray examinations being confined to the abdomen.

In assessing whether a blunt object will pass through the alimentary canal the following data are helpful: a halfpenny, which is 1 in. (2.5 cm.) in diameter, almost always passes in a child aged 3. In children aged 2 or under, a halfpenny is nearly always arrested at the pylorus. Contrary to expectation, the relatively narrow portions of the alimentary canal, viz., the cardiac orifice, the pylorus, and the ileocecal valve, are not the most common sites of arrest. In most series of collected cases the lower ileum and caecal portions of the intestine are the most frequent sites for a hold-up; on the contrary, in sixteen consecutive cases of swallowed objects, G. O. Chambers, visiting surgeon to H.M. Prisons, found that the majority of reasonably large foreign bodies pass the pylorus and the ileocecal valve, to become impacted in the large intestine. The average time taken by a foreign body to pass through the alimentary canal is six days (A. H. Siddons).

Radiographs, repeated at intervals, are essential. In cases where the foreign body is of such a shape as to be a menace, not more than six to ten hours should intervene between the examinations. The patient should continue with his normal diet. *Purgatives and enemata must be eschewed rigorously*; on the other hand, a good method is to administer normacol, two or three drachms every six hours, until the object has been expelled (*Fig. 462*). Normacol is a proprietary vegetable laxative which swells enormously when it



Fig. 462.—With normacol, suet puddings, and enemata this foreign body passed through the alimentary canal uneventfully. Daily radiographs were taken.

comes into contact with water. It forms in the alimentary canal a gelatinous mass in which the foreign body is likely to become entangled. Small quantities of liquid paraffin may be given with safety.

A partial denture with hooks is better removed without delay. Regarding pins, needles, and nails, provided the patient is under constant observation there appears to be little danger in awaiting radiological evidence of their arrest. A. H. Siddons reported a series of 35 cases of ingested pins or needles. All except three were passed naturally while the patient was under radiological observation in hospital. In the three in which an operation was considered necessary the object was removed before perforation occurred.

The great point is that the patient should be under constant observation: if the passage of a sharp foreign body is delayed at any point for several hours, it should be removed by operation. J. A. Macewen recorded a case of a soldier who died of general peritonitis from a pin piercing the cæcum. In the case of an ingested radium needle, the danger of radium necrosis as a cause of perforation should accelerate the decision to operate.

Perforation by a Foreign Body.—Of 90 cases collected by W. R. McKechnie the location was as follows:—

Gastroduodenal region	..	..	5
Lower ileum	..	..	10
Meckel's diverticulum	..	..	10
Appendix	..	..	33
Cæcum	..	..	10
Hepatic flexure	..	..	3
Transverse colon	..	..	1
Splenic flexure	..	..	2
Descending colon	..	..	1
Sigmoid	..	..	5
Rectum	..	..	3
Foreign bodies found in an abscess on laparotomy	..	..	7

The mortality following removal of the foreign body by operation and drainage of the peritoneal cavity was 25·9 per cent.

It will be noted that the stomach is not listed: perforation of the stomach wall by an ingested foreign body must be very rare: F. H. Kemp recorded an example occurring after the patient had been given a purgative that made him vomit.

LAPAROTOMY FOR AN INGESTED FOREIGN BODY

A very recent radiograph must be at hand. Once the foreign body within the intestinal lumen has been located by the fingers, and especially if it is small, the hold upon it should not be relaxed. The better to uphold this principle, if necessary the assistant can help in packing off the area, a procedure of great importance.

The removal of a foreign body from the gut follows recognized surgical principles. It suffices to say that the field of operation must be isolated by packs, a clamp should be applied whenever possible to avoid escape of fæces, and the gut closed by a purse-string suture in the case of an elongated body removed through a minute incision. When it is necessary to make an incision of half an inch (12·5 mm.) or more, the hole should be sewn up transversely in two layers.

In the Stomach.—Operation is advised: (a) When the foreign body is judged to be too large to pass the pylorus; (b) If it has failed to pass the pylorus after two days (*Fig. 463*); or (c) If it is of a dangerously spiked nature. The upper abdomen is opened and the stomach palpated for the object. When found it is manipulated against the anterior gastric wall, and if of appreciable size, such as a coin, a stomach clamp is adjusted beneath it. After a small incision is made and the foreign body extracted within reason the larger the



Fig. 463.—Whistle impacted in the pylorus.

arranging abdominal packs, a small incision is made and the foreign body extracted (*Fig. 464*). The stomach is closed in two layers. Within reason the larger the

foreign body the smaller can be the laparotomy incision for its removal. I extracted a dinner fork from the stomach (*Fig. 465*) of a convict through a 2-in. (5-cm.) mid-line incision.

In the Duodenum.—Long objects, including nails, screws, and Kirbygrips (hair clips), are inclined to be arrested in the second or third part of the duodenum. If the object is in the first or the second part an attempt should be made to push it back into the stomach,

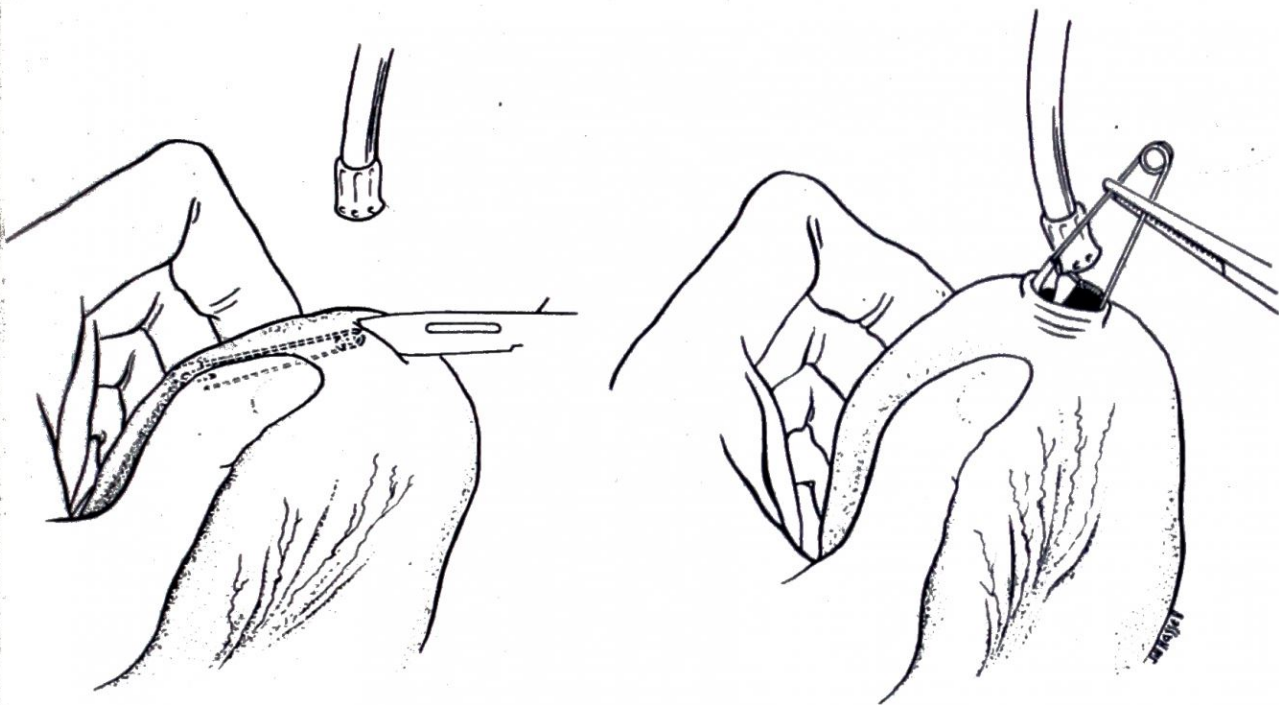


Fig. 464.—Gastrostomy for a large open safety-pin. (*After de Bakey and Cooley.*)

and there to effect extraction, for the stomach is easier to suture than the duodenum. When it has been necessary to open the duodenum very careful repair of its wall in two layers, the outer being of thread, is essential and reinforcement of the suture line by an omental graft desirable. It is also wise to place a corrugated rubber drain in Rutherford Morison's pouch; this drain should not be entirely removed for at least a week.



Fig. 465.—Dinner fork in the stomach.

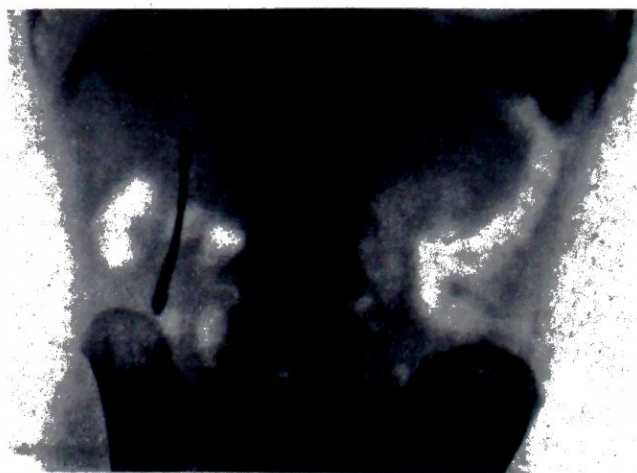


Fig. 466.—Hair-clasp situated in the ascending colon of a baby.

In the Remainder of the Intestine.—The foreign body may become lodged in any portion of the intestine. The cæcum is a favourite site. In the case of a hair-clasp situated in the ascending colon of a baby (*Fig. 466*), I manipulated the foreign body into the appendix and then performed appendicectomy. Meckel's diverticulum, when present, is another likely place for the lodgement of a foreign body.

TECHNIQUE OF THE REMOVAL OF A PIN FROM THE GUT

After isolating the segment of intestine with packs, by manipulation the point of the pin is made to protrude through the intestinal wall. As soon as the point appears it is grasped with a hæmostat (*Fig. 467*); the fingers do not touch the infected metal. A purse-string is inserted around the perforation, and with a firm tug out comes the pin. The purse-string suture is then tied. The nail in *Fig. 468* was removed in the same way.

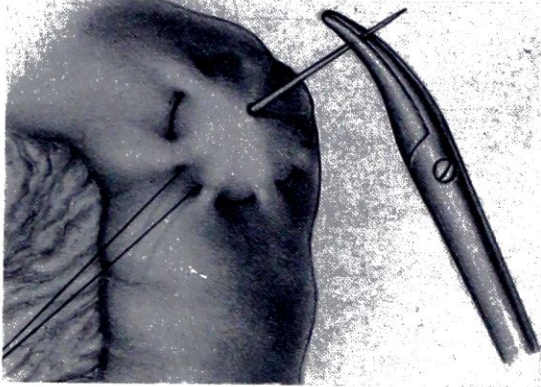


Fig. 467.—Method of extracting a pin from the intestine.

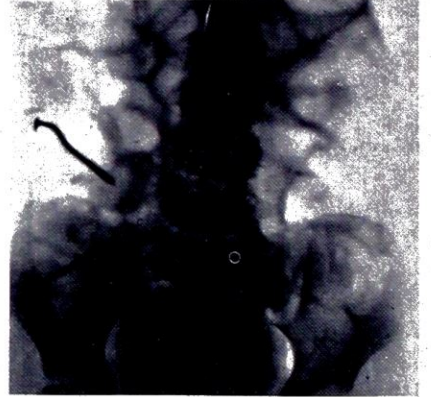


Fig. 468.—Radiograph of a nail impacted in the colon at the hepatic flexure. Removed by the technique shown in *Fig. 467*.

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CHAPTER XXXIV

INTRA-ABDOMINAL INJURIES

SOME GENERAL PRINCIPLES

THE history of the mode of injury is highly important. Street accidents are the most frequent cause; blows or kicks on the abdomen come second; falls from a height contribute a smaller quota. Another type of accident is the crushing variety, such as when a man is caught between a truck and a loading platform. Lastly, seemingly slight accidents such as falling against the edge of a table sometimes result in serious visceral injury.

The diagnosis of non-penetrating intra-abdominal injury is often rendered far more difficult when it is associated with more obvious injuries that tend to divert the attention from the abdomen. Even in the absence of other injuries, the diagnosis of serious damage to an intra-abdominal structure is usually not possible soon after the accident. At this stage the severity of the pain is often not in keeping with the severity of the abdominal lesion. The same is true of tenderness on palpation. In these cases two or three hours of vigilant observation is necessary (*a*) to come to a definite conclusion as to whether laparotomy is required and (*b*) to strive by clinical examinations to determine which organ is damaged.

A severe blow to the abdomen causes immediate shock and discomfort that is likely to persist for some time, even when no serious intra-abdominal injury is present. Conversely, quite often the patient appears to recover from the immediate effects of the trauma, only to develop signs of visceral injury later. This period of illusion makes close observation imperative. Every patient brought to hospital shortly after an abdominal injury should be detained. Even in seemingly slight injuries he should be observed for at least six hours, and if thought fit to be discharged, he should be given written instructions to report if he experiences abdominal pain, vomiting, weakness, or shortness of breath on exertion.

Detailed observation will include a half-hourly pulse-rate, hourly determinations of the blood-pressure, and at least two careful examinations of the abdomen. Usually injury to the bladder or the kidney can be eliminated by obtaining a specimen of urine, if necessary by catheterization; should the urine be clear, it is good presumptive evidence that the urinary organs have escaped serious damage. This preliminary step should never be omitted; it is also advisable to examine the specimen microscopically for blood.

Early Treatment of Shock.—If shock is present, therapy should be started immediately, as it will not interfere with the local physical signs. Infusion of dextrose-saline (or, in severe cases, dextran or plasma) should be started at once. If necessary, blood transfusion should be carried out as soon as possible; in any case, a specimen of blood for cross-matching is procured.

Morphine or other narcotics should not be administered before the diagnosis is established. Although morphine is acknowledged to be an excellent drug in the treatment of shock, it is liable to confound the diagnosis by masking the early signs of peritoneal irritation, e.g., abdominal pain and tenderness. Under these conditions morphine may jeopardize a successful outcome. The practice should be to withhold morphine until a decision has been made for or against the necessity for laparotomy. In cases of early profound shock without evidence of external bleeding of sufficient degree to account for it, intraperitoneal bleeding must be presumed. If the abdominal signs and symptoms agree with this presumption, the decision to operate as soon as possible is imperative.

Gastric Aspiration should be employed as soon as possible whenever there are signs of an intra-abdominal injury. This is valuable for several reasons. The aspirate may contain blood; this is presumptive evidence of injury to the stomach or duodenum. Gastric aspiration alleviates acute dilatation of the stomach, which often comes on early in these cases. It also prevents, or at least mitigates, abdominal distension, should paralytic

ileus develop, seeing that most of the distension in these cases is due to swallowed air. Aspiration of the contents of the stomach reduces the anæsthetic hazard, and the fact that the stomach is empty is a distinct asset to the surgeon exploring the abdomen.

Radiography.—Plain films taken in the supine and upright positions are most desirable. A film of the thorax is also helpful. Recognition of a fracture of a rib or ribs, the pelvis, or lumbar spine and transverse processes, confirms the occurrence of severe trauma, and directs attention to nearby structures as probable sites of injury. Loss of both psoas shadows is indicative of the presence of free peritoneal fluid. The presence of free air under the diaphragm is proof-positive of perforation of some portion of the gastro-intestinal tract. Acute dilatation of the stomach produces a large bubble in the left upper quadrant, and may be difficult to differentiate from gas beneath the diaphragm—a ready solution of the problem is gastric aspiration. Gas in the retroperitoneal tissues is diagnostic of intestinal perforation in one of the retroperitoneal areas, viz., duodenum or ascending or descending colon. The presence of subcutaneous emphysema from thoracic injury can give the same radiological appearance, but the latter can be excluded easily by clinical methods. A localized collection of blood or other fluid at times casts a shadow in the radiograph. Paralytic ileus with air-fluid levels may result directly from the initial trauma, or it may indicate spreading peritonitis.

Two supine films, even though taken a few moments apart, are more instructive than one, perhaps owing to minor differences in technique. A film in the erect position is highly desirable if the patient's condition permits. In lieu thereof, a film is taken in the left lateral position. Gas beneath the diaphragm if the patient is erect, or beneath the liver if the patient is in the left lateral decubitus, when present, is of great diagnostic significance. As little as 4 ml. of free gas will show.

Useful as it is in the diagnosis of intra-abdominal trauma, too much trust must not be placed in radiography. In the great majority of cases of both hæmoperitoneum and rupture of the intestine, the films are negative.

Diagnostic Aspiration of Peritoneal Fluid can be carried out with very little risk if a fine gauge needle is used. This method of attempting to arrive at a diagnosis of hæmoperitoneum is justified particularly when abdominal injury is complicated by other injuries, especially concussion. The needle is entered a fingerbreadth below the left costal margin towards the flank; if that is negative, below the right costal margin. Three or four punctures in these regions may be required before concluding that there is no free blood present in the hypochondrium. Hollow needle paracentesis of the iliac fossæ is less desirable, and should be employed only when there is dullness to percussion after the hypochondria have been tapped with a negative result, and when, because of other injuries, exploratory laparotomy is to be avoided, if possible. This test has been estimated as being 85 per cent accurate in establishing a diagnosis of intra-abdominal hæmorrhage (H. S. Collier).

Exploratory Laparotomy.—In most cases up to two hours can be spent in endeavouring to improve the patient's general condition, but it should be remembered that in cases of serious intra-abdominal trauma the response to the treatment of shock is often evanescent, and a short period of recovery is followed by a relapse. During the period of recovery from shock, usually it is possible to arrive at a diagnosis, but at times, in spite of the risks of laparotomy, it is impossible to eliminate the possibility of an intraperitoneal lesion by any means other than full exploration. Examples are as follows: (a) The effects of retroperitoneal bleeding associated with fracture of the pelvis or the lumbar spine can be indistinguishable clinically from an intra-abdominal lesion; (b) After finding an extra-peritoneal hæmatoma due to a torn epigastric artery, which was ligated, J. P. Cogley opened the peritoneum to discover a rupture of the small intestine.

Blood Transfusion.—By employing blood transfusion, in most instances, even in patients with severe intra-abdominal injuries, it is possible to commence the operation with the patient not only having a normal blood-pressure, but also warm, pink extremities. When possible, homologous blood should be available in adequate quantities, and if the patient is obviously bleeding internally, blood should be running, preferably into two veins, at the time of making the laparotomy incision. Multiple major injuries associated with traumatic hæmoperitoneum is an occasion on which to employ arterial transfusion.

Traumatic Hæmoperitoneum.—On opening the abdomen, *if blood and blood-clot are in evidence*, survey the situation rapidly as follows, bearing in mind the excellent aphorism, *‘follow the clots’*. Usually the source of the hæmorrhage is soon apparent :—

1. Palpate the spleen.
2. Palpate and inspect the under surface of the liver.
3. Pass the hand over the convex surface of the liver.
4. Examine the mesentery. This can be done by lifting out one or two coils of small intestine and observing the inferior and left aspect of the mesentery, and then passing the finger upwards and downwards over the surface. Even small tears will be detected in this way. After a tear has been found and repaired, the whole of the mesentery must be scrutinized (*see p. 378*).
5. Palpate the kidneys (intraperitoneal rupture is exceptional).
6. Re-examine the spleen, paying special attention to its pedicle.
7. Pass the hand into the pelvis. I detected a tear in the broad ligament at this stage in an obscure case of traumatic hæmoperitoneum. More blood in the pelvis than in the rest of the abdomen suggests a lower abdominal lesion. Nevertheless, pre-operative Fowler’s position renders the value of this sign less significant.
8. Examine the great omentum and transverse mesocolon.
9. Open the lesser sac between the stomach and colon and inspect the pancreas. However, an extravasation of blood into the lesser sac will be obvious at a very early stage of the examination.

RUPTURE OF THE SPLEEN

Ruptured spleen is the commonest injury caused by non-penetrating violence to the abdominal wall. In the great majority of instances it is a solitary lesion, but because it is occasionally associated with other intra-abdominal lesions requiring surgical attention (most frequently injury of the tail of the pancreas, or rupture of the left kidney) the rule to explore the whole abdomen can never be relaxed.

The nature of the violence was evident in 32 cases that I reviewed :—

Street accident—run over or knocked down by a vehicle	14
Fall on to a projecting object, e.g., the corner of a table	.. 7
Kicked in the abdomen	.. .. 3
Fall from a height	.. .. 3
‘Buffer’ accident (compression)	.. .. 3
Fall over handlebars of pedal cycle	.. .. 2

Cases of rupture of the spleen are divided into three classes :—

1. Rapid Succumbing of the Patient is uncommon. Complete avulsion of the spleen from its pedicle is the type of accident which is most likely to give rise to the symptoms that characterize this group.

A boy, aged 5, was run over and was admitted to hospital in a state of profound shock. In spite of resuscitative measures, he died two hours later. At necropsy the peritoneal cavity was found to be full of blood, and the detached spleen was discovered lying on the fundus of the urinary bladder.

2. Shock—Signs of Rupture.—This is the largest group, and about three-quarters of the total cases belong to it. After the initial shock has passed off, there are signs which point to a serious intra-abdominal disaster. It is not always possible to state precisely which organ is damaged, but in the majority of instances the physical signs should point clearly to the spleen as the site of the injury.

The patient is pale. Often the abdomen is slightly distended. Abdominal rigidity is variable, ranging from generalized rigidity to that localized to the left upper quadrant and extending towards the flank. Abdominal tenderness is likewise variable; commonly it is present in the left upper quadrant, and frequently pain is accentuated by deep breathing. In early cases the pulse-rate may not rise above 90, and the blood-pressure is often comparatively unaltered for several hours. Referred pain to the tip of the left shoulder (Kehr’s sign) is a valuable sign that may be induced by having the patient lie flat with the foot of the bed raised (T. C. O’Connell). In a number of cases the sign is present, but abdominal pain is so much more in evidence that the patient does not mention the shoulder pain unless he is asked about it.

The usual history of rupture of the spleen conforms to a definite pattern. Trauma to the abdomen or lower thorax is followed by a latent period of six to ten hours in which the patient has symptoms of an indefinite nature, or may be symptom-free, only to collapse suddenly from intra-abdominal hæmorrhage. Should the patient reach hospital during the latent period a varying degree of shock is found, and treated. If the intra-abdominal hæmorrhage is slow or intermittent, this treatment will support the blood-pressure, and the blood-count will remain close to normal, thus masking the general signs of internal hæmorrhage.

Radiography can assist in the diagnosis of ruptured spleen. In plain radiographs of the abdomen the spleen is visible in whole or part, especially when the stomach and the splenic flexure contain gas. When the spleen is ruptured this outline is partially or completely obliterated. The stomach may be displaced medially and the splenic flexure downwards. Retroperitoneal hæmorrhage is likely to obscure the psoas shadow, and this sign is present in about 50 per cent of cases. In a series of 27 consecutive cases, 10 had fractured ribs (R. Clarke).

3. The Delayed Type of Case.—After the initial shock has passed off, the symptoms of a serious intra-abdominal catastrophe are postponed for 48 hours to weeks or even months.

A navvy, aged 40, was hit in the upper abdomen by a pole. He fainted, but soon recovered sufficiently to walk to hospital, where he was examined and told to report the next day. On the morrow he felt better, and stayed at home. Five days later he was brought in with well-marked signs of internal hæmorrhage, having collapsed at home a few hours before admission. Splenectomy was performed successfully.

Straining at stool, vomiting, coughing, or a full meal, will frequently furnish the mechanism to restart the hæmorrhage.

Delay of serious bleeding is explained in one of three ways: (1) The great omentum, performing its well-known constabulary duties, shuts off that portion of the peritoneal cavity in the immediate vicinity of the spleen; (2) A clot seals the rent temporarily; (3) There is a laceration of the parenchyma within an intact capsule; a subcapsular hæmatoma forms, and later bursts. It is probable that each of these three factors, at one time or another, temporarily arrests serious hæmorrhage.

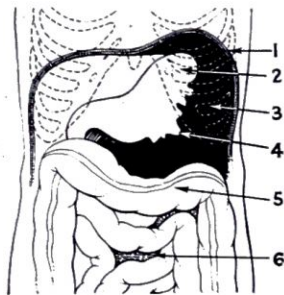


Fig. 469.—Radiographic signs of (delayed) rupture of the spleen: 1, Left diaphragm raised; 2, Stomach dilated; 3, Opacity in the left hypochondrium; 4, Indentation of the stomach; 5, Transverse colon displaced downwards; 6, Fluid between the coils of intestine. (After V. E. Siler.)

In the delayed type of case the aim should be to diagnose the condition before the hæmatoma bursts, and provided the patient is under observation, this can sometimes be accomplished, for:—

1. In patients with delayed hæmorrhage, the red blood-cell count and hæmoglobin estimation are consistently low, and give a more accurate picture of the abdominal condition than in those with immediate hæmorrhage and shock. During the latent interval the pulse-rate seldom returns to normal and usually there is some pain in the left hypochondrium.

2. As the entity delayed rupture of the spleen has become more generally recognized, various X-ray signs have been described. *Fig. 469* depicts all the radiological signs. In a given case only one or two of them is likely to be present. With such aid, it is occasionally possible to arrive at the diagnosis before the catastrophic hæmorrhage occurs.

In the delayed type of case a point worthy of earnest consideration is the baffling friability of the splenic pedicle which is encountered. The explanation of this phenomenon is fairly clear. The pedicle, after being surrounded by mildly infected blood and blood-clot for a varying time, itself becomes œdematous, and commences to undergo degeneration. It is thus more likely to be found in those cases in which serious hæmorrhage has been postponed by an omental barrier.

It behoves us, therefore, when dealing with the delayed case, to take particular care to avoid the cutting-out of a ligature. A mass ligature is more likely to cut out than a series of smaller individual ligatures applied by transfixion with a sewing needle close to the spleen. Further precaution is necessary to avoid 'losing' a pedicle which has cut out. C. H. Mayo immortalized the slipped renal pedicle which, he said, "fairly jumps into the fingers" when nimble fingers promptly follow its retraction into the depths of the wound. If the lieno-renal ligament, with its vascular contents, slips or cuts through

it might be possible to retrieve it by the same means. A better practice is to compress the splenic artery and vein (*Fig. 470*), as Andreasen describes in his chapter on **ABDOMINAL EMERGENCIES IN THE TROPICS** (Chapter XCIII).

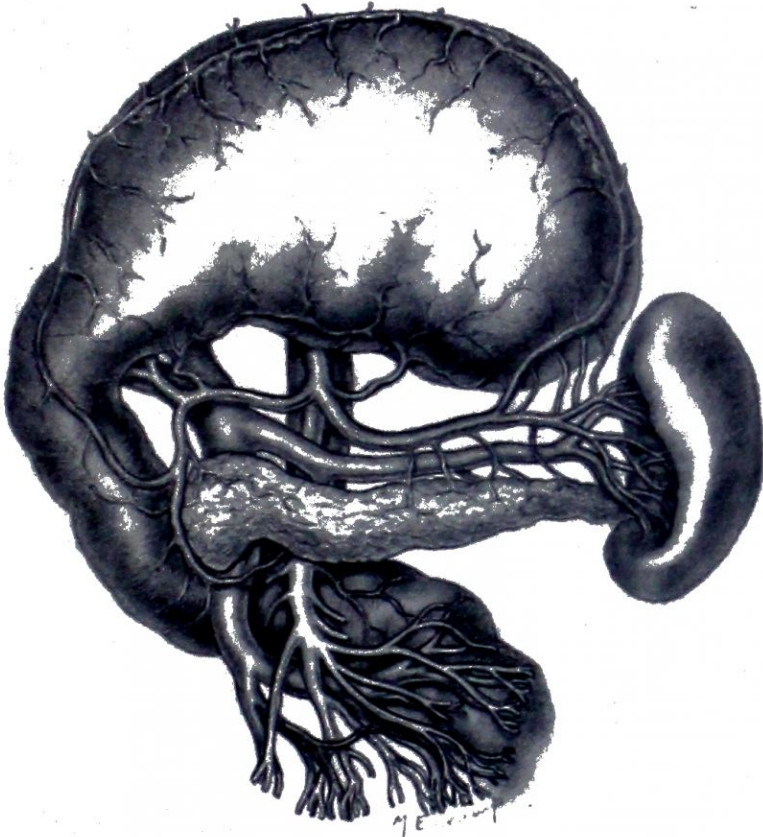


Fig. 470.—The disposition of the splenic vessels. (*After Heitzmann.*)

Operation.—

The Incision.—The left paramedian incision is justly popular for splenectomy. Nevertheless, in an emergency the supra-umbilical midline incision offers certain advantages. Foremost among these is the speed with which the abdomen can be opened or closed. That the midline incision is usually adequate for removal of a ruptured spleen (*Fig. 471*) is, I think, well illustrated by one of my patients, a fat, barrel-chested man of 52, from whom the spleen was removed successfully by this route. In those rare instances where more room is required in order to deal with an adherent organ, the incision can be enlarged by a transverse cut to the left. Especially in the delayed type of case is a transverse incision effective. This incision, while it takes longer to close securely, gives excellent access to the splenic pedicle.



Fig. 471.—Ruptured spleen removed successfully from a man of 52.

Technique of Splenectomy for

Rupture.—The left hand is passed into the wound and the spleen is palpated. Generally a tear can be felt on the convex surface of the organ. The fingers are passed over the convex surface, and thence they seek the pedicle.

A retractor is placed in the left side of the wound, and sufficient blood and blood-clot is wiped away to see the spleen. The organ is now brought gently towards the mouth of the wound. Usually it comes up without difficulty, and can be delivered, without any

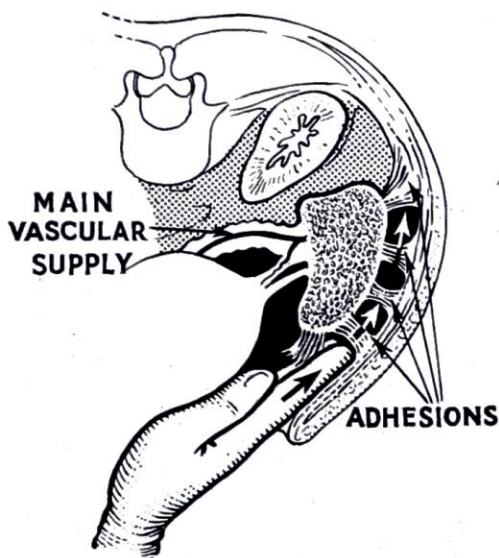


Fig. 472.—Method of separating minor and friable perisplenic adhesions. (After J. E. Dumphy.)

by little and keeping close to the spleen—cutting at the expense of the spleen if necessary—the organ is removed. We now have the pedicle secured by a number of hæmostats; losing it is impossible. Each moiety of tissue grasped by the forceps is transfixed with a needle and ligatured. After making certain that the cut surface of the pedicle is dry, it is allowed to fall back.

The technique is simple. It does away with the necessity of mass ligature, where, as it were, all the eggs are placed in one basket. There are no catastrophes from cutting out or breaking of the ligatures. The grip of the pedicle between the finger and thumb and the small amount of tissue ligatured at one time minimize the risk of injuring the tail of the pancreas. There is nothing brilliant about the method—but it is safe.

If the anæsthetist reports 'all well', a few minutes can be expended in removing blood from the peritoneal cavity. The hands, hollowed in the form of a scoop, are the most efficient apparatus for removing fragmented clot.¹ Palpation of the liver will ensure that a concomitant rupture of that organ is not overlooked. The tail of the pancreas is next examined. Finally the intestine is scrutinized. If the pancreas is damaged, many complications are minimized by a drainage tube brought out on the left flank; if it is intact, no drainage is necessary. The abdomen is then closed.

Transfusion.—The ideal method is to transfuse the patient with matched blood before, during, and after the operation. If matched blood is not available, and provided ruptured

¹ Every fragment of ruptured spleen must be removed, in order to prevent autogenous grafting of splenic tissue (splenosis).

tension, through a midline incision, especially if there is good retraction of the left side of the wound. If any resistance to delivery is encountered, the fingers of the right hand are at once available to enter the wound, pass over the convex border (Fig. 472), and find out the nature of the adhesions that are preventing easy delivery. If adhesions are considerable, the wound must be enlarged by a transverse cut to the left, in order that these adhesions may be separated or divided under vision. As has been emphasized already, this step is hardly ever required in the treatment of ruptured spleen as it is seen in temperate climates.

If necessary, an abdominal pack is inserted into the inferior portion of the wound to keep the colon out of the way. The spleen is now under vision. A little systematic swabbing will render the boundaries of the organ clear. The organ is rotated so that the diaphragmatic surface is directed towards the right; this exposes the splenic vessels entering the hilum. By elevating the inferior pole the pedicle is displayed. Clipping, then cutting (Fig. 473), little

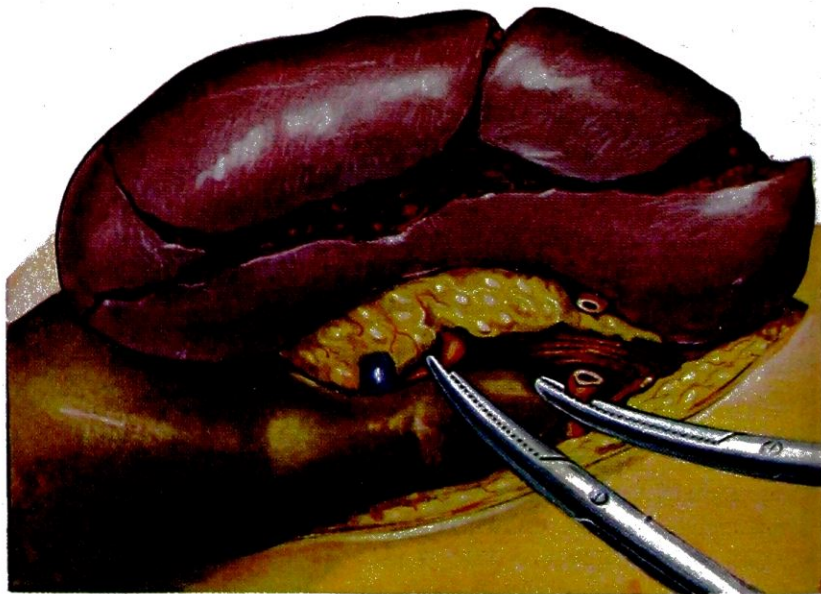


Fig. 473.—Splenectomy for rupture. By clipping, then cutting, little by little the pedicle is divided, keeping close to the spleen.

intestine is excluded, autotransfusion of blood removed from the peritoneal cavity is another method of replenishing the circulation. The blood is collected, mixed with citrate solution, filtered through four thicknesses of gauze, and returned to the patient's vein. Collection of extravasated blood from the peritoneal cavity is somewhat time-consuming, especially when the incision is an upper abdominal one. The procedure is facilitated by a suction apparatus. It must be taken for granted that there is the necessary skilled assistance at hand if this method is to be used.

In extenuating circumstances the infusion of dextran solution or plasma must be substituted for the more ideal method of blood transfusion. A good method for the single-handed surgeon is to commence the operation by inserting the cannula of a continuous intravenous infusion apparatus into a vein and allow dextrose-saline to be absorbed during the operation. Using this method, I have opened the abdomen under local anæsthesia and performed splenectomy for rupture after an unskilled assistant had injected a small dose of pentothal into the saline delivery tube.

Rupture of the Splenic Vein.—I have met with three examples of this condition. In each the peritoneal cavity contained dark portal blood. On palpating the spleen and finding it intact one naturally thinks that the portal hæmorrhage is coming from the liver; only to be disillusioned when the latter organ is examined thoroughly. Under these circumstances observe the splenic pedicle. This was the source of the bleeding in the cases to which I refer. Ligature of the splenic pedicle and splenectomy was followed by recovery in all three cases.

'Spontaneous' Rupture of a Normal Spleen.—Several examples have been reported. Such a case was encountered in a man aged 20. The symptoms came on while he was seated by the fireside at home. Admitted to hospital 18 hours later tenderness was most marked in the right iliac fossa (*Fig. 474*). The spleen was normal on macroscopical and microscopical examination. There is evidence to support the contention that spontaneous rupture never occurs in a normal spleen, but that some form of trauma has occurred which the patient has forgotten, or wishes to conceal.

Dual Lesion (ruptured spleen and left kidney).—(*See p. 587.*)

Triple Lesion (ruptured spleen, left kidney, and lacerated diaphragm).—(*See p. 587.*)

COMPLICATIONS AFTER SPLENECTOMY FOR RUPTURE

Peritoneal Effusion.—Peritoneal effusion amounting to ascites was seen in one of my cases. It was noted on the eighth day after operation, and was accompanied by slight pyrexia. The fluid began to lessen in amount about the fourteenth day, but was demonstrable until the end of the fourth week. Its presence can be accounted for by an overlooked laceration of the pancreas. Routine drainage will prevent this complication.

'Burst Abdomen'.—The wound disrupted, and had to be re-sutured in 4 of the 32 cases that I reviewed. The most feasible explanation is that pancreatic ferments digest the edges of the abdominal wound and the catgut contained therein. The tail of the pancreas may be wounded when splenectomy is being performed, or, as is probably more usual, it is injured together with the spleen at the time of the accident. There is good authority for the latter conjecture, for at the necropsy of one patient with ruptured spleen who died without operation the tail of the pancreas was found to be almost severed. The use of stainless steel wire for closing the wound would reduce the incidence of this complication.

Left Pleural Effusion.—A left-sided pleural effusion requiring aspiration occurred in three instances in the same series.

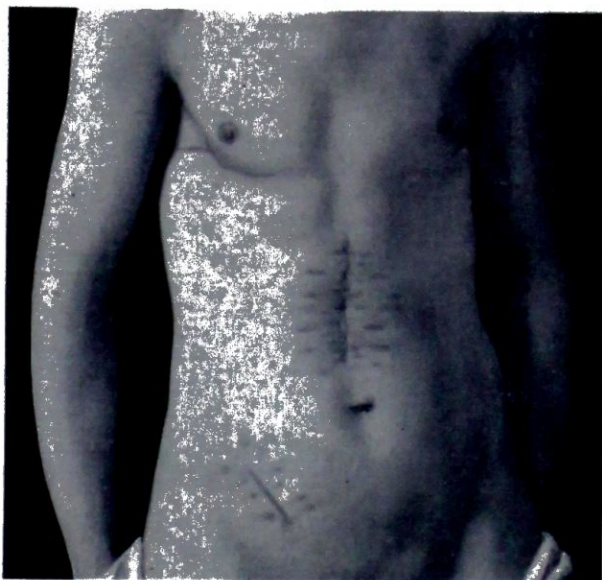


Fig. 474.—A gridiron incision was used to explore the abdomen in this case. On opening the peritoneum blood poured out. The incision was therefore closed and a midline upper abdominal one substituted, through which the spleen, which had ruptured spontaneously, was removed.

Persistent Hiccup.—Persistent hiccup, lasting more than five days and preventing sleep, seriously complicated the convalescence of one patient. Hiccup is probably due to irritation of the branches of the left phrenic nerve on the under surface of the diaphragm.

Anæmia.—Mild secondary anæmia may follow removal of the normal spleen. This may necessitate transfusions in the early weeks of convalescence, but adjustment of the hæmopoietic system soon occurs.

RUPTURE OF AN ANEURYSM OF THE SPLENIC ARTERY

This is very rare and almost impossible to diagnose with certainty. A pre-operative diagnosis of hæmoperitoneum, probably spontaneous rupture of the spleen, is creditable. Unfortunately, the possibility of a coronary thrombosis sometimes cannot be eliminated, except by electrocardiography.

While the incidence is about the same in either sex, it is noteworthy that about 25 per cent of female patients were 6–8 months pregnant at the time of the rupture of the aneurysm.

Treatment.—As can be imagined, hæmorrhage from a ruptured aneurysm is likely to be torrential, more especially after surrounding clot has been disturbed; consequently, if possible, almost the first consideration is to arrange for massive blood transfusion, which is commenced in the ward before the patient is taken to the operating theatre. Excision of a comparatively small aneurysm situated near the hilum, together with a normal spleen, presents no difficulty: a large aneurysm tends to burrow behind the pancreas. *Proximal ligation of the splenic artery alone is useless*, for the collateral circulation of the spleen is such that the aneurysm continues to bleed from its distal end.

Method of Procedure in All Cases.—(a) After entering the lesser sac between the greater curvature of the stomach and the transverse colon, ligate the splenic artery proximal to the aneurysm. (b) From within the greater sac, ligate the splenic pedicle near the hilum of the spleen.

Splenectomy, although often performed, is unnecessary.

So far, only 2 patients with a ruptured splenic aneurysm have been saved from death. On the other hand, 4 with catastrophic hæmorrhage from the region of the hilum of the spleen, due, it was thought, to the giving way of an atheromatous patch in the wall of the splenic artery, have been recorded. They all recovered after proximal ligation of the splenic artery and splenectomy.

SPONTANEOUS INTRA-ABDOMINAL APOPLEXY

Intraperitoneal hæmorrhage not due to trauma, a ruptured ectopic gestation or tubal abortion, nor yet to spontaneous rupture of the spleen or a rupture of an aneurysm of the splenic artery, is most perplexing, and an operator unacquainted with the condition known as spontaneous intra-abdominal apoplexy may well be nonplussed.

Most cases have occurred in patients with hypertension, and in a number of instances (mostly fatal) the source of the hæmorrhage has not been discovered. The commonest known site is the left gastric artery; the next most common is the right gastric artery (*Fig. 475*).

R. Burkitt's Case.—

A man of 59 suddenly experienced excruciating pain in the left abdomen. On admission one hour later he was still in great pain, and was suffering from shock. The abdomen was rigid and tender, and on the left side shifting dullness could be elicited. The abdomen was opened by a left paramedian incision; the peritoneal cavity was filled with blood. As this was being aspirated a search was made for the bleeding point. The spleen, the splenic pedicle, and the liver were examined with negative result, and in spite of blood transfusion the patient's general condition deteriorated rapidly, his pulse becoming imperceptible. As the bleeding appeared to be coming from the upper abdomen, the free edge of the gastrohepatic omentum was compressed (*see Fig. 489, p. 375*). Blood no longer welled up. Keeping the fingers in this position, the abdomen was emptied of blood; the grip was relaxed, and a spurt was seen to come from the right gastric artery about 1 in. (2.5 cm.) from the pylorus. The artery was secured and ligated. The abdomen was closed. The patient, who was not hypertensive, made an uninterrupted recovery.

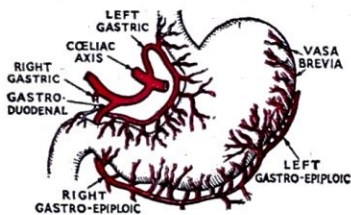


Fig. 475.—Showing the left and right gastric arteries.

RUPTURE OF THE LIVER

There is a great similarity between the clinical features of rupture of the liver and those of rupture of the spleen. There are also three comparable types: (1) rapid succumbing of the patient; (2) shock, recovery, more shock, signs of internal hæmorrhage; (3) delayed rupture.

The right lobe is involved five times more frequently than the left, and radiographic examination quite often shows fracture of any of the 9th to the 12th ribs of the right side, or fractures of the right transverse processes of the first two lumbar vertebræ. If the local signs point to a right-sided lesion, there is no particular difficulty in differentiating between a ruptured liver and a ruptured spleen.

A youth of 17 was running to catch a bus, when he fell and hit his right side on the kerb. He did not lose consciousness, and he did not vomit. The pain in the right side of the lower part of the chest was excruciating. He was brought to hospital in an ambulance.

Rigidity, and a dull note to percussion in the right hypochondrium made the diagnosis of rupture of the liver practically certain. Two hours later, in spite of a plasma infusion to combat shock, and morphine to relieve the pain, the half-hourly pulse-rate was rising.

Laparotomy revealed a cleft in the liver like a crevasse; it amounted to practically a split through the entire liver substance lateral to the gall-bladder.

Admittedly a deeply lacerated liver is a most formidable lesion carrying a high mortality, associated intra-abdominal lesions being even more common than those occurring with rupture of the spleen. Should the diagnosis of ruptured liver *per se* be rendered extremely probable, there are some who still believe in conservative treatment.¹ The patient is given a slow-drip blood transfusion, in the hope that Nature will localize a perihepatic hæmatoma. Too often the outcome of this course is as follows: if the patient escapes death from hæmoperitoneum, he succumbs to bile peritonitis. Undoubtedly the mortality following conservative treatment of rupture of the liver is much higher than that following a well-timed operation.

REPAIR OF A RUPTURED LIVER

The optimum time for operation is within three hours of the injury. Should compatible blood not be available in time, plasma or dextran is administered pre-operatively, and during the operation autotransfusion can be undertaken; this is still a most valuable measure. Even if a ruptured liver is only suspected, have in readiness:—

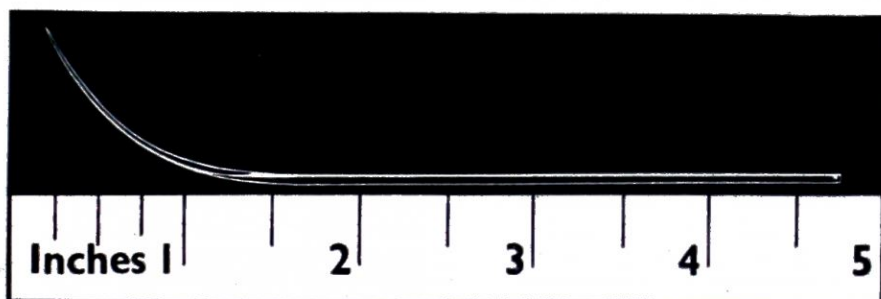


Fig. 476.—Post-mortem needle. Cutting edges have been rounded.

Special Equipment.—

1. The strongest catgut available. If there is nothing stronger than No. 2, use it doubled. See that it is soaked and made pliable, and the kinks are taken out of it before use. Ribbon catgut is most desirable.
2. Gelfoam² and/or oxycel³ absorbable gauze have become almost a necessity.
3. If a special liver needle (Fig. 477) is in the instrument cupboard, of course have this put out.

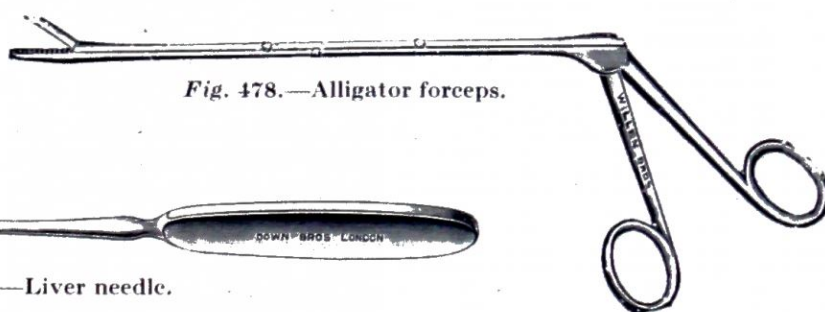


Fig. 478.—Alligator forceps.



Fig. 477.—Liver needle.

4. The largest round-bodied needles in the theatre. Often there are some very large, curved needles about 3 in. (7.5 cm.) in length that gynæcologists employ. For suturing the liver, Silvis employs a post-mortem needle, the cutting edges of which have been rounded by grinding on an emery wheel (Fig. 476). The grinding process decreases the temper, enabling the needle to be bent to any required curve. The eye is large enough to permit threading the ribbon catgut, the form of suture material that R. S. Silvis has found most satisfactory. It is well worth having two of these needles prepared against the day they will be required.

5. The longest malleable probe that has an eye in its extremity.

6. Alligator forceps (Fig. 478), provided they have fairly fine points.

¹ The conservative treatment of penetrating wounds of the liver often gives excellent results.

² Sterispon (Sterilized Gelatin Sponge) is English equivalent, Allen & Hanburys Ltd., London, E.2.

³ Parke Davis & Co. Ltd., London.

The last may prove just what is needed. Contrary to what one imagines, alligator forceps cause less trauma to the liver than needles or probes that are passed threaded.

The Incision.—Considerable thought should be given as to the best incision to employ in a given case. For an average patient, probably the right paramedian, splitting the rectus abdominis muscle for speed, is the best.



Fig. 479.—Compression of the free edge of the gastrohepatic omentum, in order to control hæmorrhage from the liver (Hogarth Pringle's method).

by converting the abdominal incision into an abdomino-thoracic incision (see p. 399), which is well tolerated under positive-pressure anæsthesia.

Temporary Control of Hæmorrhage from the Liver.—The release of intra-abdominal pressure¹ by opening the peritoneum may cause a sudden, terrific hæmorrhage from a ruptured liver; hepatic blood is dark. By passing a forefinger into the epiploic foramen of Winslow and pinching the free edge of the gastrohepatic omentum between the finger and the thumb (Fig. 479), the portal vein and the hepatic artery are compressed, thereby almost completely controlling hæmorrhage from the liver. Such hæmorrhage as does then occur is derived from the hepatic veins. The compression can be maintained by an assistant until direct control of the hæmorrhage has been effected, but the pressure should be released for about a minute every ten minutes, or viability of the liver cells is liable to be imperilled.

Another cardinal fact is, if a ruptured liver is held in such a way as to bring the lacerated surfaces even slightly into apposition, serious bleeding ceases. This is the key to ideal treatment; even one deep suture, properly placed, may be all that is required to aid Nature to cement the split.

Mobilizing the Liver.—After the round ligament of the liver is divided between hæmostats and the falciform ligament is divided with scissors, a certain amount of rotation of the liver becomes possible. By traction on the round ligament in a downward direction (Fig. 480), more of the convex surface can be brought into view. By the manœuvre illustrated in Fig. 481 a good deal of the postero-inferior aspect is rendered more accessible.

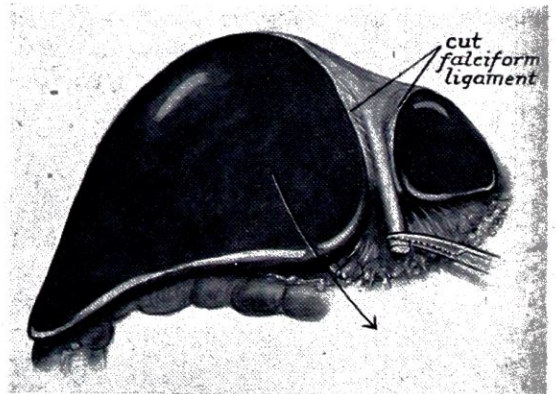


Fig. 480.—Traction on the round ligament may facilitate exposure of the laceration, which is more often on the anterosuperior surface of the liver.

¹ What is more dangerous is that as soon as the anæsthetist has administered a muscular relaxant the bleeding may become greatly increased, therefore, it is unwise to inject one of these substances in cases where a ruptured liver is suspected until the abdomen has been opened.

Excision of Devitalized Tissue.—Many ruptures are clean-cut, and do not require excision of tissue. Pulped liver is impossible to suture; detached fragments must be removed, and lacerated portions of doubtful viability, particularly pale, semi-detached pieces, must be resected. Failure to débride non-viable substance favours infection and increases the liability to secondary hæmorrhage, a combination of which is liable to culminate in the hepatorenal syndrome—a harbinger of death.

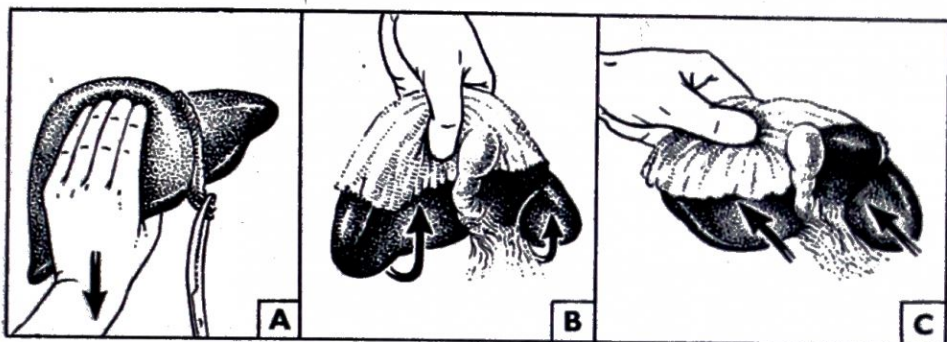


Fig. 481.—Method of enhancing accessibility to the postero-inferior surface of the liver.

G. B. Sanders' Case.—

One-third of the right lobe was partially detached, rendering its viability extremely doubtful. This was amputated. The raw surface of the liver was covered with several layers of oxycel, pressure being applied after each application, until the absorbable gauze became adherent. The hæmorrhage was staunched, and the patient recovered.

Ligation of Spurting Vessels.—Spurting vessels in the liver substance can be picked up delicately with hæmostats and ligated; the trouble is that many of them lie so deeply in the cleft that they cannot be reached without inflicting further damage to the liver. Diathermy coagulation here and there to a bleeding portal tributary is warranted, but diathermy coagulation on a large scale is hardly justifiable, for it causes too much liver necrosis.

Suturing the Tear.—Having obtained the best access possible to the rent, should it be not more than 5 in. (12.5 cm.) deep, take a long piece of catgut, mounted on the largest curved round-bodied needle available. After instructing the assistant how to compress the free edge of the gastro-hepatic omentum, pass a finger or fingers of the left hand into the rent. Insert the needle through sound liver substance quite 1½ in. (3.7 cm.) from the torn edge, as deeply into the crevice as possible. Bring out the needle here. Reinsert it on the other side of the bottom of the crevice, and bring it out on to the surface at least 1½ in. (3.7 cm.) away from the edge of the laceration.

When the laceration is deeper than about 5 in. (12.5 cm.), there is no needle long enough to carry out the work efficiently. A probe can be used, but what is better—is a pair of alligator forceps. It is possible with these to insert the necessary suture exactly where it is required (Fig. 482) and very expeditiously. Carefully and slowly tighten the suture and tie one-half of a knot. This will bring the edges together, and the bleeding will practically cease. Gradually tighten the first half of the knot, being careful not to jerk it. It will be found to hold quite well. Hand the free ends of the catgut to the assistant, and instruct him to hold them taut.

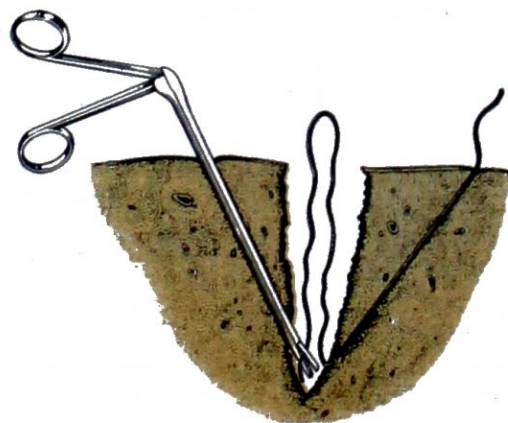


Fig. 482.—Using alligator forceps to pass the cardinal stitch that draws together an extensive deep tear.

With a ligature of cotton on a needle, undersew the half knot, and tie the cotton tightly. This will lock the half knot, when the catgut knot can be completed with impunity. It may well be that this solitary stitch will be all that is necessary; at any rate, it is the principal stitch. Other less deep stitches can be placed as necessary. When absorbable gauze is available this should be placed under the suture before tying the knot. More of it can be used under other sutures. The subsidiary stitches can take the form of any

of the accepted methods of suturing the liver. For instance, a piece of costal cartilage can be used as a buffer (*Fig. 483*). A cutting needle will easily penetrate this cartilage.

When time and excellent exposure permit, probably the ideal method of repairing a rent in the liver is to pass four or six deep sutures of ribbon catgut. These are

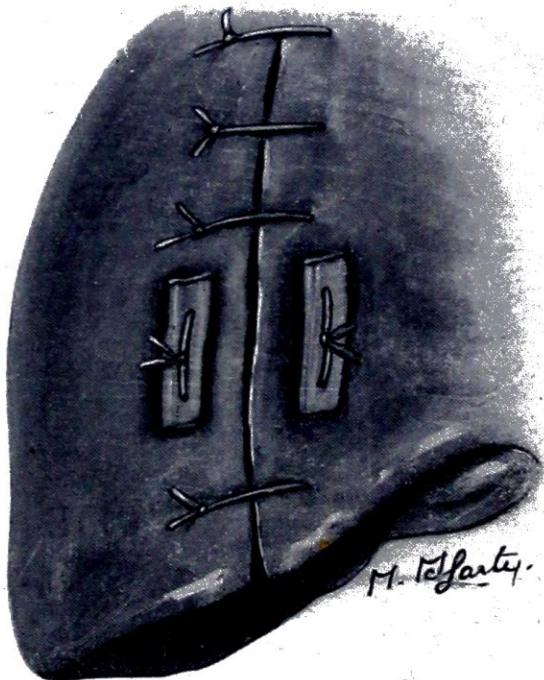


Fig. 483.—A split piece of costal cartilage can be used as a buffer.



Fig. 484.—Coaptating the surfaces of a traumatic cleft of the liver with ribbon catgut tied over oxycel as mattress sutures. Abdomino-thoracic approach. (After Devine and Burwell.)

tied in pairs over pieces of oxycel (*Fig. 484*). The everted lips of the laceration are covered with oxycel, kept in place by a sufficient number of sutures placed more superficially.

When (after débridement) there is Loss of Substance.—The laceration should be packed with strips of oxycel or a suitably-shaped piece of gelfoam, preferably soaked in thrombin topical. Two or three superficial sutures should be passed and tied loosely to keep the oxycel or gelfoam in place (*Fig. 485*).

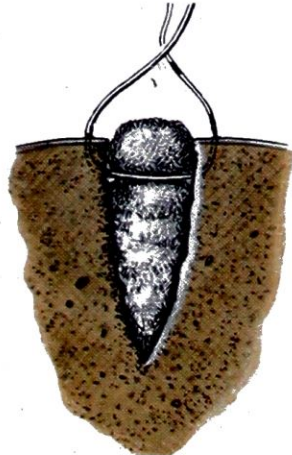


Fig. 485.—Absorbable gauze plugging a laceration with loss of substance.

When this method has been used for a laceration in a portion of the liver in contact with the diaphragm, suturing the liver capsule to the diaphragm (*Fig. 486*) will prevent the suction effect of the diaphragm on the liver.

The use of large quantities of gelfoam or oxycel (as a pack), although effective in controlling hæmorrhage, is to be discouraged if it can be avoided. Only a certain thickness of these substances can be absorbed readily; the remainder, if it becomes even mildly infected, gives rise to an abscess, especially if débridement has not been, or owing to inaccessibility cannot be, carried out.

Summarizing: Whenever possible the aim should be to bring the lacerated surfaces of the liver together, not to prise them apart with hæmostatic agents.

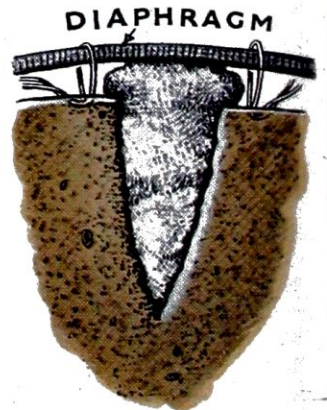


Fig. 486.—Absorbable gauze plugging a laceration with loss of substance. Liver capsule sutured to the diaphragm.

By adoption of the above principles the mortality of rupture of the liver has been reduced from 65 per cent. in 1939 to 16 per cent. (W. E. Mikesky).

Drainage.—Because of oozing, leakage of bile, and extrusion of small fragments of autolysed liver, drainage of the perihepatic tissues in the vicinity of the rupture is highly desirable. It is important that the drainage tube should not be disturbed until the fifth day, and that the drain should be removed rather slowly at the rate of about 1 in. (2.5 cm.) a day.

Packing a Deep Rent with Gauze has been practised since the early days of abdominal surgery. The results have been poor; often the patient has given promise of recovery, only to succumb (usually after the packing was removed) to secondary hæmorrhage or the hepatorenal syndrome, and this method fell into disrepute. While packing *should be resorted to only when more refined methods are considered impracticable*, with antibiotic therapy the outlook has improved. In the following successful case, reported from the Cook County Hospital, Chicago, the very long time the packing was left in the liver should be noted particularly. Doubtless this is the secret of success because it prevents bile peritonitis, which has so often proved fatal in the past.

J. M. Green's Case.—

A man, aged 32, was admitted after a quantity of steel tubing had fallen on his back one hour previously. There was tenderness and some rigidity in the upper right quadrant, and a tentative diagnosis of injury to the liver without intra-abdominal hæmorrhage was made, and conservative treatment advised. Radiography was negative. A blood-saline-dextrose drip was given. Forty-eight hours after the injury there was severe abdominal pain, rigidity, distension, and tenderness over the whole abdomen. Shortly afterwards the abdomen was opened through a vertical right

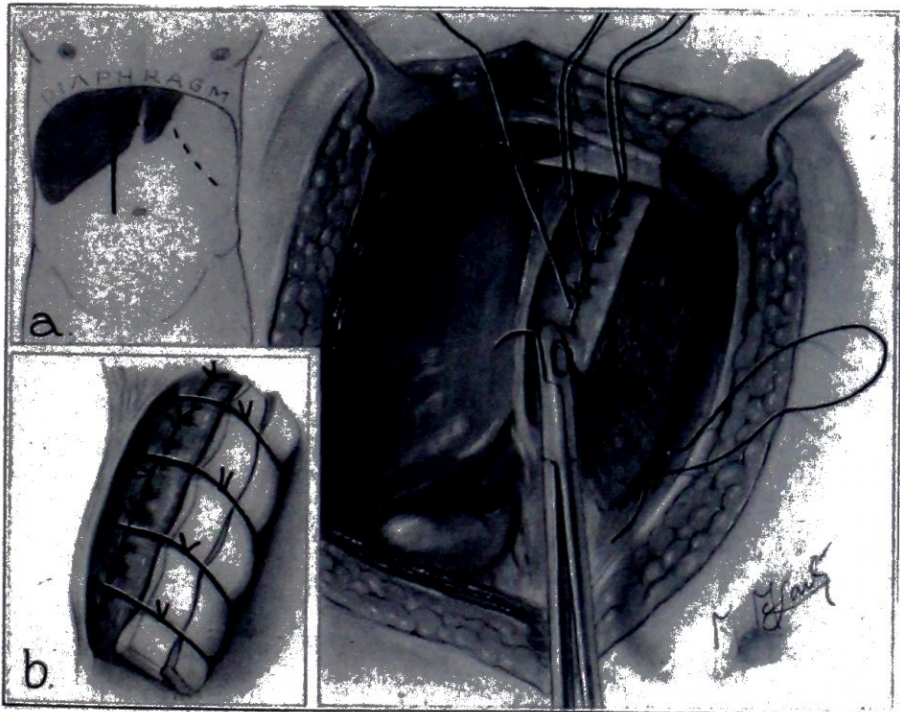


Fig. 487.—Repair of the liver after amputation of its left lobe; (b), sutures lie over gelfoam (After E. W. Werbel.)

rectus incision, and the peritoneal cavity contained approximately 2000 ml. of fresh blood containing clots. There was a tear of the right lobe of the liver just to the left of the gall-bladder. The liver was split across, except for 3 in. (7.5 cm.) posteriorly, where it was held by the hepatic capsule. The two halves were separated by a gap of 3 in. The liver was situated high under the ribs, and it was decided to pack the rent with gauze. About 19 ft. (5.8 m.) of gauze was packed into the tear, which controlled all bleeding. The abdominal wall was closed in layers and the gauze was left protruding from the upper end of the incision. During the operation the patient received 500 ml. of whole blood and 1000 ml. of saline solution. Following the operation, he received penicillin and streptomycin daily.

The post-operative course was very stormy. For eight days the patient was semi-comatose and suffered from pulmonary œdema, as well as œdema of the ankles and feet, which abated after intravenous fluids were decreased. For the pneumonia which followed, in addition to other antibiotics, 500 mg. of aureomycin was administered daily. Continuous gastric aspiration was discontinued on the tenth day, when fluids by mouth were started. On the thirteenth post-operative day 5 ft. (1.5 m.) of packing was removed by constant twisting and gentle traction under thiopentone

anæsthesia. On the fifteenth day an additional 6 ft. (1.8 m.) was removed. The remainder was removed on the eighteenth day. Bile continued to drain from the wound for 103 days, but the patient recovered completely.

It might be added that removal of the packing under anæsthesia should be conducted with blood transfusion in progress. If undue bleeding occurs, it must be controlled by repacking with fresh gauze.

Rupture of the Left Lobe of the liver is comparatively infrequent. When the tear is extensive the viability of the lobe becomes doubtful. In such a case it is best to complete the amputation of the lobe and after ligating spurting vessels to pass sutures through the whole liver 1 in. (2.5 cm.) from the lacerated surface. The raw area is covered with a sheet of gelfoam and the sutures are tied over it *Fig. 487*.

E. W. Werbel's Case.—

In a case of almost complete rupture of the left lobe, Werbel completed the amputation. Spurting blood-vessels on the cut liver surface were ligated. Sutures were passed through the entire thickness about 1 in. (2.5 cm.) from the cut surface. They were tied mattress fashion, in pairs. The ends were left long, and tied over gelfoam.

Post-operative Care (All Cases).—The patient must be maintained on full doses of antibiotics for at least ten days, with adequate blood, fluid, and electrolytic replacement.

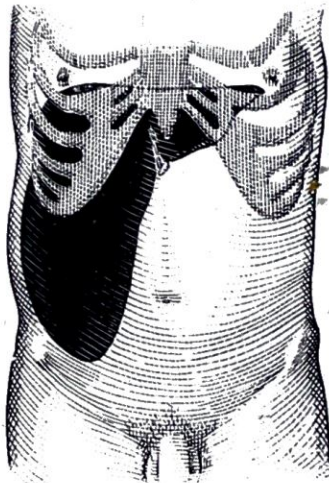


Fig. 488.—Operative findings in Weeks's case of subcapsular rupture of the liver.

Delayed Rupture.—Like certain cases of rupture of the spleen, symptoms of severe intraperitoneal hæmorrhage from a ruptured liver are sometimes delayed for hours, or even days. From time to time a subcapsular hæmatoma is a cause of diagnostic perplexity, and, if it can be evacuated before it bursts, so much the better.

A. Weeks's Case.—

A cowboy was kicked by a horse, and four lower ribs on the right side were broken. For two days he passed a little blood in the urine.

On admission to hospital fourteen days later, a large swelling was found in the right side of the abdomen. By cystoscopy, etc., it was proved that the right kidney was normal. An incision was made beneath the right costal margin, and the swelling was found to be an enormously enlarged liver quite free from adhesions (*Fig. 488*). A trocar with a tube attached was inserted, and straw-coloured fluid poured out. As the patient's pulse-rate rose to 140, the tube was clamped, the trocar left in place, and the wound was closed around the trocar. At intervals $1\frac{3}{4}$ pints (1000 ml.) drained away over a period of three days. The patient made a good recovery.

Spontaneous Rupture.—Spontaneous rupture of the liver is very infrequent. *Most of the patients have been pregnant at the time of rupture.*

H. Link's Case.—

Mrs. A., aged 42, sixteen weeks pregnant, was admitted as an acute abdominal case. Twelve hours previously she experienced sudden violent abdominal pain while peeling potatoes. Laparotomy showed that the peritoneal cavity was full of blood. No cause for the hæmorrhage could be found in the pelvis. The incision was extended upwards, and the spleen was found to be normal. Following the clots, the hæmorrhage was found to be pouring out of the foramen of Winslow. The gastro-hepatic omentum was incised, and after the blood and blood-clot had been removed from the lesser sac, a rupture 2 in. (5 cm.) in length was located in the caudal lobe. The rupture was blocked with a piece of the right rectus muscle sutured into place. Blood transfusion was given, and the patient recovered.

Other cases have been reported where the rupture was thought to be due to the violent contractions of the diaphragm and the abdominal muscles during labour. Eclamptic lesions constitute a primary cause of subcapsular hæmorrhage and capsular rupture. The mortality of spontaneous rupture of the liver is very high; five reported cases have recovered following surgical intervention (D. Kramish).

Massive Intestinal Hæmorrhage following Traumatic Rupture of the Liver (Traumatic Hæmobilia) is a rare complication of central rupture of the liver. There are periodic attacks of bleeding due to an accumulation within the liver of blood and bile. When the intrahepatic pressure becomes sufficiently raised, the contents of the cavity are expelled through the bile ducts. The mortality is 50 per cent. The hæmorrhage must be controlled by open operation, with packing and drainage of the interior of the cavity.

Closed Traumatic Rupture of the Diaphragm.—*See p. 434.*

LACERATION OF THE MESENTERY

Hæmorrhage from the mesentery may be brisk, but it is readily controlled (*Fig. 489*). Should a tear in the mesentery be parallel to the gut (*Fig. 490*), the blood-supply to the intestine in the immediate vicinity of the tear is endangered. When the tear is more than two inches in length, resection and anastomosis should be carried out. Small tears may be closed, but always wait a few moments after the closure has been effected before returning the coil of intestine. Even a slight change in colour in the intestinal wall in the vicinity of the injury, as

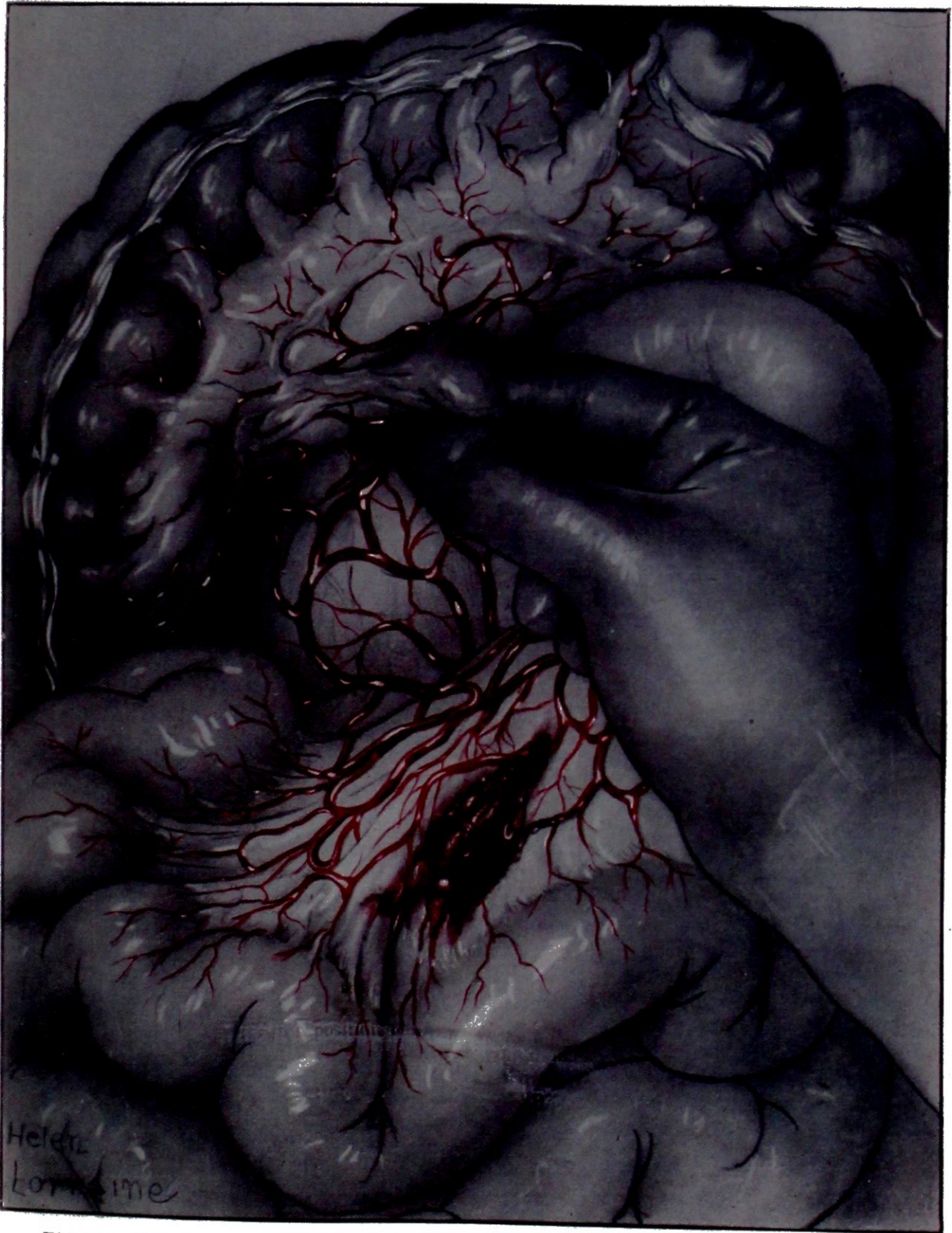


Fig. 489.—Compression of the superior mesenteric artery in a case of laceration of the mesentery.

compared with the remainder of the intestine, indicates an impaired blood-supply, and the advisability of resection should be reconsidered. Longitudinal tears (*Fig. 491*) can be closed safely.

For closing mesenteric lacerations the following practice is a good one. Bleeding points are caught, care being taken to include as little tissue as possible in the hæmostats. A ligature

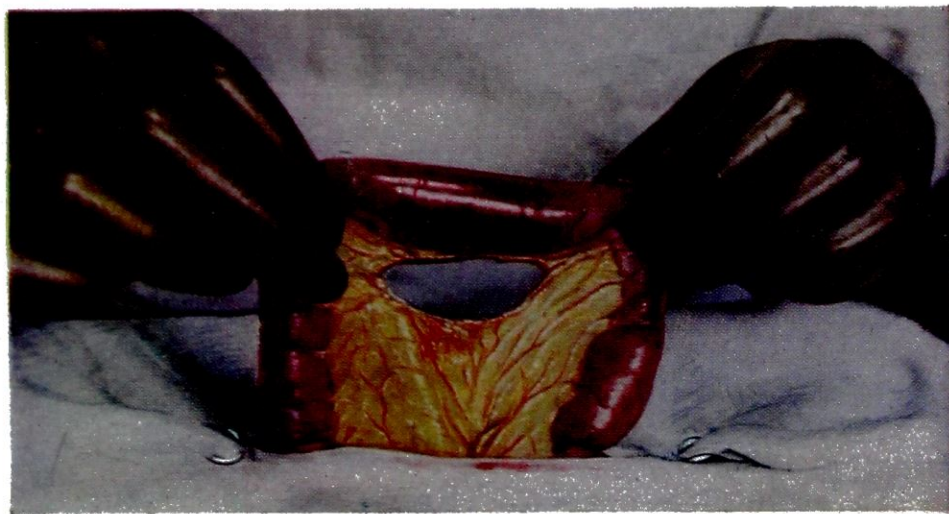


Fig. 490.—Laceration of the mesentery. A tear more than 2 in. (5 cm.) in length parallel to the gut. Resection imperative.

is then thrown about two hæmostats situated on opposite sides of the laceration. Thus the ligatures not only ensure hæmostasis, but bring together the edges of the mesentery (*Fig. 492*). This technique has the advantage over stitching in that blood-vessels are not pricked.

Hæmatoma of the Mesentery.—A large hæmatoma may strangulate the blood-vessels supplying the gut. In deciding whether it is safe to leave a hæmatoma entirely alone, one should first examine both sides of the mesentery. If the hæmatoma is in evidence on both sides, it should not be passed by lightly. When the overlying gut appears healthy, aspiration of the blood in the hæmatoma may be attempted. If, after aspiration, the hæmatoma re-forms quickly, it is a sign that a vessel

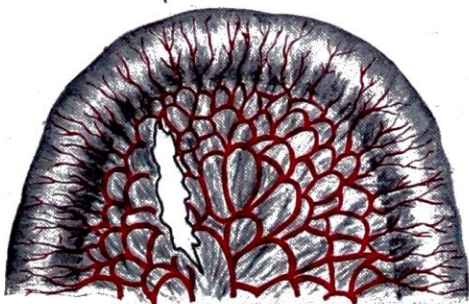


Fig. 491.—Longitudinal laceration of the mesentery. Such a laceration can usually be closed safely.

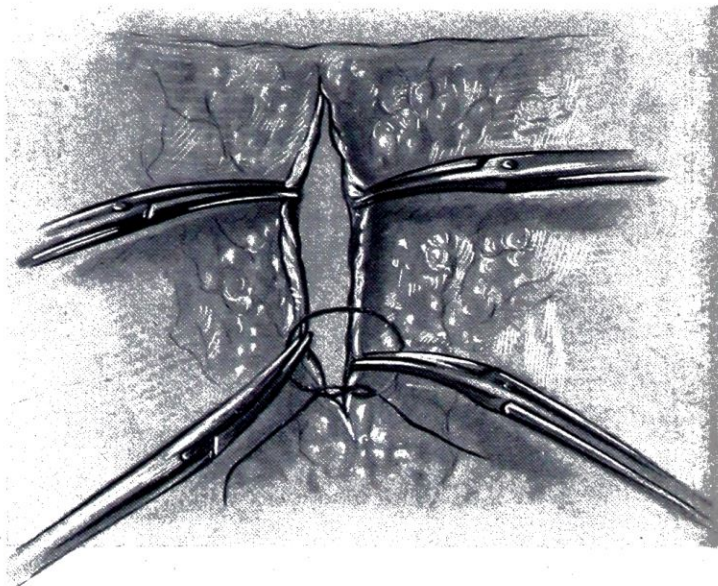


Fig. 492.—Coapting the edges of the mesentery by ligatures thrown about hæmostats situated on opposite sides of the cut surfaces.

requires ligature, and the hæmatoma must be opened. After hæmostasis has been secured, the same precautions of deciding upon the viability of the intestine as were detailed above should be taken.

TRAUMATIC RUPTURE OF A MESENTERIC CYST

S. S., aged 5½, was pushed over in a playground at school, and immediately cried out with pains in the stomach. Four hours later, when admitted into hospital, the child was obviously shocked. On examining the abdomen, rigidity was found and the percussion note was dull.

During the two hours he was under observation the pulse rose from 106 to 180. A diagnosis of ruptured spleen was made.

On opening the abdomen, fluid like curdled milk ran out in large quantities. This was traced to an opening near the duodenojejunal flexure. I was about to suture up the ragged hole, believing that the duodenojejunal flexure had been torn, but the absence of bile in the fluid caused me to make a more thorough examination. It was soon clear that a mesenteric cyst had ruptured. The third and fourth parts of the duodenum and the neighbouring jejunum had been pushed upwards by the cyst wall. A tube was passed through the hole in the cyst and the cyst wall closed about the tube. The general peritoneal cavity was drained. The abdomen became very distended on the second day, but the bowels moved freely. After the fourth day recovery was uneventful.

RUPTURE OF THE SMALL INTESTINE

Early diagnosis is of great importance. If operation is delayed more than six hours, the patient's chance of recovery is greatly decreased. If twelve or more hours have elapsed between the accident and operation, the prognosis is bad. If operation is delayed twenty-four hours or more, the result is usually fatal. The small intestine is ruptured ten times more often than the large.

When a patient has been struck upon the abdomen, and tenderness on pressure can be evoked, even in the absence of all other signs, if the tenderness persists for four hours, the

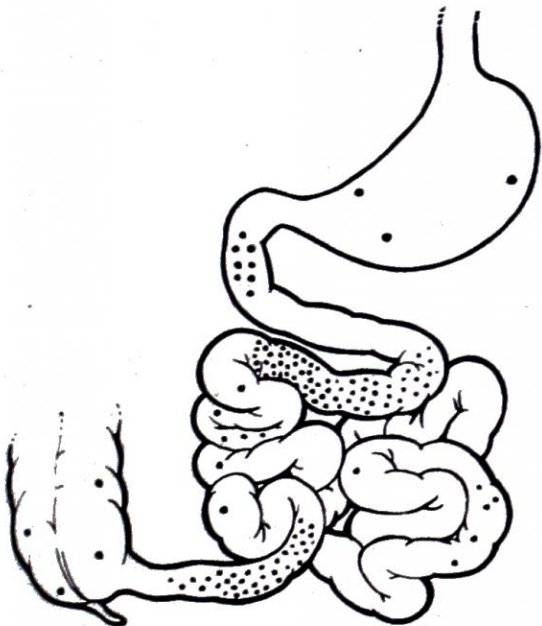


Fig. 493.—The sites of traumatic rupture of the small gut from massed statistics. (Veal and Barnes.)

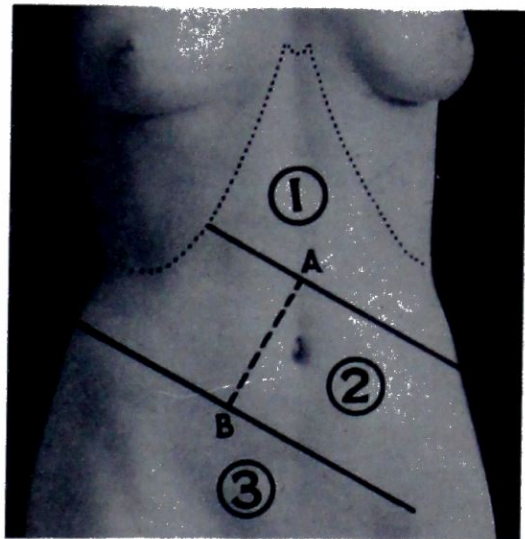


Fig. 494.—Monk's method of intestinal localization. A-B, Line of mesenteric root. Parallel lines are erected at the extremity of this line, dividing the abdomen into three equal parts. The upper, middle, and lower compartments here indicated contain, in most cases, the upper, middle, and lower thirds of the small intestine respectively.

decision not to operate is many times more dangerous than to explore. In assessing the diagnosis, Schrire draws attention to the pitfall of the presence of an unsuspected lesion of the spinal cord. There may be most excruciating abdominal pain from such a lesion.

In 19 consecutive cases of rupture of the intestine, Jacobson and Carter found the duodenum ruptured in 3, the jejunum in 7, and the ileum in 9. It is evident that the relatively fixed first and last 18 in. (45 cm.) of the small intestine are the most frequent sites for traumatic rupture (Fig. 493).

Local tenderness is often the key to the site of the rupture (Fig. 494). Attention is drawn to the fact that in rupture of the small intestine, at any rate during the first six hours following the accident, in more than 90 per cent of cases there is no radiographic evidence of free subphrenic gas in the peritoneal cavity.

Laparotomy.—The abdomen should be entered by a long paramedian incision. On opening the peritoneum, purulent, faecal, or bile-stained fluid may be found. It should be noted, however, that in early cases, especially when the rupture is situated in the jejunum, there is often only a little blood-stained fluid in the peritoneal cavity.

In some cases the site of rupture, with its mucous membrane pouting, is evident at once. In others a cursory examination brings it to light on account of flakes of coagulated lymph in the vicinity, and the fact that the site of the rupture is always surrounded by œdema.



Fig. 495.—The whole of the intestine is examined systematically. A damaged segment is left outside wrapped in an abdominal pack; undamaged intestine is returned.

When a rupture is found at this, or at a later stage of the examination, a light clamp is applied to that coil, which is then wrapped in an abdominal pack and set aside until the presence or absence of similar lesions is confirmed or excluded. Rupture is most frequent near the antimesenteric border of the intestine.

Ten per cent of intestinal ruptures are multiple; therefore do not be satisfied after finding one rent, but examine the whole course of the gut.

With an adequate incision, and the relaxation afforded by modern anæsthesia, it is an excellent practice to bring the whole of the small intestine on to the surface of the abdomen, and there to cover it with hot, moist towels, or place it in a Lahey's bag (see *Fig. 556*, p. 417). This permits a view of the fixed portion of the colon, the paracolic gutters, and the retroperitoneal regions, but its main objective is to facilitate examination of the whole of the small intestine and its mesentery. Commence by examining the duodenum and the duodenojejunal flexure. If this is negative, undertake a survey of the whole of the small intestine by running it through the fingers as it is held up (*Fig. 495*), and then returning each coil to the abdomen. In this way not only the small intestine, but also its mesentery, can be scrutinized rapidly from the duodenojejunal flexure to the ileocæcal junction.

A rupture should be closed with a double layer of sutures. For the first layer, catgut on an eyeless needle is the most suitable material, but the catgut should have been soaked in warm saline solution; when it first comes out of the glass container it is very wiry. The second layer is of interrupted thread.

A small puncture is closed by a purse-string suture. Before attempting to close a larger rent, in order that the gut may be steadied and slightly stretched, pass a stay suture on either side of the rupture in a transverse direction. Leakage of intestinal contents is arrested by placing an intestinal clamp on the proximal side of the rupture. This, however, is seldom called for, for the pouting mucous membrane prevents much outpouring. Always remember to sew up a perforation of moderate size ($\frac{1}{2}$ –1 in. (1.25–2.5 cm.)) in the transverse axis of the gut to prevent undue narrowing of the lumen (*Fig. 496*). However, if it is found, after sewing up a more extensive tear, that some narrowing of the gut has occurred, this need not be a source of anxiety, for the contents of the small gut are fluid and their passage is

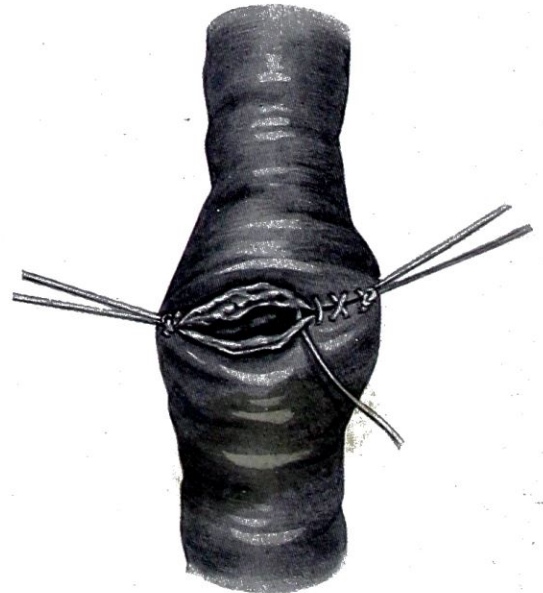


Fig. 496.—Repair of a large wound of the intestine. The gut should be sewn up transversely to prevent narrowing of the lumen. For small puncture wounds a purse-string is used.

unaffected by a certain amount of constriction. After closing the perforation the suture line can be reinforced with a free omental graft, which also helps to prevent adhesions to the suture line and possible intestinal obstruction.

The mortality is increased greatly by resection, which should be carried out only if the mesentery, with its all-important blood-supply, is so damaged as to imperil the viability of the gut, or when there are several large perforations within a short distance from one another.

In the event of a rupture being too long to close transversely, Poth and Martin's ingenious method of repair (Fig. 497) can be employed safely. The rent in the intestine

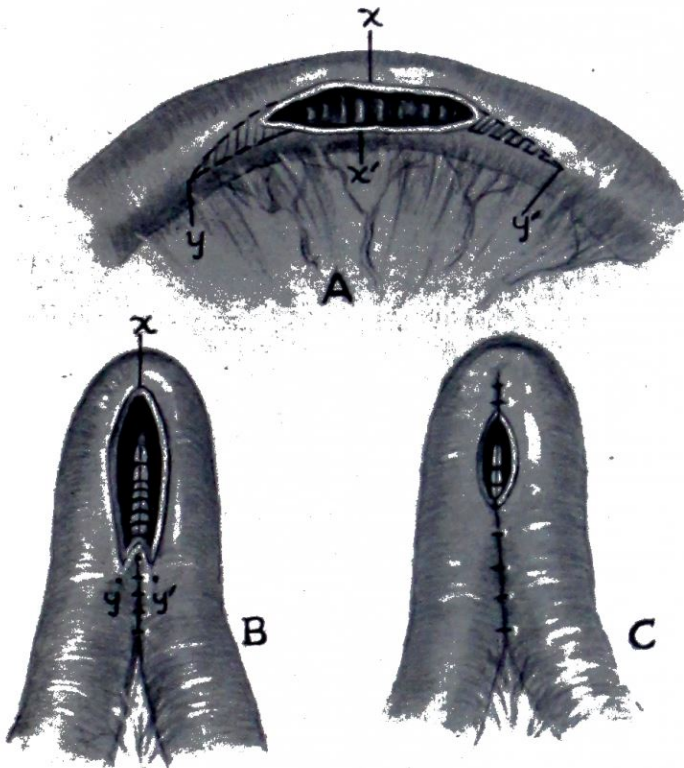


Fig. 497.—A, The defect may be enlarged to obtain a sufficiently long stoma; B, Showing the two posterior rows of sutures in place. The intestine has been folded on itself around points xx' ; C, Uncompleted anterior sutures. (After Poth and Martin.)

must be really long, and in some cases it may be necessary to enlarge the defect to provide a sufficiently large stoma.

A suprapubic drainage tube should only be omitted in very early cases, and rupture of the jejunum is less likely to contaminate the peritoneum grossly than rupture of the ileum. The after-treatment is that of peritonitis. It is most important to keep the gastric aspiration tube in place until peristaltic sounds are heard, to administer an adequate quantity of parenteral fluid, and to continue with antibiotic treatment for at least ten days.

Case 1.—Male, aged 41. Stated that twenty-seven hours previously, whilst groping about to find a match, he fell over a chair and caught his abdomen to the left of the navel on a fender. Immediately afterwards he was in great pain and crawled to bed, but had no sleep. Agonizing supra-umbilical pain continued all night, but there was no vomiting. He had passed urine twice since the accident.

On examination, pulse 84, temperature 98° F. (36.7° C.). The abdomen moved well on respiration. The skin was burnt with a poultice above the umbilicus. There was intense general rigidity. Shifting dullness could be elicited. The most tender spot was just to the left of the umbilicus. Per rectum there was tenderness in the rectovesical pouch. A diagnosis of ruptured intestine was made. Midline laparotomy. Free fluid in the general peritoneal cavity and much flocculent general peritonitis. The duodenum and duodenojejunal flexure were examined and found intact. The small intestine was then passed through the fingers. Three feet (90 cm.) from the duodenojejunal

flexure there was a tear 2 in. (5 cm.) long near the mesenteric border. This was sewn with a double layer of catgut, and the suture line reinforced with omentum. The rest of the intestine was examined with a negative result. Suprapubic drainage.

During convalescence the real cause of the accident came to light. He had been kicked in the abdomen by his wife. One year later he was seen in perfect health.

Case 2.—Male, aged 40. Saw a policeman endeavouring to arrest a drunken student, and went to the aid of the law, with the result that he was kicked in the hypogastrium. Four hours later he was admitted to hospital.

On examination he was very considerably shocked. The temperature was 96° F. (35.6° C.), pulse 84. There was board-like rigidity and tenderness, most marked to the right of the umbilicus. A right paramedian incision was employed. On opening the peritoneum, faecal fluid escaped. A perforation was found 1 ft. (30 cm.) from the ileocaecal valve. The tear was 1 in. (2.5 cm.) in length and was situated on the antimesenteric border. The perforation was closed. Suprapubic drainage.

For the next few days the patient was in a desperate condition, the abdomen distended and drum-like. Improvement set in on the seventh day, and, with the exception of some suppuration in the lower abdominal wound, he made a good recovery.

Case 3.—Male, aged 39. Fell fifteen feet from a scaffold. An iron barrow which he was wheeling fell on top of him.

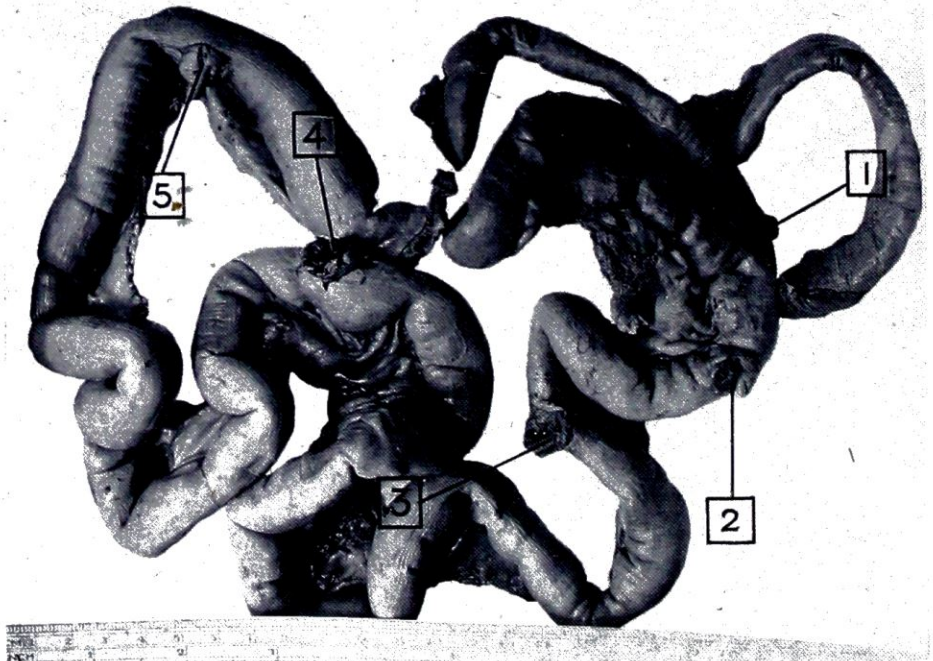


Fig. 498.—A segment of jejunum 5 ft. in length containing seven perforations (five of which are shown). Resection had to be undertaken because of a large wound of the mesentery. Otherwise multiple wounds should be sutured.

On admission he was profoundly collapsed and blanched. Pulse 110; the temperature would not register. On examining the abdomen there was general board-like rigidity. The maximum tenderness was in the left hypochondrium. A catheter was passed, and the urine found to be normal. A diagnosis of ruptured spleen was made. By the time he reached the theatre half an hour later, pallor was profound and the pulse barely perceptible.

Midline upper laparotomy. The peritoneal cavity was full of blood. The spleen and liver were intact. The hæmorrhage was found to be coming from a tear in the mesentery through which the fist could be passed. The intestine itself in the immediate neighbourhood contained no less than seven perforations in 5 ft. (1.5 m.) (*Fig. 498*). This segment of jejunum containing the ruptures was resected, for the hole in the mesentery had, to a large extent, cut off its blood-supply. End-to-end anastomosis was performed. At this stage the patient stopped breathing, and death appeared imminent. The abdomen was closed by through-and-through sutures as quickly as possible, and as this was being done occasional sighing respirations occurred. The head of the table was tilted downwards, and intravenous infusion was given, as no matched blood was available.

He was returned to bed, and six hours later had fully regained consciousness and gave some hope of recovery. During the night his condition became grave, and he died. The post-mortem examination showed a tear 1 in. (2.5 cm.) in length in the mesentery 4 in. (10 cm.) from the ileocaecal valve. The renewed hæmorrhage which had occurred from this lesion probably determined the fatal issue. This case is quoted to emphasize the necessity of examining every inch of the small intestine.

THE ASSOCIATION OF INGUINAL HERNIA WITH TRAUMATIC RUPTURE OF THE INTESTINE

Ian Aird has drawn attention to a very important association between inguinal hernia and traumatic rupture of the intestine.

Late one evening a ship's engineer, aged 56, while returning to his ship, slipped and knocked his abdomen. Soon afterwards he felt sudden severe pain over the symphysis pubis, where the pad of a truss only partially controlled a long-standing right inguinal hernia. This pain increased, and rose gradually higher in the abdomen. Vomiting occurred and was repeated. When seen four hours later, the patient persisted in blaming his hernia for the attack of pain. It was obvious, however, that early general peritonitis was present, and laparotomy was performed. A large quantity of turbid fluid was evacuated from the peritoneal cavity. The peritoneum was everywhere congested, and numerous petechial hæmorrhages were present. The lower ileum was considerably dilated, and a circular perforation was found, 4 mm. in diameter, in the antimesenteric border of the bowel a few inches above the ileocæcal valve. The perforation was 'punched-out', and there was no pouting of the mucosa. The perforation was closed and a temporary ileostomy performed above the closure. The patient was discharged three weeks later after an uneventful recovery.

It is well known that rupture of the intestine may complicate ill-advised attempts at forcible taxis. Even reduction of a hernia oft-reduced by the patient himself can prove disastrous. An elderly man, reducing his own inguinal hernia in the erect position in the lavatory of a café, ruptured his ileum (J. P. Cogley). Less common is the variety of rupture of the bowel occurring in a patient with an inguinal hernia after comparatively slight abdominal violence or sudden muscular strain. No case has yet been recorded of the condition occurring in a woman. All the reported cases, save one, have been confined to some part of the small intestine.

Summarizing: A loop of intestine lying within an inguinal hernial sac can be injured by *direct* force applied to the hernia. Rupture of the intestine may also be caused by violence to the abdominal wall owing to the transmission of *indirect* force to a loop of intestine within an inguinal hernia (Fig. 499). If the signs of diffuse peritonitis present, *laparotomy*, and not exploration of the hernia, must be performed. A paramedian incision on the side of the hernia will allow herniotomy from within should the patient's condition permit.



Fig. 499.—Explaining how remote violence can cause rupture of a loop of intestine in an inguinal hernia.

RUPTURE OF THE DUODENUM

Nine per cent of closed rupture of the intestinal tract are of the duodenum. The rupture may be: (1) Intraperitoneal; (2) Extraperitoneal; (3) Both intra- and extra-peritoneal.

Intraperitoneal Rupture produces symptoms and signs similar to those of rupture of the intestine. Possible distinguishing features are that the pain is localized mainly to the epigastrium, and the serum-amylase is usually somewhat elevated, but it is not high (1000 Somogyi units) unless there is a concomitant rupture of the pancreas.

Extraperitoneal Rupture.—The clinical features are liable to be misleading. After the initial shock has passed off, there is often an interval of comparative freedom of serious symptoms. Then, usually following a meal or even a drink, sudden pain, often situated in the lower thoracic and upper lumbar region posteriorly, commences, and repeated vomiting frequently occurs. Pain in the testicles, due to extraperitoneal irritation of their nerve-supply, is sometimes present. When the diagnosis of retroperitoneal rupture of the duodenum is missed and operation is not performed, or when a retroperitoneal rupture is overlooked at laparotomy, extreme toxæmia supervenes. Should the patient survive, signs simulating those of a perinephric abscess develop. Incision of the abscess is followed by a duodenal fistula.

Radiography.—A plain radiograph not infrequently shows the presence of small bubbles of air in the region of the right kidney, and sometimes the margin of the right psoas muscle is outlined by the gas shadow. In a few cases leakage into the retroperitoneal tissues has been demonstrated radiologically after the ingestion of lipiodol or a little thin

barium mixture, but this method should only be employed when the symptoms are mild. Lateral or oblique films are particularly valuable.

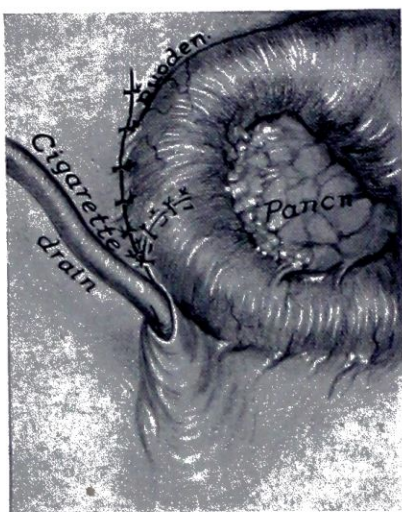


Fig. 500. — Intraperitoneal rupture of the second part of the duodenum with a retroduodenal extension. Suture completed, showing site of drainage tube. (After V. E. Siler.)

duodenum. One must be watchful lest the rupture extends extraperitoneally, and to this end, when a tear extends to the peritoneal reflexion, the interior should be explored with the little finger. An intraperitoneal rupture is closed in two layers, the outer being mattress sutures of linen thread (Fig. 500) reinforced by a patch of omentum. All extravasated material is removed from the operation area with a sucker and swabs. In cases of only a few hours' duration, provided the pancreas appears quite undamaged, drainage is unnecessary; otherwise Rutherford Morison's pouch should be drained through a stab incision. If, as is often the case, there is soiling of the general peritoneal cavity, suprapubic drainage is carried out also.

Retroperitoneal rupture has been overlooked at laparotomy on a number of occasions, for it is not readily seen. Frequently it is only diagnosed by a hæmatoma at the base of the mesocolon. In other early cases inspection will show that the duodenum in the vicinity of the rupture is œdematous, and the surrounding retroperitoneal tissues are bile-stained or the seat of extravasation of bloody fluid. In many cases the rupture can be palpated through the anterior duodenal wall. The rupture is often in the first, or particularly in the second, part of the duodenum. Always in the latter, and usually in the former, situation the lesion can be displayed by:—

Mobilizing the Duodenum.—The posterior parietal peritoneum is incised along the right lateral border of the duodenum. The incision is a generous one. By gauze dissection in the retroperitoneal tissues directed towards the middle line, the attachment of the ascending colon is freed, allowing this portion of the bowel to be packed away from the field of operation, thus exposing the greater part of the first part, and all the second part of the duodenum (Fig. 501). Further dissection behind the duodenum permits good exposure of the posterior wall of the parts in

Pre-operative Treatment.—For intense pain, pethidine (demerol) is advised. The rationale in the use of this drug is based upon the fact that its atropine-like action diminishes gastric secretion. The stomach should be emptied and kept empty through a gastric aspiration tube. Water and electrolyte balance must be maintained intravenously. Antibiotic treatment is commenced as early as possible.

Laparotomy, undertaken early, greatly enhances the prognosis, but even with the benefits of antibiotics and blood transfusion, the total mortality is at least 30 per cent. A right paramedian incision gives satisfactory access. If a midline incision has been employed, and the first or second parts of the duodenum are involved, the exposure is liable to be inadequate, and a transverse cut to the right becomes necessary. Should the pre-operative diagnosis be tolerably certain, a transverse incision through the right rectus gives splendid access.

An *intraperitoneal rupture* can be demonstrated without much difficulty. Division of the gastrocolic omentum may be required to expose a tear in the distal half of the

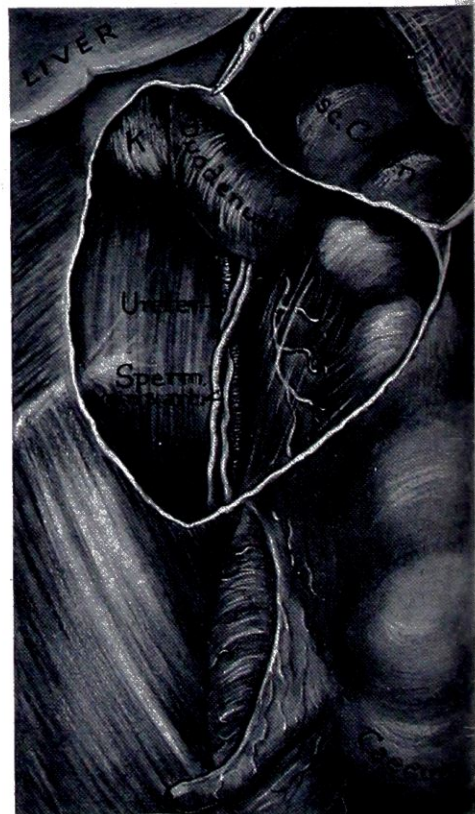


Fig. 501. — Mobilizing the greater part of the first part, the second part, and the inferior duodenal flexure. By grasping the right border of the second part with Babcock's forceps, and further gauze dissection, the posterior wall is displayed.

behind the duodenum permits good exposure of the posterior wall of the parts in

question. This manœuvre allows closure of the rent in the usual manner. The retroperitoneal space must always be drained with a soft drainage tube or a roll of corrugated rubber.

C. V. Salisbury opened the abdomen of a man aged 29 seven hours after he had been struck in the left upper quadrant. There was some blood-stained fluid in the peritoneal cavity, but no evidence of peritonitis. The peritoneum over the second part of the duodenum was œdematous and elevated to the size of a large orange. The second part of the duodenum was mobilized, and after the bile-stained fluid had been swabbed away, the second part of the duodenum was found to be almost completely divided. The edges of the tear were trimmed and united by interrupted stitches in two layers. Drainage was instituted and the patient made a good recovery.

In a case described by Estes et al. a peculiar grey-black hæmatoma was found in the right paracolic gutter, and retroperitoneal crepitation could be elicited. Exposure of the rupture in the second part of the duodenum was not obtained until the hæmatoma had been evacuated, the ascending colon and the duodenum had been mobilized, and the gastrocolic omentum divided.

As a rule, if the duodenum is mobilized thoroughly, retroperitoneal rupture of the first part of the duodenum is quite accessible. Should it be impossible to display clearly a rupture just distal to the pylorus, the method of procedure is as follows:—

J. A. Simpson's Case.—

At laparotomy a large retroperitoneal hæmatoma overlying the head of the pancreas and extending into the base of the transverse mesocolon was apparent. After incising the peritoneal covering, the contents of the hæmatoma were evacuated, and on palpation a rent could be felt in the posterior wall of the first part of the duodenum. An attempt was made to visualize the lesion, but satisfactory exposure could not be obtained. The stomach was therefore divided through the pyloric antrum and the duodenum turned back. The tear was then displayed fully. It was closed by two layers of linen thread sutures. The proximal end of the duodenum was closed and invaginated, and the distal cut end of the stomach was brought through the mesocolon and an end-to-side anastomosis made between it and the jejunum. Drainage of the retroperitoneal tissues was carried out by passing a tube through a separate stab incision.

Retroperitoneal Rupture of the Third part of the Duodenum.—Should the rupture extend far into the third part of the duodenum it cannot be displayed adequately by mobilizing the duodenum. After the superior mesenteric vessels have been retracted to the left, the anterior wall of the duodenum is incised, thereby giving access to its posterior wall (*Fig. 502*).

Rupture of the Duodenojejunal Flexure.—As a rule it is not a difficult matter to trim the ends and perform end-to-end anastomosis. Sometimes, when the intestine is torn across very close to the (retroperitoneal) duodenum, the proximal end retracts. However, it is usually possible to catch the edges of the proximal end blindly in toothed forceps, and gently, but firmly, withdraw them from the retroperitoneal tissues sufficiently to be enabled to make an end-to-end anastomosis. This must be done at all cost, for it is the only method likely to succeed. Avoid closing the proximal end and performing gastrojejunostomy, as it will only lead to a life of invalidism from food passing into the duodenum, from which there is no escape except by regurgitation into the stomach.

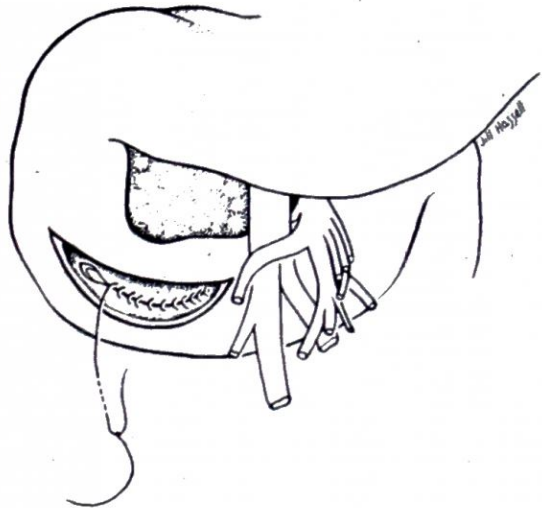


Fig. 502.—Repairing a retroperitoneal tear in the third part of the duodenum. (*After R. Russell Best.*)

RUPTURE OF THE LARGE INTESTINE

For obvious reasons, rupture of the large intestine is very lethal. Fortunately, it is comparatively rare. Of 221 cases of traumatic rupture of the alimentary canal without external wound collected by Sir James Berry, only 15 were of the large intestine.

There are few intra-abdominal catastrophes where the time factor is more important than rupture of the large intestine. When operation can be undertaken within hours of the accident, the outcome is often successful, particularly since the introduction of antibiotic therapy, which should be instituted as soon as possible.

Rupture of the large intestine may be intra- or extraperitoneal.

Radiography is especially helpful in the diagnosis of both these lesions, for gas escapes from a rupture of the large intestine at a very early stage, and with considerable rapidity (*Fig. 503*).

Bruising of the Large Intestine should always be regarded with circumspection, for undoubtedly it is a precursor of secondary perforation (delayed rupture) of

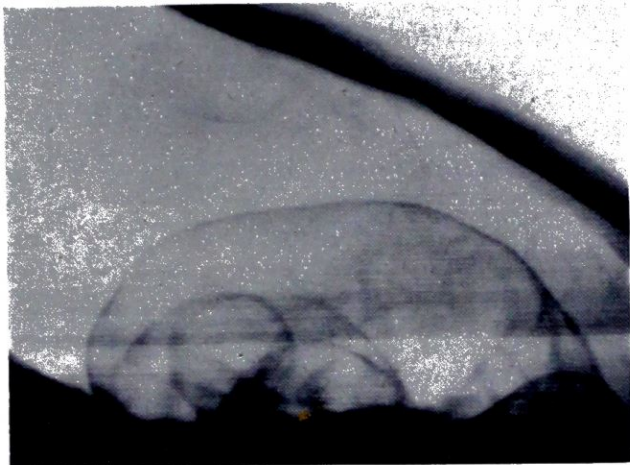


Fig. 503.—Lateral radiograph showing both distended intestine and gross pneumoperitoneum, following delayed traumatic rupture of the cæcum. (*Gummer and Ranking.*)

relatively thin-walled portion of the alimentary tract. Several cases of delayed rupture of the cæcum and colon occurring days after the accident have been reported. A small area can be invaginated with a string suture, while a larger one is best cared for by covering it with omentum.

Juxtacolic Hæmatomata should be evacuated by incising the peritoneum overlying the paracolic gutter vertically. Since the retroperitoneal portion of the colonic wall may be bruised, the retroperitoneal tissues should be drained through a posterolateral incision, because of the possibility of a delayed rupture to devitalized tissues. Should crepitations be elicited in the retroperitoneal hæmatoma, after

attended to an intraperitoneal lesion, if such be present, the laparotomy wound should be closed and this infected collection of fluid evacuated and drained through an extraperitoneal incision.

Intraperitoneal Rupture.—In some situations, if the patient is spare, a good method of dealing with the lesion, founded on military surgery, is to exteriorize the damaged segment of intestine through a special incision. Time and circumstances permitting, the Paul-Mikulicz operation (*see Fig. 519*, p. 396) is ideal: nevertheless, just to exteriorize the segment, if this can be done promptly, will probably save the patient's life. Some segments of the large intestine, e.g., the transverse colon, lend themselves to a Paul-Mikulicz procedure. With a little suitable dissection and freeing anatomical anchors, the hepatic and splenic flexures can be brought to the surface. In the case of the ascending colon, and the pelvic colon particularly, an incision through the peritoneum covering the posterior abdominal wall on the lateral aspect of the colon (*Fig. 504*) allows retroperitoneal gauze dissection towards the middle line, and by stripping up the peritoneum from the retroperitoneal tissues, a false mesentery is formed. This expedient frequently renders a ruptured segment of the large gut sufficiently mobile to be brought to the surface, and be supported by one or two colostomy rods (*see p. 447*). When this can be done the operation itself provides a convenient vent for faecal matter, and no other colostomy is required.

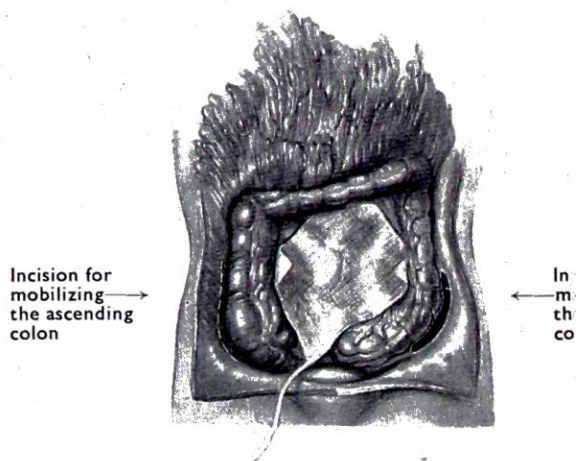


Fig. 504.—Site of incisions made through the peritoneum covering the posterior abdominal wall in order to mobilize fixed portions of the colon.

When this can be done the operation itself provides a convenient vent for faecal matter, and no other colostomy is required.

When the colon cannot be mobilized sufficiently (and such will be the case when the rupture is situated at the rectosigmoid junction, or when the patient is obese), recourse must be made to suture (*Fig. 505*).

It is inadvisable ever to rely on suture only, even in early cases. (a) Drainage must be provided down to the suture line, and the incision is closed about the tube. (b) Colostomy should then be performed well above the injured segment, for instance, transverse colostomy, and the colostomy opened forthwith. If a lesion of the ascending colon has been sutured, cæcostomy is performed. If the cæcum is ruptured, a de Pezzer catheter is introduced through the tear, which is closed and embedded around the catheter.

Summarizing: Although exteriorization is sometimes the treatment of choice, particularly on the left side, suture with proximal colostomy is frequently more advantageous, because the extensive mobilization necessary for exteriorization causes considerable shock, and in the obese it is liable to be impracticable.

Retroperitoneal Rupture.—Initially there is an escape of flatus into the retroperitoneal tissues, but soon afterwards rapidly progressive crepitating cellulitis, caused by gas-forming organisms, commences, and complicates the situation, rendering retroperitoneal colonic rupture even more dangerous than the intraperitoneal variety. After laparotomy to confirm or exclude other injuries, it is of paramount importance to close the laparotomy incision and to approach the retroperitoneal rupture through a lateral extraperitoneal incision. An attempt should be made to close the perforation, but sometimes the stitches do not hold well. Meticulous closure need not be insisted upon, for if free drainage is provided and maintained, retroperitoneal lesions heal spontaneously. A temporary colostomy in the anterior abdominal wall above the lesion should be provided.



Fig. 505.—Closing a rupture at the rectosigmoid junction.
(After Sir Cecil Wakeley.)

COMPRESSED-AIR RUPTURE OF THE COLON

To those cases of traumatic rupture of the large intestine that accrue from the usual hazards of civil life must be added compressed-air rupture of the gut. This is nearly always the result of a damnable form of practical joke. A hose carrying air under considerable pressure is turned on near the victim's anus. The site of rupture is usually in the pelvic colon (*Fig. 506*).

J. C. Conline reported the following case from Ancoats Hospital, Manchester:—

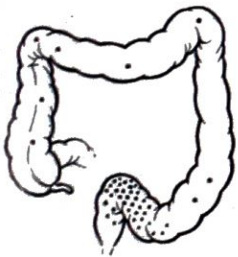


Fig. 506.—Location of perforation in collected cases of compressed-air rupture of the bowel.
(After Brown and Jwinelle.)

An engineer's apprentice, aged 16½, was admitted complaining of difficulty in breathing and abdominal pain. He stated that about an hour previously, while leaning over a balcony, two of his fellow-workers put the nozzle of a pipe conveying compressed air between his buttocks, and pressed the release button. Suddenly he felt "blown up", and could breathe only with difficulty. He had not vomited. The patient was pale, but his lips were cyanosed; he was dyspnoic, with movement of the alæ nasi. Respirations were shallow and grunting. The abdomen was greatly distended, tympanitic, with generalized tenderness and an absence of peristaltic sounds. There was a reddish-blue mottling of the flanks extending on to the lateral abdominal walls. Nothing abnormal was felt per rectum, but withdrawal of the finger was followed by a profuse discharge of blood-stained faecal-smelling fluid. The diagnosis of pneumatic compressed-air rupture was obvious. A Ryle's tube was passed, and the contents of the stomach evacuated.

Operation.—Right lower laparotomy was performed, and a small opening made in the peritoneum. Air whistled out, the abdomen collapsed like a pricked balloon, and the patient's breathing improved considerably. There was no free fluid in, and no obvious faecal contamination of, the peritoneal cavity. The upper end of the pelvic colon was ruptured, and in the hole was a plug of solid faeces. The pelvic mesocolon

and retroperitoneal tissues were infiltrated with blood, and there was a little free blood in the rectovesical pouch. The pelvic colon and rectum showed tears in the serous and muscular coats on the antimesenteric border of the bowel. They started at the upper part of the rectum, where they were small and increased in size until the point of rupture was reached; thereafter all the injured part was viable and active pulsation could be seen in the vessels supplying it. The hole in the pelvic colon was closed in two layers with No. 60 thread, and the tears in the serosal and muscular coats repaired with similar sutures. Transverse colostomy was performed at the end of the operation. The abdomen was closed around a sump drain inserted into the pelvis. One pint (570 ml.) of blood was given in the operating theatre. A course of 500,000 units of crystalline penicillin twice daily was given. During the first 24 postoperative hours 2 oz. (60 ml.) of blood-stained fluid was withdrawn from the sump drain, which was removed after 48 hours. Convalescence was uninterrupted.

A similar type of perforation of the colon has occurred during sigmoidoscopy. In reported cases the patient has been under a general anaesthetic. Sigmoidoscopy under a general anaesthetic is a dangerous procedure.

RUPTURE OF THE PANCREAS

Traumatic rupture of the pancreas is rare, and is not infrequently accompanied by damage to other abdominal organs, particularly the spleen, duodenum, and jejunum. For some hours after recovery from the initial shock, signs of serious intra-abdominal injury are often lacking, then (owing to the extravasation of pancreatic ferments) epigastric pain and repeated vomiting set in. That the pancreas has

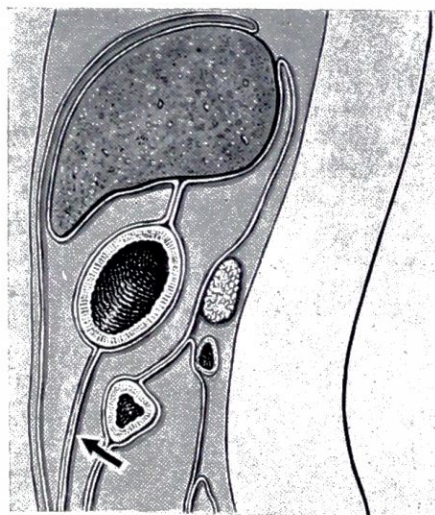


Fig. 507. — Approach to the pancreas by detaching the greater omentum from the transverse colon.

been severely damaged can be diagnosed only by a serum-amylase estimation which, if raised considerably, is good evidence that the pancreas (or the duodenum) has been ruptured. In the case of the pancreas, very soon after the accident the serum-amylase level becomes very high. At laparotomy the presence of fat necroses and a small quantity of blood should direct attention to the pancreas as the seat of the damage.

Approach to the Pancreas.—The organ can be displayed to the best advantage, not through the gastrocolic omentum, as is usually described, but by detaching the greater omentum from the transverse colon (*Fig. 507*) (R. Maingot).

Should the Pancreas be sutured?—If the tail of the pancreas is completely or nearly severed, it should be removed, and it would seem advisable to cover the raw surface with a freed piece of omentum, and to retain it there with two sutures passed through the whole thickness of the pancreas. Whether suture

of a deep laceration in the body or head of the pancreas (the body is the more usual site) should be undertaken is open to question. Burnett considers that suture of the friable pancreas only causes further pancreatic destruction. Certainly in some reported cases, when a deeply lacerated pancreas has been stitched, putty-like sloughs of necrotic pancreatic tissue have been extruded through the drainage tract about the tenth day. To compromise, it is suggested that one stitch passed through the entire pancreas on either side, and tied not tightly, so as to prevent cutting out, can serve a dual purpose of arresting hæmorrhage and bringing the severed ends of the duct of Wirsung into apposition. Drainage to the site of rupture must always be provided.

Prevention of Burst Abdomen.—Burst abdomen is a common complication after pancreatic injuries.

To suture the abdominal wall with unabsorbable sutures, for instance, stainless-steel wire, is of definite prophylactic value, but other preventative measures (*see p. 172*) must be taken in addition.

Prevention of Skin Excoriation from Escaping Pancreatic Ferments.—Aluminium paste should be applied to the skin of the abdominal wall as a routine prophylactic measure.

The Use of Drugs to inhibit Pancreatic Secretion.—During the first ten post-operative days, drugs that diminish pancreatic secretion enhance the healing of the pancreas. Unfortunately, they are almost useless unless the total fluid intake is limited to about 1500 ml. daily. Care must be taken to prevent severe dehydration, and if untoward signs of dehydration develop, more fluid must be given. The best drug for the purpose is propantheline bromide, given by mouth in doses commencing at 15 mg. daily, working up to 60 mg. daily by the fifth day, and stopping the drug on the tenth day. If this drug is not available, the subcutaneous administration of 0.4 ml. of 1-1000 solution of epinephrine produces a marked diminution of the flow of pancreatic juice, owing to the vasoconstrictor action of the drug causing a decreased volume of blood-flow through the pancreas.

W. Burnett's Case :—

As a result of a football accident, a man aged 20 received a blow in the epigastrium. After visiting the Casualty Department, where no serious signs or symptoms were found, he went home. Slight epigastric pain returned, and after a meal he vomited, and the pain became more severe. The pain and vomiting persisted during the night, until his admission to hospital the following morning. There was abdominal tenderness, more noticeable on the left side, with slight rigidity on the left. Radiological examination showed some gaseous distension of two loops of small intestine in the mid-abdomen. The serum-amylase level was 4180 Somogyi units.

After drinking a cup of tea, the symptoms returned, the pulse-rate rose to 86, and the temperature to 101.6° F. (38.7° C.). At this time, about thirty hours after the injury, laparotomy was performed through a left paramedian incision. There was a little blood in the left paracolic gutter and in the pelvis. There were a number of fat necroses in the mesentery of the jejunum. On opening the lesser sac the pancreas was found to be completely transected in the region of the portal vein and mesenteric vessels. The two parts of the pancreas were separated by a distance of 1-2 cm. After a soft-rubber tube had been passed down to the site of the rupture, the abdomen was closed around the tube. No repair of the pancreas or its duct was attempted.

The post-operative treatment was directed towards keeping the pancreatic secretion to a minimum. Little or no fluid was allowed by mouth for the first 48 hours after operation, and only 1.5 litres of intravenous fluid was given during this period. In addition, propantheline bromide was given by mouth in doses rising from 15 mg. to 60 mg. daily for the first ten days. Morphine was not used to control the pain because of its tendency to cause spasm of the sphincter of Oddi; pethidine was found to be effective, but was required in a dose of 300 mg. daily for the first three days. On the fifth day a degree of peripheral circulatory failure became apparent, and an intravenous infusion of dextran and 5 per cent glucose was given over the next 72 hours, by which time he was able to drink adequately, and rehydration soon occurred. At the termination of the course of propantheline bromide, pancreatic fluid commenced to discharge from the drainage track, but the total daily loss was small. Skin digestion was prevented by aluminium paste. The fistula healed completely in thirty-three days.

Pseudo-pancreatic Cyst following an Injury to the Pancreas.—The development of a large collection of fluid in the lesser sac (pseudo-pancreatic cyst) following a pancreatic injury is a recognized clinical entity. The interval elapsing between the injury and the recognition of the cyst is usually between one and three weeks.

W. K., aged 20, was admitted with abdominal pain and repeated vomiting. Fourteen days previously he had been jammed between a pillar and the shaft of a horse-van. After the accident he walked home and called in a doctor. Since that time he had been in bed, with a dull pain in the upper abdomen, but vomiting was the chief complaint. He had vomited twelve times on the day of admission and eight times on the previous day. On examination the patient looked pale and ill. The pulse was 100 and the temperature 99° F. (37.2° C.). There was a large tender swelling, dull to percussion, extending from beneath the left costal margin to the umbilicus. On opening the abdomen the stomach was found to be pushed forward by a tense cystic swelling in the lesser sac. There was a considerable amount of straw-coloured fluid in the general peritoneal cavity. After packing off the area so as to avoid soiling the general peritoneal cavity, the lesser sac was opened between the colon and the greater curvature of the stomach (Fig. 508). Pints of yellowish

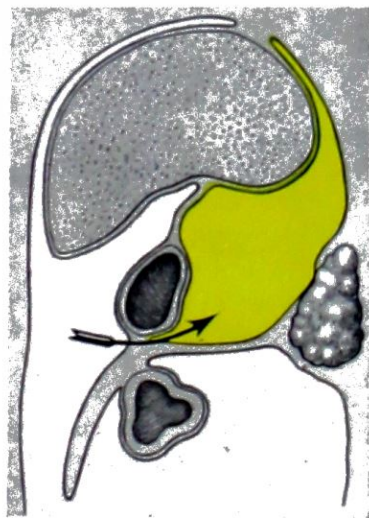


Fig. 508.—Pseudo-pancreatic cyst following injury of the pancreas. The lesser sac is drained by opening the peritoneum between the greater curvature of the stomach and transverse colon.

opalescent fluid escaped, and as the cyst collapsed some flocculent curd-like material was evacuated. A tube was passed into the lesser sac and the wound closed about the tube. The sinus took over six weeks to close finally. An examination of the fluid evacuated showed it to be sterile, but rich in pancreatic ferments.

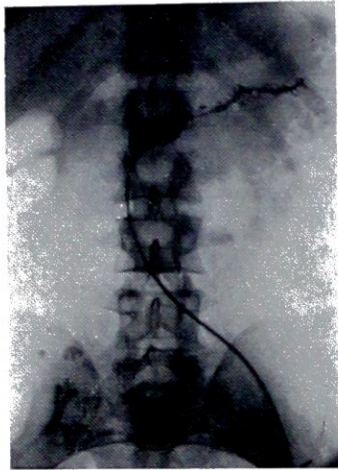


Fig. 509.—Radiograph of lipiodol injection of the pancreatic fistula. (Sir Geoffrey Keynes.)

Jurasz's Operation.—In cases of pseudo-pancreatic cyst of several weeks' standing, or recurrent cases, Jurasz's operation is probably preferable. A large opening is made into the cyst through the posterior wall of the stomach by the transgastric route. To the edges of the opening a hæmostatic suture is applied. The contents of the cyst then drain into the stomach. The operation is said to be very successful; convalescence is greatly shortened thereby, and the complications of recurrence and fistula formation are obviated.

Pancreatic Fistula.—Should the duct of Wirsung be involved in the rupture, a pancreatic fistula is liable to follow drainage of the peripancreatic tissues. Sir Geoffrey Keynes's patient, aged 20, developed a copious fistula after his ruptured pancreas had been treated by drainage of the lesser sac. The fistula healed, and a pseudo-cyst formed. The cyst was drained, only to be followed by a recrudescence of the fistula (Fig. 509). By dissection the fistula was mobilized with difficulty; it was then implanted into a loop

of jejunum, the anastomosis being made around a suitable piece of rubber tubing. After a stormy convalescence, the patient recovered.

INJURY TO THE GALL-BLADDER AND BILE-DUCTS

On opening the abdomen, if *bile* is chiefly in evidence, examine: (1) The gall-bladder; (2) The duodenum; (3) The cystic duct; (4) The common bile-duct; (5) The hepatic ducts.

Moynihan's method of rotating the common bile-duct may be useful in searching for the point of rupture. The left hand is passed transversely above the stomach along the gastrohepatic omentum. When the hand is well placed, the fingers are flexed and the hand and wrist are directed towards the patient's left, with the result that the common duct is twisted up into the wound.

RUPTURE OF THE GALL-BLADDER

If the gall-bladder is found to be irreparably damaged, cholecystectomy will have to be performed, but there can be but few cases in which the edges of the tear cannot be approximated around a tube. In most cases the tear is a small one. If it is near the fundus, the hole can be used for cholecystostomy; if elsewhere, it should be sewn up and deliberate cholecystostomy performed. The peritoneal cavity should be drained.

Run-over accidents have accounted for most of the cases. The late W. Thelwall Thomas, of Liverpool, operated upon a boy who had been run over by a cart. On opening the abdomen, bile poured forth. The torn gall-bladder was stitched about a tube, and in addition the peritoneal cavity was drained. The boy recovered, and five years later I saw him when he presented himself on account of some vague abdominal pain.

A rupture of the gall-bladder in a healthy subject results in extravasation of normal bile, which is sterile. If operation is undertaken reasonably early, the results are exceedingly good.

Serious symptoms are sometimes delayed.

Benson and Prust's Case :—

A boy, aged 3½ years, was admitted after having been knocked down by a motor car. There was a tyre mark over the right upper quadrant of the abdomen, and the right lower thorax, and multiple abrasions. The child showed gradual improvement until three days after admission, when he developed spasmodic pain in the right upper quadrant of increasing severity, accompanied by rigidity and tenderness. The attacks lasted for a few minutes, then disappeared for five to six hours.

Laparotomy disclosed small collections of bile among coils of small intestine plastered together with exudate. Examination of the gall-bladder revealed a perforation on its peritoneal surface at the junction of the lower and middle thirds. Cholecystostomy was performed through the dome of the gall-bladder. The perforation was sutured and drainage of the subhepatic pouch was carried out. Uninterrupted recovery.

TRAUMATIC RUPTURE OF THE BILE-DUCTS

This is less common than injury to the gall-bladder and, unless it is associated with other grave injuries, is not rapidly fatal. Often it is the gradual distension of the abdomen with fluid, and perhaps jaundice, that call attention to the condition after several days. Aspiration of bile from the peritoneal cavity is pathognomonic of some part of the biliary tree having been torn.

Untreated, pyrexia, loss of weight, increasing jaundice and toxæmia precede a fatal termination.

Rupture of the Cystic Duct.—Clearly the treatment indicated is to clamp and ligature the stump and to perform cholecystectomy.

Partial Rupture of the Common Hepatic Duct and Its Branches.—In comparatively early cases, before the surrounding parts become œdematous and bile-sodden, it is possible to determine whether the rupture is complete or incomplete. If incomplete, drainage of the vicinity (and drainage of the general peritoneal cavity, if there is bile therein) will, in all probability, result eventually in a restitution of the continuity of the duct. It is certainly well worth trying. In the unlikely event of biliary fistula ensuing, after three months the fistula must be treated by further operation.

Complete Rupture of the Common Hepatic Duct, or One of Its Branches.—If simple drainage is carried out, a biliary fistula will result, the surgical treatment of which is extremely difficult. If suture is undertaken, it is doomed to failure—a stricture has developed in every reported case. The surgical rectification of a stricture of this duct is even more difficult than the dissection, and implantation of a biliary fistula. To circumvent these depressing sequelæ the operation devised by Milnes Walker has everything to recommend it :—

A male, aged 2 years, was brought to hospital twelve days after an abdominal injury. The patient was lethargic, slightly jaundiced, the abdomen was distended with fluid, and the stools were pale. Paracentesis revealed bile.

After careful and prolonged pre-operative preparation, a subcostal incision allowed escape of bile, and after separating adhesions, bile was found issuing from a minute orifice at the porta hepatis. A fine probe passed only 8 mm. up the sinus. Dissection amidst the œdematous bile-stained tissues was impracticable. A short length of polythene tubing was passed into the sinus and secured by a stitch passed through the margin of the orifice. The protruding tube was then implanted into a loop of jejunum, which was afterwards stitched to the tissues around the porta hepatis. Side-to-side anastomosis between the limbs of the loop was made, and the abdomen was closed with drainage. Recovery. A year later the child was quite well.

Partial Rupture of the Common Bile-duct.—If the rupture is on the anterolateral aspect of the duct, it can be remedied by passing a T-tube into the rent. Perhaps one stitch can be useful in approximating the severed ends (*Fig. 510*), but as a rule this is unnecessary. This tube should not be removed for at least fourteen days. Drainage to the site of rupture and of the general peritoneal cavity is also required. Stricture, which so often follows operative accidents to the common duct, does not occur after incomplete traumatic rupture treated in this way, because in the latter there is no loss of a portion of the duct wall.

When the rupture is situated on the posterior aspect of the duct, it can be cared for by incising the overlying peritoneum and inserting a drainage tube down to the site of rupture, followed by cholecystostomy, as was done in Hicken and Stevenson's case. The general peritoneal cavity should be drained, also.

A boy, aged 7 years, was admitted intensely jaundiced with a distended abdomen, accompanied by persistent vomiting and dehydration; a week previously, at an outlying farm, he had been involved in a crushing accident to his abdomen.

Immediate treatment consisted of oxygen therapy, gastric aspiration, fluid therapy, and administration of penicillin. By abdominal paracentesis 3000 ml. of bile was aspirated; this was found to be bacteriologically sterile. After four days' pre-operative preparation the abdomen was opened and much bile was sucked from the general peritoneal cavity. The lesser sac was also full of bile. Fifty ml. of 70 per cent diodrast was injected into the collapsed gall-bladder, and a radiograph was taken. In the film a narrow stream of opaque medium could be seen issuing from the

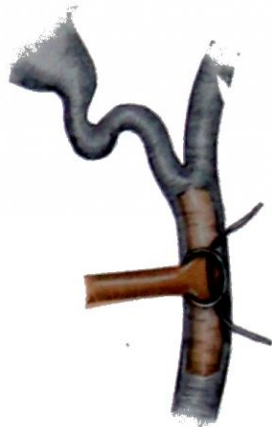


Fig. 510.—Treatment of incomplete rupture of the anterior or anterolateral wall of the common bile-duct.

duct and escaping into the lesser sac. Armed with this information, after incising the peritoneum covering the duct, a rupture was located on the posterior wall of the common bile-duct. Cholecystostomy was performed and the lesser sac was drained. On the fifth post-operative day an additional 1500 ml. of bile was aspirated from the peritoneal cavity. A week later a further cholangiogram showed the diodrast passing down the common duct into the duodenum. The tubes were removed and the patient made an uninterrupted recovery.

Complete Rupture of the Common Bile-duct.—Provided the cystic duct is patent, which can be ascertained at once by squeezing the gall-bladder, the best procedure is to ligate both ends of the common bile-duct, and proceed to perform cholecystjejunostomy (see p. 323).

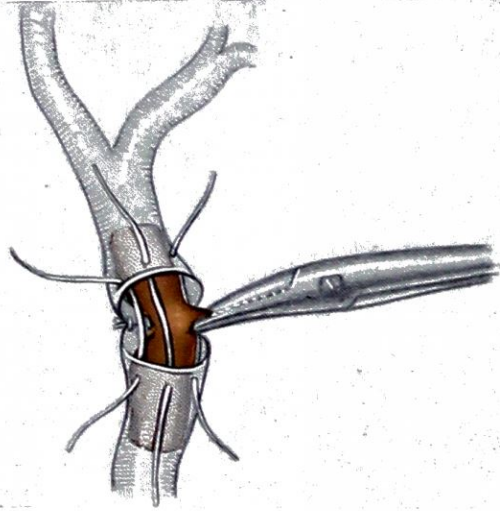


Fig. 511.—Method of repairing a complete rupture of the common bile-duct. After the sutures have been placed, but before all are tied, the tube is removed. This method is only employed if the gall-bladder is fibrotic or has been removed previously.

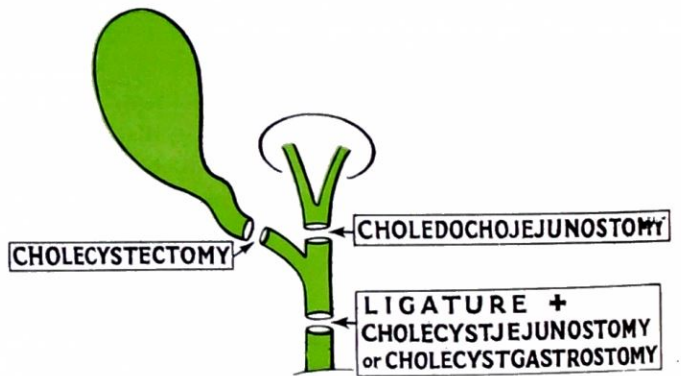


Fig. 512.—A symposium of methods of treating early complete tears of the biliary tract.

Should the gall-bladder be diseased, or have been removed previously, the ends of the common bile-duct must be repaired by end-to-end anastomosis (Fig. 511). A T-tube is then inserted through a vertical incision in the common bile-duct above, or preferably below, the seat of anastomosis.

TRAUMATIC RUPTURE OF THE ABDOMINAL WALL

Subcutaneous rupture of the abdominal muscles from trauma is very uncommon. R. S. Jamieson's patient, a labourer of 42, was caught between trucks, the left side of his abdomen being crushed by a projecting edge. On admission there was an oval hernia to the left of the rectus sheath. Laparotomy showed that the aponeurosis of the external oblique, the internal oblique and the transversalis had all been torn, as well as the peritoneum, which allowed a loop of intestine to escape subcutaneously. Repair of the rupture was straightforward.

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CHAPTER XXXV

PENETRATING WOUNDS OF THE ABDOMEN

“ It is safer to look and see than to wait and see.” (*Sir Cuthbert Wallace.*)

DURING the Second World War, the very considerable reduction in mortality from war wounds of the abdomen was due to adequate resuscitation and skilful anæsthesia, to the adjuvant effect of sulpha drugs and antibiotics, to the use of continuous post-operative gastric suction and intravenous fluid replacement, and last, but not least, to the adoption of the principle of exteriorization of the large bowel advocated so vigorously by Sir Heneage Ogilvie. Since then, further developments in intravenous fluid therapy and the wider use of thoraco-laparotomy have played their part in further reducing the mortality associated with these grave injuries.

Diagnosis.—The majority of penetrating wounds of the abdomen present no difficulty in diagnosis, the wounds of entry and exit marking only too clearly the path of destruction and the viscera likely to have been involved. When the missile is retained within the abdominal cavity, and the wound of entry lies on the periphery, it is essential to ascertain the exact posture of the patient at the time of wounding, and the direction from which the missile came, in order to surmise its probable course within the abdomen. It should be remembered that missiles entering the supraclavicular or popliteal fossæ have at times terminated their course in the abdominal cavity, that 50 per cent of wounds of the buttock are accompanied by intraperitoneal or intrapelvic lesions, and that over 10 per cent of thoracic wounds involve the abdomen in addition.

In the early stages after wounding, physical signs of involvement of a viscus are misleading. Rigidity is not often present in the early stages. Vomiting, unless it contains blood, is of little diagnostic value, and diminution of liver dullness is not often present when a hollow viscus has been perforated by a missile. When the diagnosis is in doubt, the presence or absence of bowel sounds is of some diagnostic value, but it is essential to listen for these for a full minute. When large bowel alone has been involved, bowel sounds may indeed still be present—a trap for the unwary. In all cases, the urine must be examined for blood, and a rectal examination must be carried out. X-ray localization of foreign bodies, if feasible and considered essential, should be undertaken preoperatively in the anæsthetic room to avoid unnecessary movement which these patients stand badly.

PRINCIPLES IN TREATMENT

Urgent though operative treatment of penetrating abdominal wounds may be, the first essential is to establish and maintain adequate resuscitative measures with blood, dextran, or plasma. These patients are always shocked to a greater or less degree, and it has been well said that “ if the patient has cold feet, the surgeon would do well to develop cold feet until the patient’s feet have improved ”. As a general rule, no surgical procedure should be commenced until the systolic blood-pressure is at least 100 mm. Hg. The one exception is when the patient’s blood-pressure fails to rise, despite speedy and adequate transfusion of up to 12 pints (6·8 litres) of blood in the course of one to two hours. Such a patient is suffering from a major internal hæmorrhage, usually from the spleen or from torn mesenteric vessels. To save his life he requires not only resuscitative measures, but an immediate operation to control the bleeding vessel or vessels.

Autotransfusion.—Three hundred and thirty-six cases of gunshot and stab wounds of the abdomen occurring at Louisville City Hospital were reviewed by Hamilton and Duncan, who made great use of autotransfusion. What is astounding is their statement that, if the injury is not of more than six hours’ duration, contamination of the blood by bowel contents does not seem to matter. On opening the abdomen, free blood was sucked out of the peritoneal cavity into a receptacle containing citrate solution. The resulting mixture was poured through ten thicknesses of gauze and then transfused. E. Gratton, dealing with Mau Mau casualties in Nairobi, had similar gratifying results.

Contra-indications to Operation after Resuscitation.—

1. Late cases receiving wounds thirty-six hours or more previously, and obviously improving, are best treated conservatively. Similar cases not improving, but showing evidence of localization, may be treated in a like manner.

2. Wounds caused by shot from a sports gun (q.v.).

Débridement of the Wounds of Entrance and Exit Prior to Laparotomy.—Before commencing laparotomy, débridement of the wound of entry, and of the wound of exit if there is one, is a matter of cardinal importance. These wounds are excised in the usual manner (see p. 134) down to, and including, the peritoneum. The wound or wounds are then packed temporarily, and gloves, instruments, and towels are changed. After concluding the intra-abdominal operation and closing the laparotomy incision, the packing referred to is removed. The edges of the peritoneum in the depths of the wound are approximated by sutures, and the wounds are packed with petroleum-jelly gauze. Unless infection supervenes, delayed primary closure of these wounds is undertaken within a week.

LAPAROTOMY

The Incision.—A careful estimate of the wound track and of the organs likely to be involved is a prerequisite to the correct placing of the abdominal incision. When there are wounds of entry and exit on opposite sides of the abdomen, a midline incision centred on a line joining these wounds is needed. When there is an entry wound only, a similar incision centred on a line joining this with the estimated site of the missile is required. The incision should curve 1 in. (2.5 cm.) away from and avoiding the umbilicus, and should rarely exceed 7 in. (17.5 cm.) (Fig. 513). In closure, the peritoneum should be securely sutured with a continuous interlocking stitch. The aponeurotic layer and skin require

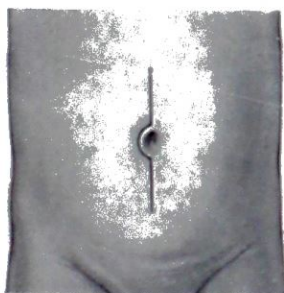


Fig. 513.—Standard incision for exploratory laparotomy in the case of a penetrating wound of the abdomen.

interrupted stainless-steel wire through-and-through sutures (Fig. 514), the edges being approximated with interrupted thread. Drainage of the fascial layer is advisable if there has been leakage of intestinal contents. Paramedian rectus-splitting and rectus-displacing incisions have no advantage over the midline approach which is no more liable to the development of incisional hernia.

When entry and exit wounds are on the same side of the abdomen, and consequently are comparatively close together, the skin incision for exploration should encircle and join the two, and the wound should be excised thoroughly in layers. It will soon be apparent whether the abdominal cavity has been involved in the wound, and if not, an unnecessary opening of the peritoneum is avoided. If it is, the incision is elegantly placed over the viscus involved. It may be enlarged if necessary with ease.

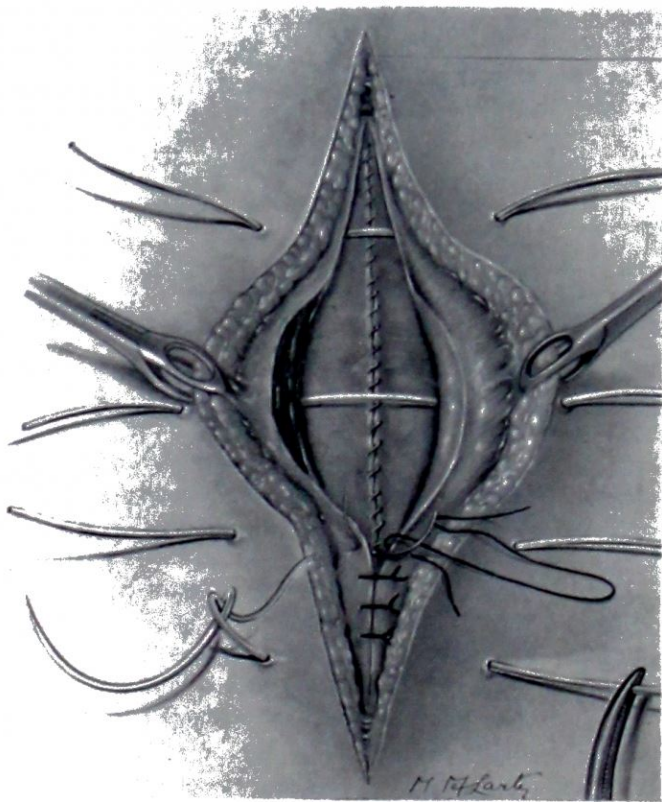


Fig. 514.—Closing the incision. The peritoneum has been approximated by a continuous catgut suture. The aponeurosis is being brought together by interrupted cotton sutures. Four through-and-through stainless-steel sutures are in place. (*Surgery of Modern Warfare.*)

In wounds of the flank involving the large bowel, kidney, or spleen, a transverse incision from the outer border of the rectus passing midway between the twelfth rib and the iliac crest, ending at the outer border of the erector spinæ, gives a very satisfactory exposure. (*Figs. 515, 516.*) The wound is closed in layers with drainage, but its posterior part may be left open when there has been an extraperitoneal wound of the colon.

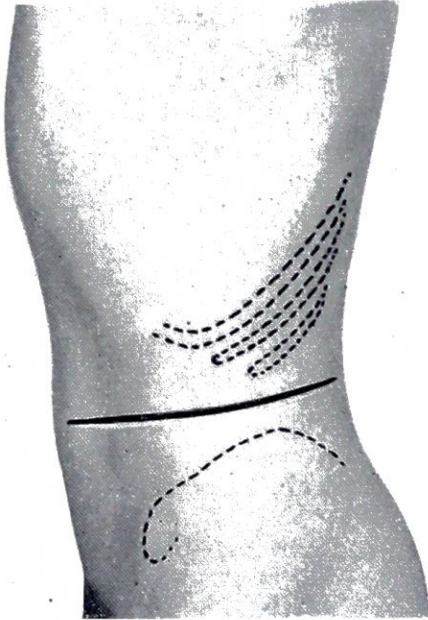


Fig. 515.—The lateral transverse incision.



Fig. 516.—All the lateral musculature between the edges of the rectus muscle in front and the erector spinæ behind are divided. (*Surgery of Modern Warfare.*)

Procedure.—When there are associated injuries of the back or buttock, these should be dealt with first, unless the case is one of immediate urgency to control hæmorrhage. The need for turning the patient on to his abdomen after laparotomy is thus avoided.

On opening the abdomen, the source of any hæmorrhage present must firstly be found and controlled. If there is a fæcal odour denoting a lesion of the large bowel, this is identified. Should there be other injuries, the wound of the large bowel is packed off and dealt with last. The liver, spleen, and kidneys are next examined and any injuries found are dealt with. This is followed by definition and treatment of wounds of the small intestine. If the missile is met with in the course of this exploration, it is of course removed, but the operation should not be prolonged unnecessarily by a meticulous search for it. When a wound of a hollow viscus has been repaired, it is desirable that the affected area be drained. This can be carried out effectively by a rolled corrugated rubber drainage tube, brought out through a separate stab incision in the flank. Should the retroperitoneal spaces be involved, it is absolutely essential that very free drainage be provided to these easily infected areas. This call for retroperitoneal drainage holds good when large bowel has been exteriorized, a drainage tube being brought out alongside the lateral aspect of the gut. Drainage is also required in wounds of the liver, spleen, bile-ducts, and pancreas.

WOUNDS OF THE MESENTERY

These are the second most frequent cause of hæmoperitoneum, the first being injuries of the liver and spleen. Bleeding points in the torn mesentery are carefully picked up and tied, avoiding injury to other mesenteric vessels. The viability of the corresponding portion of the small intestine must be closely observed. When there are no colour changes, nothing need be feared. Pallor or cyanosis are signals that resection must be performed unless the general condition is so poor that a risk must be taken. When the rent is near the mesenteric border of the gut (*Fig. 517*), and exceeds $1\frac{1}{2}$ in. (3.8 cm.) resection is usually needed.

In the mid-section of mesentery, the collateral blood-supply in tears of moderate size, is usually sufficient to enable hæmostasis and suture to be undertaken. When the wound is close to the root of the mesentery, a torn vessel places a large segment of gut in jeopardy, and wide resection is usually needed. Ecchymoses and small hæmatomata may be disregarded, but large hæmatomata must be evacuated and the offending vessel sought. The superior mesenteric vessels are compressed (*Fig. 518*), the clot is wiped away, and on



Fig. 517.—Type of wound of the mesentery which makes resection inevitable. (*Surgery of Modern Warfare.*)



Fig. 518.—The peritoneum over a large mesenteric hæmatoma has been incised. The blood-clot is evacuated while the superior mesenteric vessels are compressed.

momentarily releasing the vessels the torn artery declares itself and is picked up and tied. Accurate ligation preserves the maximum amount of intact arterial tree and may obviate the necessity for resection. After ligation, the corresponding segment of small bowel must be watched closely for colour changes.

RETROPERITONEAL HÆMATOMA

Except when in close relation to the colon, small hæmatomata can be left alone. Large hæmatomata which are increasing in size may on occasion demand evacuation and ligation of the bleeding vessel. The overlying peritoneum is incised, and as the source of the bleeding is very variable, the surgeon must steel himself to act calmly and purposefully, should the wound involve the renal pedicle, the vena cava, or the iliac vessels. Digital pressure between finger and thumb will control any hæmorrhagic cascade. With efficient swabbing on the part of the assistant, the bleeding vessel can usually be dealt with effectively.

If there is much associated bruising of the large bowel, it is often prudent to perform temporary cæcostomy.

WOUNDS OF THE LARGE INTESTINE

There are certain special features of these wounds which render their treatment difficult and at times hazardous. The wound, often solitary, is commonly retroperitoneal and thus liable to be missed, the only clue to its existence being a retroperitoneal hæmatoma. The bowel wall is thin, and extensive bruising around the lacerated area renders suturing of the wall insecure. Secondary perforation in the bruised area, the flooding of the peritoneal cavity with highly fluid fæcal material, and the development of lethal infection in the retroperitoneal tissues after mobilization of the affected portion of the large bowel add to the gravity of these cases. For these reasons the treatment of choice for lesions from the hepatic flexure onwards is to exteriorize it *in toto*, through a separate stab incision (*see Fig. 504, p. 384*).

Before passing the loop to be exteriorized through the stab incision, a 'spur' may be formed by joining the antimesenteric borders of the limbs of the loop together for 4 in. (10 cm.) (*Fig. 519*). This 'spur' is crushed later when the colostomy is to be closed. The formation of a spur is not essential and should it be difficult of execution owing to tension it is better to omit it. In such cases subsequent closure of the colostomy by excision and end-to-end anastomosis is now practised safely.



Fig. 519.—Exteriorization with spur formation (the Paul-Mikulicz operation).

Lesions affecting the descending colon should be approached extraperitoneally. With the patient partly rolled over to the sound side, a separate transverse incision (*see Figs. 515, 516*) made well towards the flank provides access to a perforation which would otherwise be quite inaccessible.

Wounds of the cæcum and ascending colon present peculiar difficulty owing to the dehydration and skin excoriation which follow exteriorization of this portion of large intestine. In cases with considerable bowel-wall destruction, resection of the cæcum and right colon, with ileotransverse colostomy, is indicated if the patient's condition will allow. Alternatively, the injured segment is exteriorized and a short-circuiting ileotransverse colostomy

performed. A third plan is to resect the injured segment and to exteriorize both ends with the addition of an ileotransverse colostomy to short circuit the wounded segment. In minor cases a two-layer repair with unabsorbable sutures, covered by an omental graft, and with an associated temporary cæcostomy, is the treatment of choice. When this portion of the gut is exteriorized the skin should always be protected from excoriation by the use of aluminium hydroxide paste.

WOUNDS OF THE RECTUM

Intraperitoneal wounds of the rectum should be repaired with a double layer of sutures followed by a proximal colostomy as near to the injured gut as is practicable. In extra-peritoneal wounds colostomy is performed, but no attempt is made to repair the injured intestine. The widest possible drainage of the perirectal tissues must be established. This is accomplished by excision of the coccyx, division of the fascia of Waldeyer, and the opening up of perirectal tissues by finger dissection. By these means the best possible dependent drainage is obtained (*Fig. 520*).

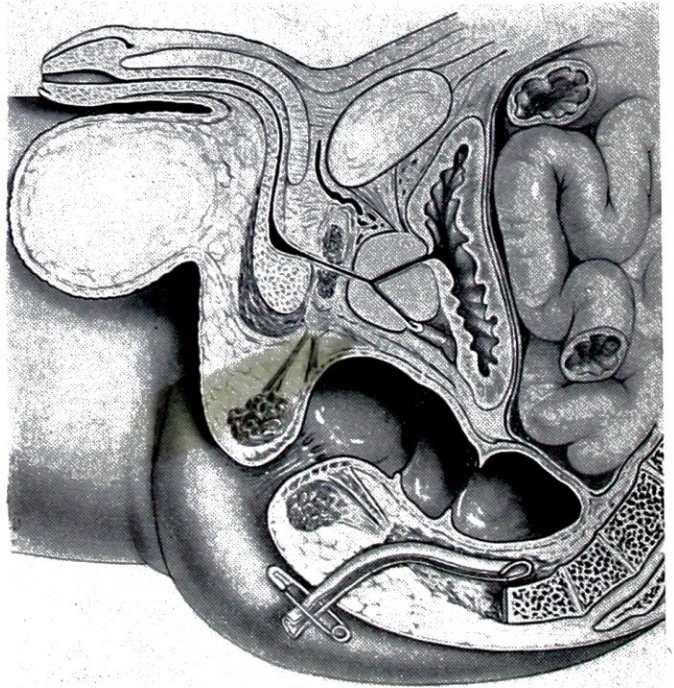


Fig. 520.—Drainage of the pararectal extraperitoneal tissues after removal of the coccyx.

WOUNDS OF THE SMALL INTESTINE

The lesions are almost always multiple; the average number in the case of a bullet wound is four, but there may be as many as twenty. Generally it is best to commence by examining the intestine at the ileocaecal valve and to work upwards, but on occasion common

sense dictates that to commence at the duodenojejunal flexure and work downwards will be the procedure of choice. In either case, the whole length of the small intestine must be examined. In no circumstances should evisceration be practised. Deft segmental scrutiny is the procedure to be adopted. After the integrity of each 8-10 in. has been verified, it is replaced by the surgeon or his assistant. When a wound is found, it may be repaired at once. Alternatively, the whole length of the gut may be examined first, perforations being marked with fine forceps as they are found. The mucosa is well inverted, and the perforations are closed transversely (*Figs. 521, 522*) to avoid stenosis. When there is a number of perforations in a relatively small segment, closure of each by a single layer of thread suffices. In more isolated lesions a double layer of thread is used. When there are perforations close together, it is desirable that they be repaired if possible in preference to



Fig. 521.—An oblique wound about to be repaired in the transverse axis of the bowel. (*After Grey Turner.*)



Fig. 522.—Two small wounds converted into one, ready for suture in the transverse axis. (*After Grey Turner.*)

carrying out a resection, as the mortality associated with the latter is quite double that of suture. However, resection is demanded when:—

1. The gut is separated from its mesentery for more than 1½ in. (3·8 cm.).
2. The suturing of multiple wounds close together would inevitably lead to a gross stenosis.
3. The gut is extensively damaged as well as perforated.
4. Infarction.
5. When the perforation is along the mesenteric border of the intestine and consequently its viability is in doubt.

After resection, an end-to-end anastomosis should be carried out.

WOUNDS OF THE STOMACH

These are commonly encountered in thoraco-abdominal injuries. There is always considerable bleeding. Both surfaces of the viscus are involved. The wound in the posterior wall is approached through the greater omentum. Should it be difficult to find, it may be located by passing a finger through the wound in the anterior wall. Repair should always be carried out by an inverting suture in two layers.

WOUNDS OF THE DUODENUM

These carry a very heavy mortality owing to injury of neighbouring vital structures, and difficulty of closure. Approach is greatly facilitated by medial mobilization of the hepatic flexure of the colon. The wound, which is not infrequently on the posterior wall of the second part, should be closed with at least a double row of sutures. If considerable stenosis is likely to result, gastrojejunostomy should also be carried out. The retroperitoneal tissues must be drained freely through the flank.

WOUNDS OF THE SPLEEN AND PANCREAS

Wounds of the spleen and pancreas require no special mention, for their treatment is identical with that of closed injuries of these organs (*see Chapter XXXIV*).

WOUNDS OF THE KIDNEY

Conservative treatment is indicated in minor wounds of the kidney. If appreciable bleeding continues after 24 hours, the organ should be explored. Large wounds in the renal area are explored as part of routine wound treatment. If damage to the kidney is minimal, the area is drained. In a penetrating wound of kidney, nephrectomy is indicated if the ureter is divided, if the renal pelvis or renal pedicle is involved, or if there is parenchymatous involvement of half or more of the renal substance. For the indications for partial nephrectomy, *see p. 590.*

WOUNDS OF THE LIVER

These wounds should as far as possible be treated conservatively, but involvement of other abdominal organs may necessitate laparotomy. When so met with, the tears should be packed firmly with absorbable gauze, and the region of the tear drained through the flank. Gauze roll packs and attempts at suturing are to be avoided. When there is a thoracic wound of entry, the usual wound revision will expose the tear in the diaphragm, and through this, at times, an accessible missile may be removed. No exploration of the track in the liver should be carried out. The diaphragm is repaired and the thorax closed.

THORACO-ABDOMINAL INJURIES

In thoraco-abdominal wounds, which represent over 10 per cent of penetrating abdominal injuries, the missile penetrates the chest and diaphragm and may emerge through the abdominal wall or be retained in the abdomen. Conversely, a missile entering the abdomen may pass through the diaphragm and either end in the thorax or emerge through the chest wall. Such an injury is referred to as an abdomino-thoracic wound and carries a heavier mortality than either an abdominal or a thoracic wound. Considerable damage is often caused by the missile, and by indriven rib fragments, to the lung and diaphragm, and to the liver, stomach, spleen, kidney, and transverse colon.

Diagnosis.—In the majority of cases the direction of the path of the missile will indicate the nature of the abdominal damage. When the missile is retained, X-ray examination is essential to locate it. Clinically, it should be remembered that abdominal rigidity due to thoracic injury is usually unilateral and there is some relaxation during inspiration, whereas with involvement of a subdiaphragmatic hollow viscus it is generalized and constant. Bowel sounds will be present on auscultation if the abdominal contents have escaped uninjured. If the diaphragm has been involved, there is often a catch or hiccup at the end of inspiration and pain may be referred to the shoulder.

Treatment.—If there is an open sucking wound of the chest, this must be sealed off at once by a large occlusive dressing, stitched into position if necessary, as a temporary measure. The patient is often shocked and dyspnoëic owing to the pleural cavity being full of blood. This should be aspirated as soon as possible as a resuscitative measure. Blood should only be transfused in amounts to replace blood lost and only at a rate of about a pint an hour. The condition of the opposite lung must be carefully checked, as it may be the site of blast contusion or collapse, and may preclude operation.

In the first place, if there is an open wound of the thorax, this assumes surgical priority and must be dealt with at once. However, in right-sided wounds, with no significant thoracic damage, and with intra-abdominal injury confined to the liver alone, conservative treatment of the lesion should be adopted. In similar cases, but with thoracic-wall damage requiring wound revision, the liver may be inspected through the diaphragmatic rent, and an accessible foreign body removed. No extensive search for the missile should be made, neither should the wound track in the liver be explored, curetted, or otherwise interfered with. The rent in the diaphragm should be repaired and the chest closed.

It is in left-sided thoraco-abdominal wounds, where there is major thoracic damage, and which also involve the stomach, spleen, transverse colon, or splenic flexure, that the operation of thoraco-laparotomy so greatly facilitates the work of the surgeon.

THORACO-LAPAROTOMY

The operation here described is the full operation to expose widely and simultaneously the thoracic and abdominal cavities and is the same incision, used in other circumstances,

for procedures such as radical total gastrectomy. The extent to which the full incision is required will depend on the nature and extent of the injuries found. When the damage is mostly thoracic, and access is required only to the fundus of the stomach or spleen, the incision need not cross the costal margin, the latter organs being approached by enlarging the diaphragmatic wound.

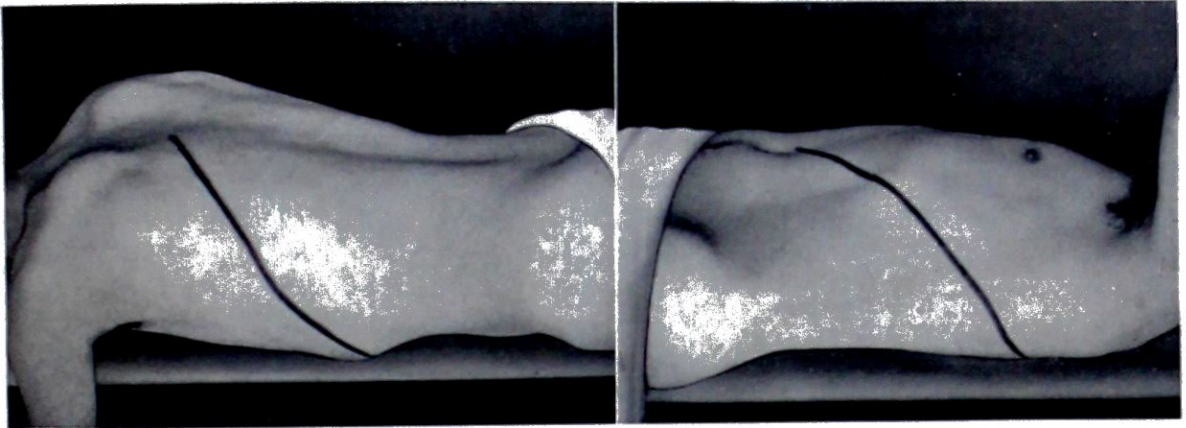


Fig. 523.—Incision for thoraco-laparotomy.

Position.—The patient is placed in a right lateral position, the left arm on an arm support, the right knee bent, and the left lower extremity extended. Sometimes the patient is tilted backwards so that the abdominal part of the operation is easier of access, but this is not essential.

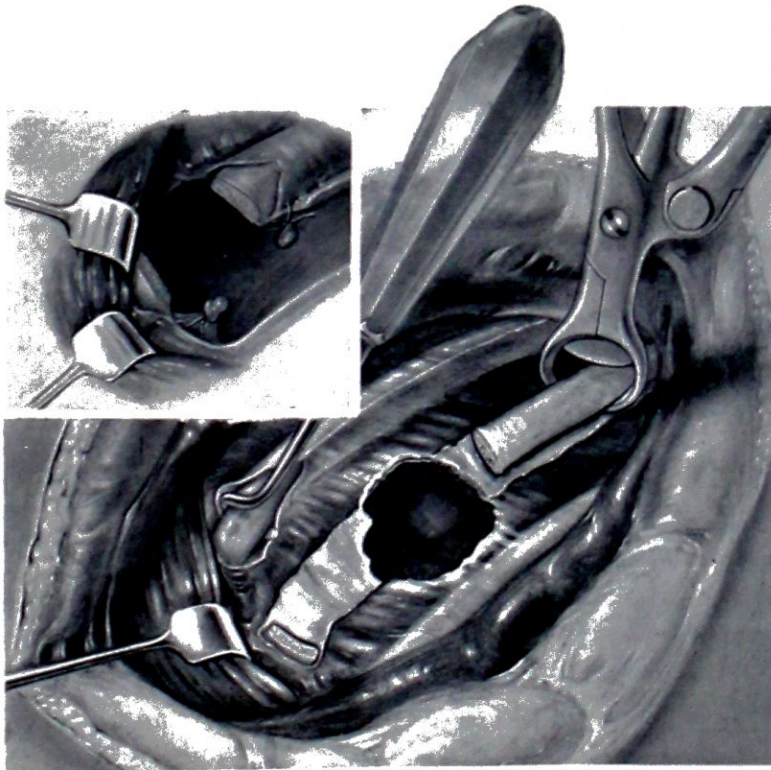


Fig. 524.—Transthoracic laparotomy. The external wound, including a piece of shattered rib, has been excised. With fresh instruments, more of the rib is removed. The rib above is divided near the posterior end of the wound, in order to allow a good view of the interior by suitable retraction. *Inset*: The rib above divided, and its intercostal vessels ligated.

Incision.—The incision commences in the midline, at a point in the line of prolongation of the 8th rib¹. It crosses the left rectus and left hypochondrium obliquely to the left costal

¹The 9th rib gives better access to the abdominal cavity; the 8th rib to the thoracic cavity.

margin, and continues in the line of the 8th rib, to end $1\frac{1}{2}$ in. (3.8 cm.) medial to the lateral border of the sacrospinalis (*Fig. 523*). The incision is deepened down to muscle. The whole of the abdominal musculature in the line of the incision, including the left rectus is divided, preferably with diathermy. The periosteum of the 8th rib is then divided in the line of the rib and is reflected with a sharp, curved raspator. The rib is freed from the posterior periosteum and intercostal vessels by a curved Doyen's rib raspator inserted at the posterior end and pushed forwards towards the costal cartilage. The posterior end of the rib is divided by a costotome or rib shears and the rib, with its attached costal cartilage, is excised (*Fig. 524*). The incision is then carried down across the costal margin and the peritoneal cavity opened freely. The pleural cavity is opened through the bed of the rib, and the upper surface of the diaphragm exposed. The left pulmonary ligament is divided and the left lung packed off lightly.

Dividing the Diaphragm.—The diaphragm is divided at right angles to the line of the original incision towards and up to the œsophageal hiatus. As it is divided, thread or silk sutures are passed through the cut edges on each side, the ends being left long. These secure hæmostasis and act as retractors. When division is complete, the edges can be stitched temporarily to the parietal muscles of the chest wall and of the abdominal wall, so increasing the width of the wound. The pleural and peritoneal cavities are now joined and a wide operating field is available. Retractors are usually unnecessary (*Fig. 525*).

Closure.—The diaphragm is closed by a close series of interrupted silk sutures. When necessary, drainage of the intra-abdominal operation site is carried out, and the tube is made to emerge below the tip of the 12th rib. The peritoneum is closed and an accurate layer-by-layer repair of the divided abdominal musculature is performed. The pulmonary ligament is sutured, and a scrupulous but gentle cleansing of the pleural cavity carried out. The phrenic nerve should not be crushed. An intercostal catheter is placed in position and the rib bed sutured. At this stage the anæsthetist clears the bronchial tree by intermittent suction through the endotracheal catheter or a bronchoscope before fully re-inflating the lung. The spigot is placed in the intercostal catheter, and the thoracic parietal musculature is then repaired in layers. The skin incision is closed, and the intercostal catheter is connected to an under-water seal. When possible, a radiograph to confirm full re-expansion of the lung should be taken before the patient leaves the operating theatre.

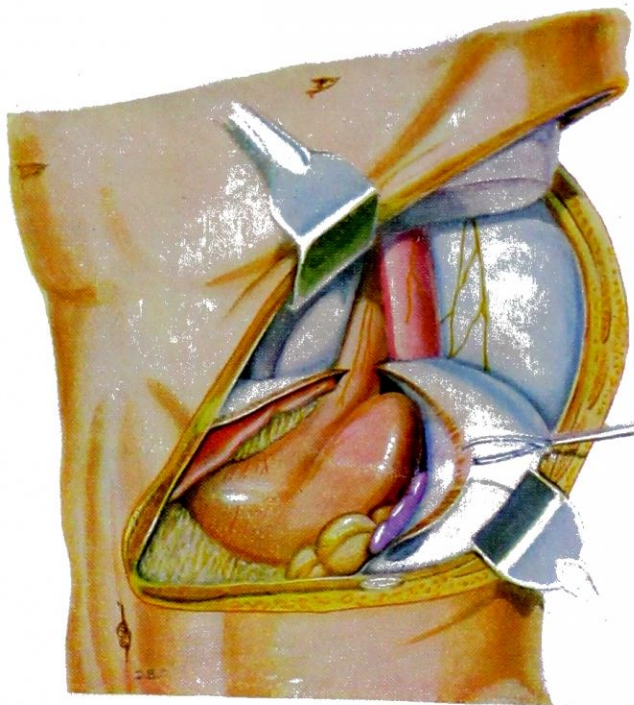


Fig. 525.—Left thoraco-abdominal incision. Showing the splendid access to the thorax and the viscera of the upper abdomen.

(Painting by Capt. D. B. Clarke, R.A.M.C.).

SHOTGUN WOUNDS

When, as the result of being 'peppered' by a shotgun, a patient receives scattered penetrating wounds of the abdomen, it is justifiable to adopt a conservative attitude, as the intestinal wounds caused are so minute that they are virtually self-sealing. The patient is placed on continuous gastric suction and intravenous therapy for three days, being observed closely the while. In very few cases, if any, will surgical intervention be required.

Close-range injuries from a shotgun, of course, require the same urgent treatment as any other penetrating wound.

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