Gall-stones : their complications and treatment / by A.W. Mayo Robson and P.J. Cammidge.

GALL-STONES

THEIR COMPLICATIONS AND TREATMENT

MAYO ROBSON & CAMMIDGE

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BY

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PREFACE

In the following pages we have endeavoured to present as briefly, and yet as clearly, as possible both the medical and surgical aspects of cholelithiasis, and also the complications to which the presence of gall-stones may give rise. Before dealing with the more strictly practical subjects of diagnosis and treatment, we have thought it advisable to summarise the present position of our knowledge with regard to gall-stone formation, for modern experiment and research have done much to indicate what are probably the most reliable means to adopt for preventing the appearance of calculi in the biliary apparatus, and palliating their effects when once they have done so. The radical treatment of gall-stones is unquestionably surgical, and this is now established on such a firm basis that no excuse need be advanced for dealing with it fully. Of the numerous com-

plications associated with, and due to, gall-stones, inflammatory affections of the pancreas and malignant disease of the gall-bladder and bile ducts are, according to recent observations, among the most important; we have therefore devoted considerable space to their discussion.

A. W. MAYO ROBSON.
P. J. CAMMIDGE.

August 1909.

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CHAPTER I

ANATOMY OF THE GALL-BLADDER AND BILE DUCTS

A KNOWLEDGE of the anatomy of the bile ducts and gall-bladder is an essential preliminary to the study of gall-stones and the effects that they produce, for, without it, it is impossible to clearly comprehend the causes that contribute to their formation, or to understand the various symptoms and secondary effects that may be associated with their presence.

Starting as minute channels, known as *bile canaliculi*, between the hepatic cells, the excretory ducts of the liver unite in the interlobular connective tissue to form the *interlobular ducts*. These by their union give rise to progressively larger ducts, which again

join together, as they course toward the portal fissure, to emerge from the liver substance as five or six channels. Those from the right lobe unite to form the larger, right, terminal biliary duct, while those from the left lobe, together with tributaries from the Spigelian and caudate lobes, give rise to the smaller, left, terminal biliary duct. Occasionally the union into right and left ducts does not take place, the separate channels converging together to form the hepatic duct direct.

The hepatic duct arises at the right extremity of the transverse fissure of the liver by the junction of the terminal biliary ducts. It then runs downwards, and a little to the left, to terminate in the common bile duct, which is formed by its junction with the cystic duct, outside the mouth of the portal fissure (Fig. 1). The hepatic duct varies in diameter from 4 to 5 millimetres. Its length is usually from 25 to 31 millimetres, but it varies considerably in different subjects, the difference depending upon the uncertain point of junction of the terminal biliary ducts, and its high or low union with the cystic duct. In a few instances the terminal biliary ducts unite directly with the

cystic duct to form the common bile duct, so that no hepatic duct exists. In its whole course the hepatic duct is situated between the two layers of the gastro-hepatic omentum, and lies practically altogether

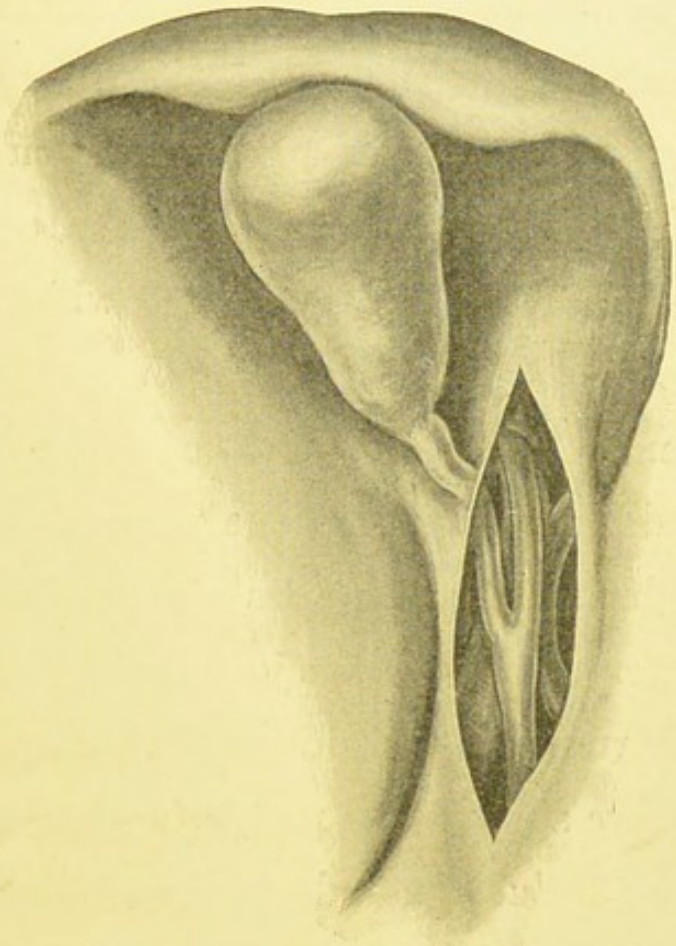


Fig. 1.—Gall-bladder and bile ducts.

within the portal fissure. Above, at its origin, it crosses the right branches of the hepatic artery and portal vein on their anterior aspect, perpendicularly. Below, it runs on the antero-external aspect of the

portal vein, which position it maintains to its termination. It is in intimate relation to the lymphatic glands in the hilum of the liver, and also with the nerves running to the liver. The wall of the hepatic duct can be divided into two layers, an external and an internal. The external consists of connective tissue and elastic fibres, with a few longitudinally arranged unstriped muscle fibres. The internal is composed of mucous membrane, which shows a number of small lateral diverticula corresponding to those found in the intra-hepatic ducts. The blood supply and innervation are the same as those of the common duct. The arteries are branches of the hepatic artery, and the veins join the portal vein. The lymphatics run to the glands in the hilum of the liver, and the nerve supply is from the hepatic plexus.

The cystic duct extends backwards and inwards from the neck of the gall-bladder to the termination of the hepatic duct, with which it unites to form the common bile duct. Occasionally, however, it may join the right hepatic duct. It is slightly longer than the hepatic duct, varying from 33 to 45 millimetres, but is only about half the diameter, ranging

from 3 to 4 millimetres. Its narrowest point is where it joins the hepatic duct (Fig. 2). Its structure is the same as that of the walls of the gall-bladder. Owing to an infolding of the mucous membrane, similar to that seen in the neck of the gall-bladder, the interior of the duct presents a convoluted appearance (valves of Heister).

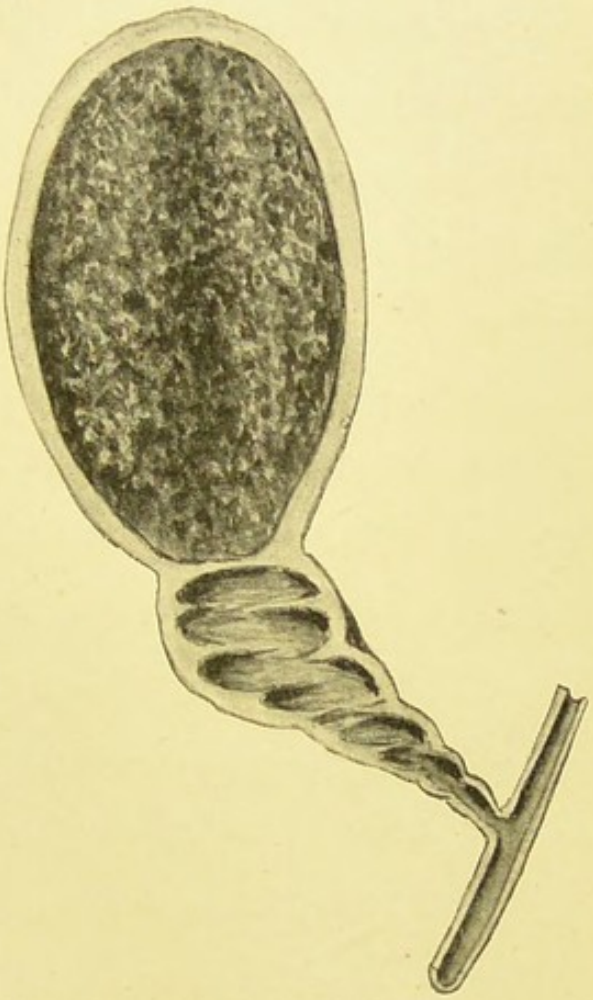


Fig. 2.—Diagram of the interior of the gall-bladder and cystic duct showing the valves of Heister.

The gall-bladder is situated on the inferior surface of the right lobe of the liver, in a large, but shallow, depression, known as the *cystic fossa.* The peritoneum covering the under surface of the liver is reflected on to, and covers, the unattached fundus and inferior surface, but the upper aspect is directly united to the fossa by areolar tissue.

The gall-bladder is usually pear-shaped, the large extremity lying anterior to, and below the neck, where it merges in the cystic duct. It varies considerably in size according to the volume of its contents. In a state of moderate distension it holds from 50 to 60 c.c. of bile. Its walls are very elastic, and it is possible to introduce under pressure from 200 to 250 c.c. of water without producing rupture. If the distension is continued, rupture takes place close to the neck of the organ.

It is divided into three portions, the fundus, the body, and the neck, the latter being continuous with the cystic duct.

The rounded *fundus* projects beyond the free border of the liver, the margin of which in this situation presents a more or less distinct notch—*the cystic notch*—and comes into contact with the anterior abdominal wall, close to the anterior extremity of the ninth or tenth costal cartilage (Fig. 3). Practically, the fundus of the gall-bladder lies immediately below the point where the outer edge of the rectus abdominis muscle crosses the costal margin.

The *body* of the gall-bladder presents two aspects,

a superior and an inferior. The superior surface is in contact with the cystic fossa.

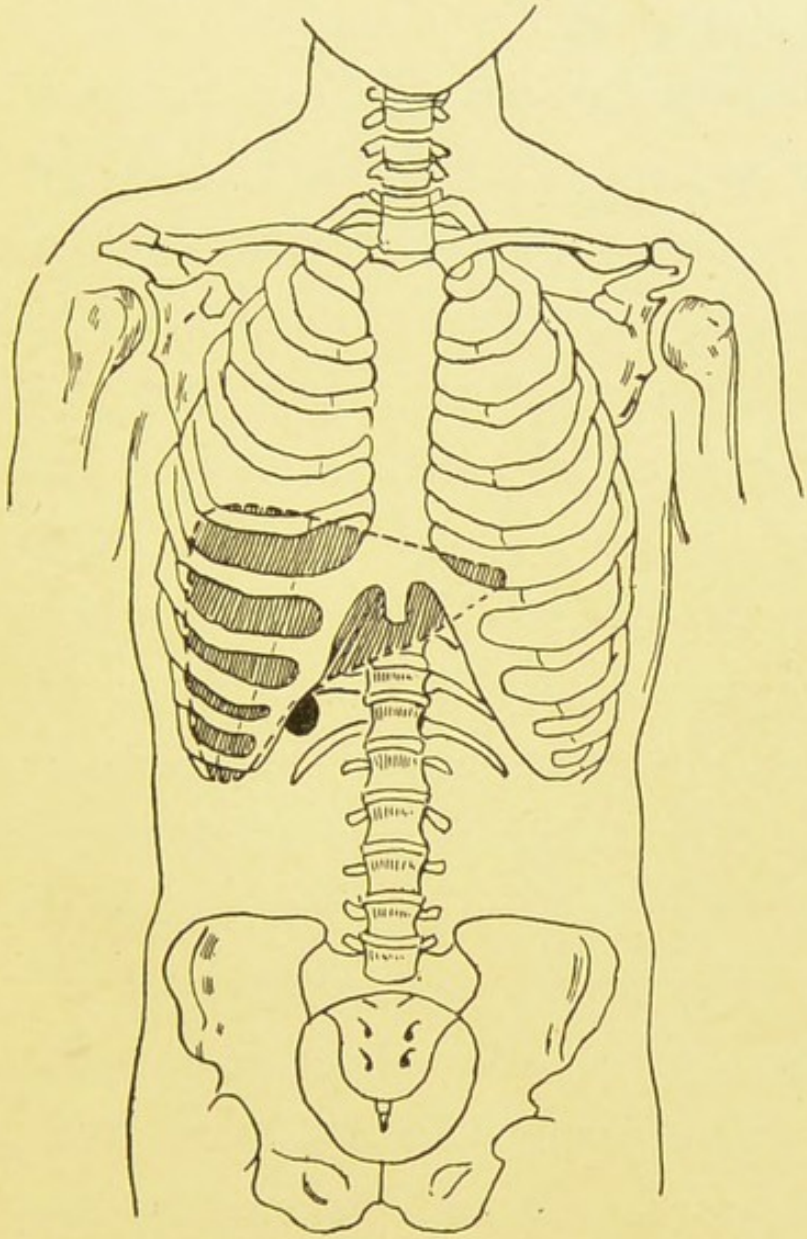


FIG. 3.—Diagram showing the relation of the gall-bladder to the surface.

The lower surface lies in contact with the second part of the duodenum and with the transverse colon.

Its relations, however, vary considerably according to the state of distension of the organ. It may be pushed upwards and lie in contact with the first part of the duodenum, with the pylorus, or with the anterior surface of the stomach; or it may be displaced downwards and lie in contact with the ascending colon or the anterior surface of the right kidney. Occasionally a fold of peritoneum connects the body of the gall-bladder to the anterior aspect of the transverse colon.

The *neck* of the gall-bladder is the narrowest part of the organ. It is bent into the shape of the letter S, and maintained in this position by loose connective tissue and by the peritoneum which covers it. Internally, two inflections give rise to the formation of two valves of mucous membrane, the lower of which separates the gall-bladder from the cystic duct.

The wall of the gall-bladder is composed of three layers: a serous coat, a fibro-muscular coat, and a mucous membrane.

The serous covering is continuous with the peritoneum, covering the under surface of the liver. It covers all that portion of the gall-bladder which is

not in contact with the cystic fossa. The fundus of the gall-bladder is completely covered by peritoneum, and its upper surface, unlike the body of the organ, is not in direct contact with the surface of the liver. It is separated by a double serous fold, the angle of which is formed by the reflection of the peritoneum from the margin of the liver on to the fundus of the gall-bladder.

Occasionally the gall-bladder is completely invested by peritoneum, there being on the upper aspect a distinct mesentery, which allows more or less free movement. A much more common condition found on the operating-table is the presence of a mesentery, not reaching the fundus, but extending to the lower third or half of the gall-bladder.

The fibro-muscular coat is composed of fibrous tissue, with an internal covering of irregularly disposed muscular tissue, the fibres of which run, some transversely, some longitudinally, and some obliquely.

The mucous membrane covers the whole of the internal aspect, and is continuous at the neck of the organ with the mucous membrane lining the cystic

duct. When the organ is empty it is thrown into numerous folds, which become effaced on distension. In addition to the temporary folds there are permanent ridges, which divide the mucous membrane into triangular, quadrangular, or polygonal areas. It possesses a fibrous and an epithelial stratum, the latter being formed by a single layer of cylindrical cells.

The mucous membrane of the gall-bladder is richly studded with glands resembling those found in the biliary ducts. They are lined with cells similar in every respect to those of the intervening mucous membrane, and secrete mucus.

Obstruction of the cystic duct, while it probably, to a certain extent, interferes with this function, does not entirely do away with it; hence in mechanical obstruction it is common to have the gall-bladder distended to a varying extent with clear, translucent, glairy fluid. The usual capacity of the cyst is said to be about 6 drachms, but it is not infrequently distended so as to hold over a pint of fluid, while several cases are on record of tumours due to dilated gall-bladders reaching such dimensions as to have

been operated on by surgeons under the impression that they were ordinary ovarian tumours. When moderately distended, it is usually to be felt in the direction of a line drawn from the ninth or tenth costal cartilage, and passing somewhat to the right of the umbilicus; but this position may be altered, from an unusual size of the left lobe, or other structural variations of the liver, so that it may even project into the right lumbar region. On the other hand, especially where there have been repeated attacks of gall-stone colic extending over a long period, it is more usual to find the gall-bladder smaller than normal, and occupying a position just in front of the transverse fissure of the liver. So far may this contraction go that there may be almost complete obliteration of the sac. In these cases there is not infrequently increased difficulty in recognising the true relation of the parts, from the adhesions of some of the surrounding organs by more or less intimate bonds to the gall-bladder and liver, so as completely to hide the gall-bladder from view when the peritoneal cavity is opened.

With cirrhosis of the liver the gall-bladder is

carried up well under the ribs, while, if the liver is enlarged from any cause, or displaced downwards by emphysema of the lungs, the gall-bladder will be pushed to a lower level. We have seen it in the cæcal region, and even in the pelvis.

In a few cases there has been noted congenital absence of the gall-bladder, and in these the hepatic duct and its subdivisions in the liver have been found dilated.

The blood supply of the gall-bladder is derived from the cystic artery, a branch of the right division of the hepatic artery. This vessel runs by the side of the cystic duct to the neck of the gall-bladder, and there divides into two branches, an internal and an external, which run on either side of the viscus to the fundus. In addition, the gall-bladder receives some very fine branches, which come directly from the liver.

The cystic veins enter the right branch of the portal vein. The nerve supply is derived from the cœliac plexus of the sympathetic.

The common bile duct is formed by the junction of the cystic duct with the hepatic duct. Commenc-

ing at the transverse fissure of the liver, it runs from above downwards and a little to the left, between the layers of the lesser omentum, and in front of the foramen of Winslow. After coursing behind the first part of the duodenum to the upper border of the head of the pancreas, it turns to the right and passes forward, within the pancreas, to the postero-internal aspect of the second part of the duodenum, into which it opens. The canal in its entirety describes a curve with the concavity to the right. It varies in length from 60 to 80 millimetres, while its diameter, which is very variable, is usually a little greater than that of the hepatic duct. According to Quenu, an average of the circumference in twenty subjects gave 13 millimetres. The common duct is, however, very extensile, as also are all the biliary ducts, and in cases of calculus and malignant obstruction may dilate to a very considerable size, equalling in calibre the small, or even the large, intestine. It is not at all unusual for the common duct to be sufficiently dilated to permit a gall-stone half an inch or more in diameter to "float" in it, and stones quite as large as that have been at

times extracted from the cystic duct. More rarely the hepatic duct also is enlarged sufficiently to admit the finger.

The relations of the common bile duct are of

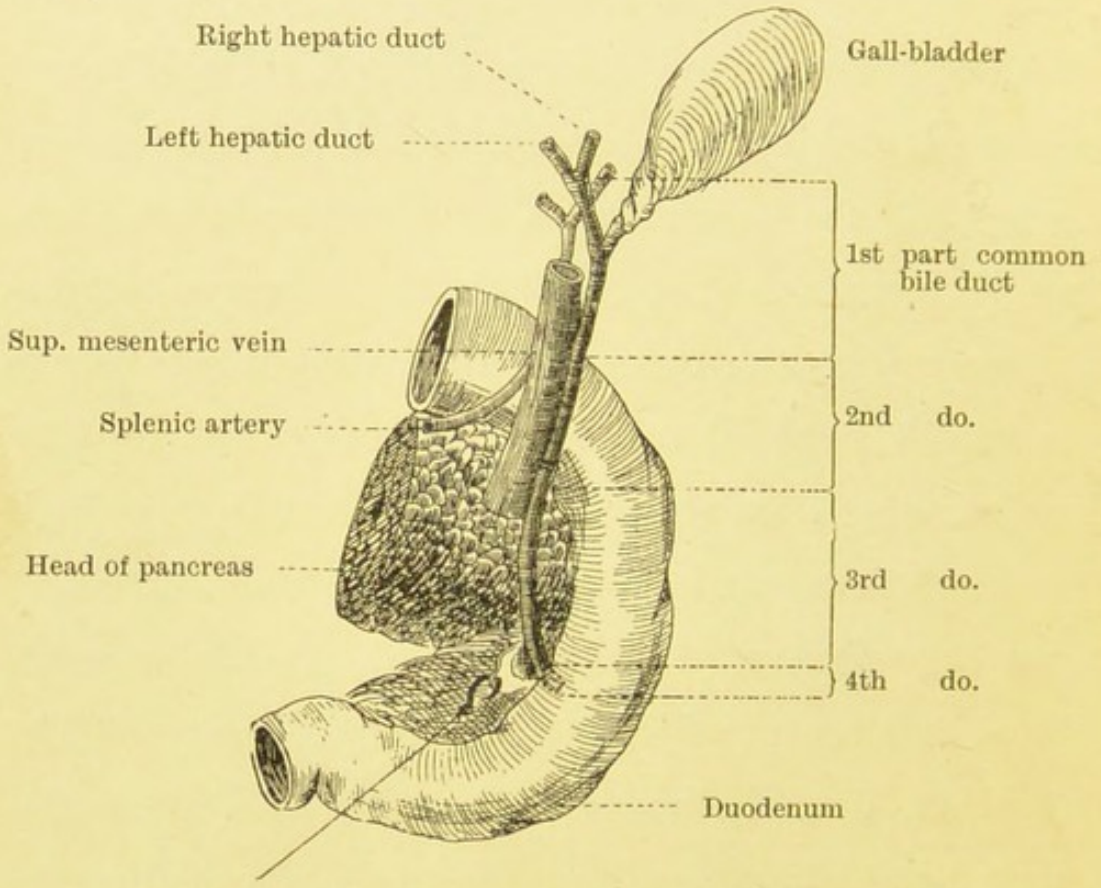


FIG. 4.—Diagram of the head of the pancreas and duodenum from behind, showing the relation of the common bile duct to the head of the pancreas, part of which has been reflected. (After Testut.)

extreme importance, as we shall show when we come to consider the etiological connection of diseases of the pancreas with affections of the common duct, and

the various operations which are performed for the relief of obstruction in the duct. The duct may be divided into four parts (Fig. 4)—

1. The supraduodenal.
2. The retroduodenal.
3. The pancreatic.
4. The intraparietal.

1. The *supraduodenal* portion measures from 10 to 14 millimetres in length, though it may be shorter or longer, according to the point of junction of the hepatic and cystic ducts. It runs in the free border of the gastro-hepatic omentum, immediately in front of the foramen of Winslow (Fig. 5). Here it lies on the antero-external aspect of the portal vein, while the hepatic artery is to its inner side. A small branch of the pancreatico-duodenal artery crosses this part of the duct just above the duodenum. A chain of three or four lymphatic glands lies in contact with the supraduodenal portion of the common bile duct, their vessels passing to the glands in the transverse fissure of the liver.

2. The *retroduodenal* portion corresponds to the posterior aspect of the first part of the duodenum, to

the wall of which it is closely applied. The portal vein lies to its inner side, while behind it is the inferior vena cava.

3. The *pancreatic* portion is the name applied to that section of the common bile duct which extends

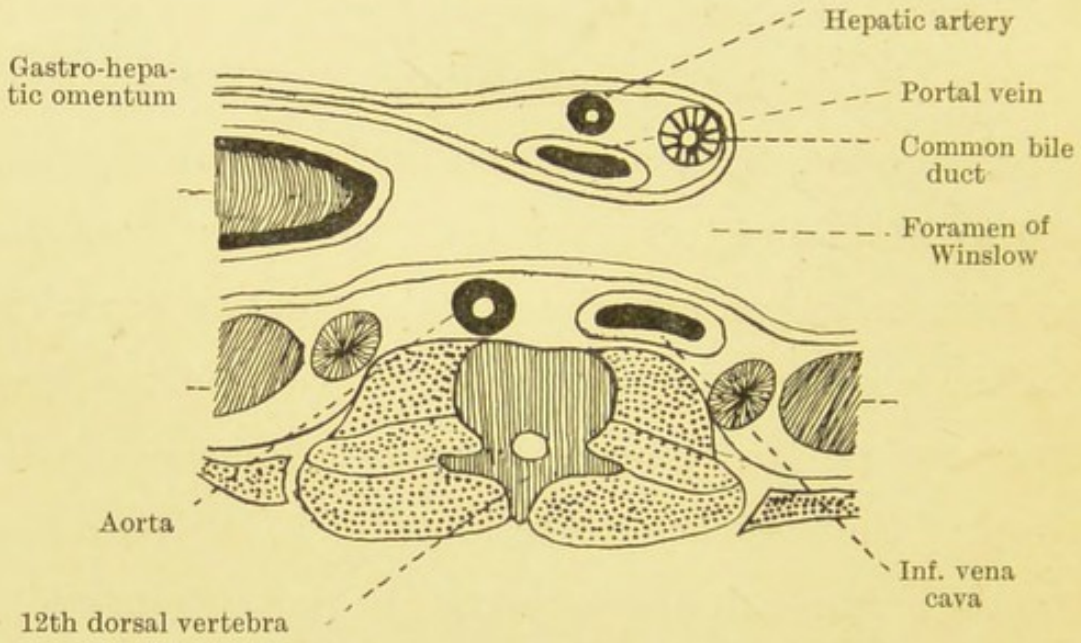


FIG. 5.—Relation of the structures in the gastro-hepatic omentum. Viewed from above.

from the inferior border of the first part of the duodenum to the point where the duct penetrates the wall of the second part; it measures from 20 to 25 millimetres in length. This portion of the common duct crosses a small quadrilateral area, bounded above by the inferior border of the first part of the duodenum, below by the superior border of the third

part, externally by the internal border of the second part, and internally by the superior mesenteric vein.[1] It is here closely applied to the pancreas, lying in a groove in the posterior surface of the gland in some 32 per cent. of cases, while in the remaining 68 per cent. it is completely surrounded by pancreatic tissue. These anatomical relations are of considerable importance, since swelling of the pancreas will in the former cases push the common duct out of the way without compressing it, whereas in the latter compression leading to occlusion may occur. This portion of the common duct is in close relation to the inferior vena cava.

4. The *intraparietal*, or *interstitial, portion* of the common duct comprises that section of the canal which is contained in the thickness of the wall of the duodenum. It passes obliquely through the muscular coat of the intestine, and then dilates into a little reservoir underneath the mucous membrane, into which the main pancreatic duct also opens. This cavity is known as the ampulla of Vater. The opening of the common duct is above that of the

[1] Quenu, *Revue de Chirurgie*, 1895.

pancreatic duct, and the two are separated by a small transverse fold of mucous membrane. The ampulla, with the termination of the two ducts, is surrounded by a thin layer of unstriped muscular tissue, forming a sphincter (Oddi). The ampulla opens into the duodenum by a little round or elliptical orifice, which is the narrowest part of the bile channel. It is important to note that the length of the diverticulum of Vater may vary from zero to 11 millimetres, the average being 3·9 millimetres, according to Opie, who measured 100 specimens. It is from 4 to 5 millimetres in breadth. Viewed from the interior of the duodenum, the ampulla forms a rounded eminence of the mucous membrane, known as the caruncula major of Santorini, the opening being seen at the apex of the caruncle. It lies about 8 to 12 centimetres from the pylorus. Above it there is constantly found a small transverse fold of mucous membrane, which must be raised in order that the caruncle and its orifice may be clearly seen. Running downwards from the caruncle is a small vertical fold of mucous membrane known as the frenum carunculæ. Above the caruncula major is found a smaller eminence, the caruncula minor,

marking the termination of the accessory pancreatic duct. The accessory pancreatic duct, or duct of Santorini, opens into the duodenum about three-quarters of an inch above the biliary papilla. According to Opie,[1] this duct is always present, and anastomosis with the main pancreatic duct, or duct of Wirsung, within the pancreas in about 90 per cent. of cases. Its orifice is, however, obliterated or markedly constricted in more than half the cases, so that it cannot assume the function of the duct of Wirsung when this is occluded, as it may be by the pressure of gall-stone in the ampulla of Vater, in some 50 per cent. of these. Moreover, the duct of Santorini itself, even if patent and communicating with the duodenum, may be compressed by a moderate sized gall-stone in its passage through the pancreatic portion of the common bile duct.

The mode of formation of the ampulla of Vater and the termination of the common and pancreatic ducts are liable to great variations. Letulle and Nattan Lorrier distinguish four types.

The first type is the classical one described above.

[1] *Diseases of the Pancreas*, 1903, p. 29.

In the *second type* the pancreatic duct joins the common duct some little distance from the duodenum; the ampulla of Vater is absent, and the duct opens into the duodenum by a small, flat, oval orifice (Fig. 6).

In the *third type* the two ducts open into a small

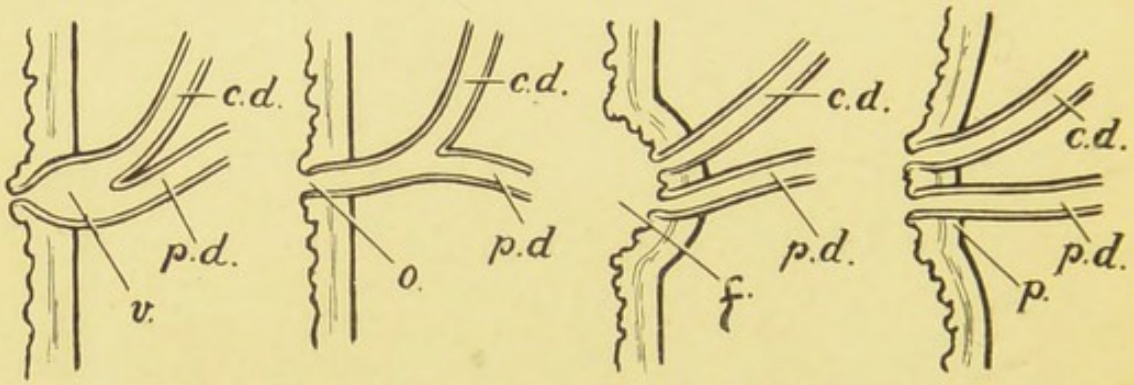


FIG. 6.—Diagram of the four methods by which the common bile duct and duct of Wirsung enter the duodenum.

c.d. Common bile duct.
p.d. Pancreatic duct (duct of Wirsung).
v. Ampulla of Vater.
o. Common orifice.
f. Cup-shaped depression in the wall of the duodenum.
p. Papilla.

fossa in the wall of the duodenum, while the caruncle and the ampulla of Vater are both absent (Fig. 6).

In the *fourth type* the caruncle is well developed, but the ampulla of Vater is absent, the two ducts opening side by side at the apex of the caruncle (Fig. 6).

In structure the common duct resembles the other biliary ducts, its blood supply and innervation being the same as those of the hepatic duct.

Congenital malformations. — There is apparently no part of the biliary apparatus, except the liver, which may not be absent. While this is not to be wondered at in the case of the gall-bladder and cystic duct—since they are normally wanting in certain animals, such as the horse, ass, deer, and certain birds, and are frequently obliterated by disease in the human subject — it affords serious food for thought to find that life has been possible for six months where even the hepatic and common ducts were represented by mere fibrous

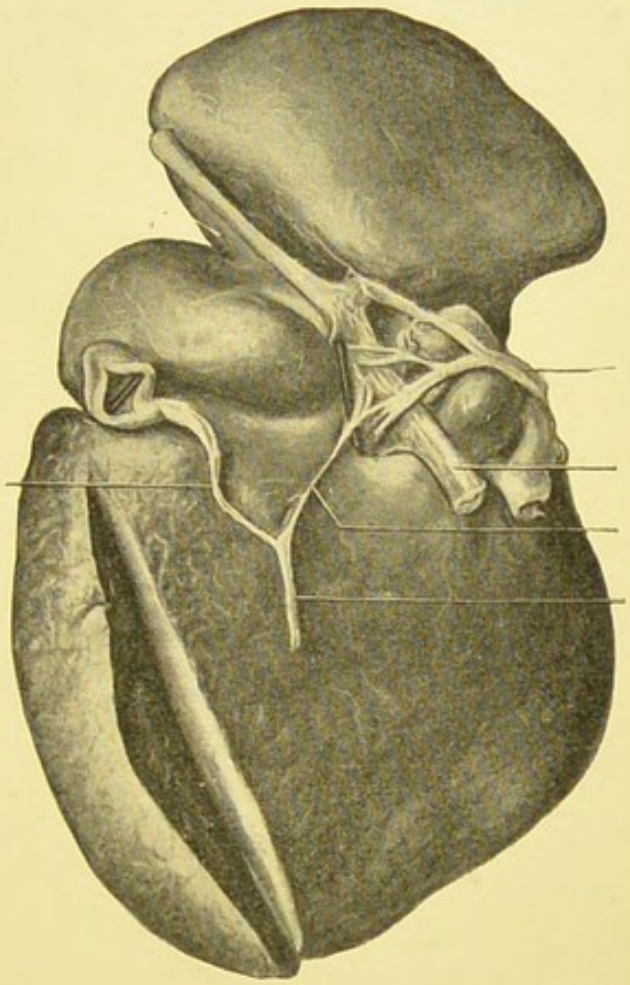


FIG. 7.—Congenital obliteration of the bile ducts with shrunken gall-bladder. (St. Mary's Hospital.)

cords, as in Specimen No. 973 in St. Mary's (see Fig. 7), and No. 1017 in King's College Museums.

Hourglass-shaped gall-bladder is probably not uncommon, and a vertical division of the fundus is sometimes met with. This may even extend to the whole viscus, and give rise to two gall-bladders each with a separate cystic duct (Purser).

Occasionally the distal part of the gall-bladder contains calculi, and communicates by a narrow neck with the cyst proper, or the distal portion may simply contain mucus, and the proximal sac one or more calculi. In some instances the condition arises from contraction of an old ulcer, but in others, the mucous membrane being smooth, and showing no evidence of cicatrisation, the deformity appears to have been congenital.

A curious malformation is seen in Specimen No. 1391 in Guy's Museum, in which the gall-bladder is dilated and turned to the left, forming an ovoid tumour 3 inches long, parallel with and projecting beyond the anterior edge of the liver.

In the *Annals of Surgery* for May 1899, is related a case in which there was transposition of viscera;

and as the patient was the subject of gall-stones, cholecystotomy was successfully performed on the left side.

In palpating the common duct for gall-stones, the surgeon frequently feels several more or less hard nodules within the free border of the lesser omentum, by the side or in front of the common duct, and unless it be borne in mind that three or four lymphatic glands normally exist here, they may be apt to mislead, especially as they are not unusually considerably enlarged where there is gall-stone irritation. Frequently they are as large as beans, and at times the size of filberts.

The large peritoneal pouch, bounded above by the right lobe of the liver, below by the ascending layer of the transverse mesocolon covering the duodenum internally, externally by the peritoneum lining the parieties down to the crest of the ilium, posteriorly by the ascending mesocolon covering the kidney, and internally by the peritoneum covering the spine, has been long recognised, but was not sufficiently appreciated in gall-bladder surgery, until Mr. Rutherford Morrison's paper appeared. It is possible to drain

this pouch satisfactorily by means of a long glass tube, but it is safer to make use of a lumbar drain. It is interesting to note that the pouch is capable of holding nearly a pint of fluid before it overflows into the general peritoneal cavity through the foramen of Winslow or over the pelvic brim.

A deformity of the liver, congenital or acquired, known as the linguiform process, may at times lead to a difficulty in diagnosis or in treatment. The common form is a tongue-shaped prolongation of the right lobe, which may project below the costal margin for several inches, and simulate a tumour of the liver or an enlarged gall-bladder.

One form of the enlargement shown in Cruveilhier's *Atlas* is supposed to have been due to tight-lacing; it was associated with dropsy of the gall-bladder and gall-stones.

In some instances the gall-bladder projects beyond the apex of the linguiform projection, in others the dilated gall-bladder lies under cover of the projecting lobe, which is thin and spread out over it.

In a case operated on by one of us, the gall-bladder and linguiform process of the liver reached the cæcal

region, and the recurrent attacks of pain, associated

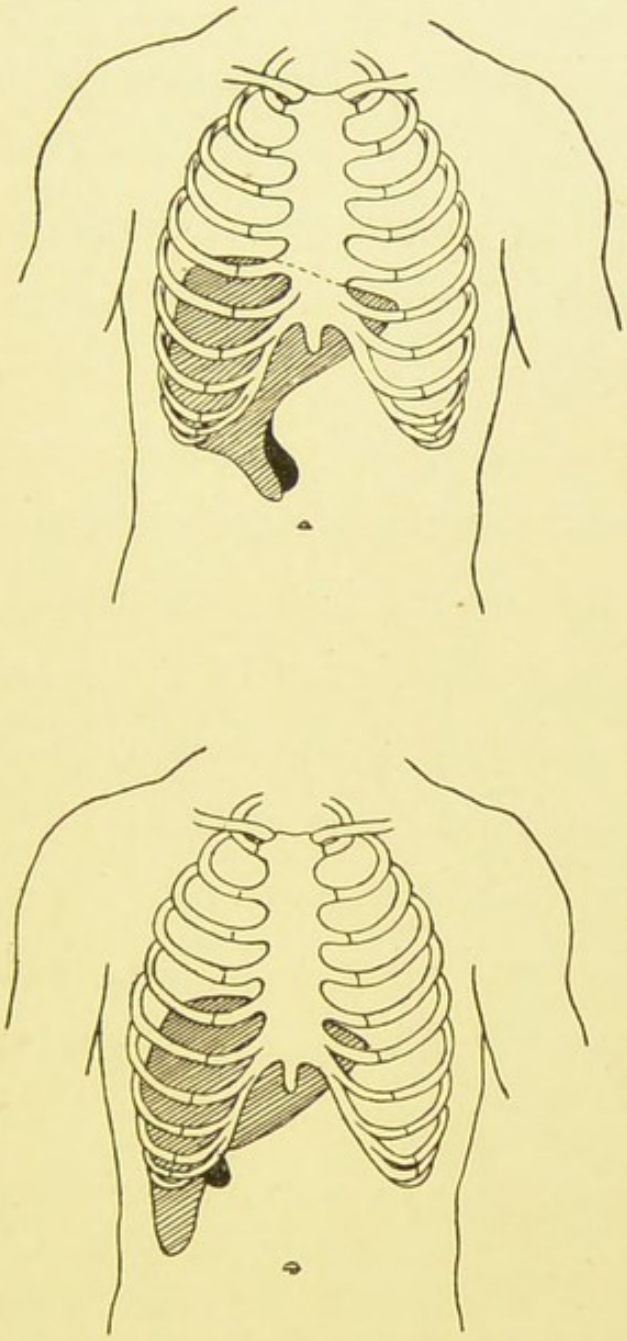


FIG. 8.—Linguiform process of the liver.

with local peritonitis and unaccompanied by jaundice, much resembled recurring appendicitis, the point of

greatest tenderness being situated midway between the umbilicus and anterior superior spine of the ilium, in which position the incision for the operation was made.

In others, the projection is external to the gall-bladder, which is then found lying on its inner side (Fig. 8).

In a case of this kind, where the gall-bladder is contracted, and calculi are impacted in the cystic duct, there may be the greatest difficulty in extracting them, owing to a limitation of the space for manipulation, caused by the abnormality, unless the liver be lifted up as described on p. 252.

We believe that Professor Riedel first described this linguiform projection of the liver, which is sometimes known as Riedel's lobe. It is said to be uniformly due to cholelithiasis, but that it is not always associated with gall-stones our experience in several cases demonstrates.

The liver is sometimes displaced vertically. The incision has then to be prolonged quite up to the ensiform cartilage, in order to reach the shrunken gall-bladder, lying under cover of the right lobe.

In one such case the left lobe was much smaller than the right, which formed the great bulk of the liver; while in another the left lobe was apparently wanting, and the gall-bladder was deeply placed under the right lobe, which faced to the left.

There have been several cases reported where the distended gall-bladder projected into the loin, and was reached and evacuated through a lumbar incision, the condition of liver just described being the probable cause of the distortion.

CHAPTER II

CHARACTERS AND COMPOSITION OF BILE

BILE is a mixture of the secretion of the liver cells with a certain proportion of so-called "mucus" derived from the glands of the biliary passages and mucous membrane of the gall-bladder. Although it is being constantly secreted by the liver cells, at a varying rate depending upon the metabolic activity of the body, it does not at once find its way into the intestine, but, in the intervals between meals, is stored in the gall-bladder. When the acid contents of the stomach come in contact with the mucous membrane of the duodenum, there is a slow contraction of the gall-bladder, which gradually empties its contents into the common duct and intestine ; at the same time there is an increased secretion of bile by the liver. The exact mechanism by which the contraction of the gall-bladder is brought about is

not understood, but it is generally supposed to be a reflex nervous act set in motion by the contact of the acid chyme with the duodenal mucous membrane, and transmitted to the muscles of the gall-bladder by the vagus, which contains the motor nerves, and sympathetic, which contains the relaxing fibres. The increased secretion of bile by the liver appears to be due to the same cause as the flow of pancreatic juice that simultaneously occurs, namely, a stimulation of the secreting cells by "secretin," carried by the blood, and formed from the mucous membrane of the intestine by the acid stomach contents in their passage along the gut. The flow of bile into the intestine begins almost immediately after food has been taken, and attains a maximum about three to five hours later. The quantity discharged, like that of the pancreatic juice to which it runs parallel, varies with the different classes of food stuffs, the difference appearing to depend upon the acidity of the chyme, its content of oil, and its rate of discharge into the intestine; thus a meal of proteid induces a larger flow than one consisting largely of fat, while carbohydrates excite but a comparatively small flow.

The total daily excretion varies in different animals and under different conditions. In some experiments carried out by one of us in 1889 [1] it was found that, in a person of average weight, from 39 ounces 4 drachms to 25 ounces 6 drachms, with an average of 30 ounces, was collected from a biliary fistula in the course of twenty-four hours; subtracting from this the 2½ ounces of fluid secreted daily by the gall-bladder, as found by observations on another case, an average of 27½ ounces of bile is obtained. It was also found that more bile is excreted during the day than in the night, the difference varying between 5 ounces and 3 drachms. The amount of fluid consumed does not appear to exert any influence upon the quantity of bile excreted.

Observations made at the same time on the *effect of drugs* on the bile flow gave results at variance with the then accepted views as to the action of medicines on this function of the liver. Euonymin, rhubarb, podophyllin, and benzoate of soda were found to produce no noticeable alteration in either the rate or quantity of the secretion; iridin caused a temporary

[1] *Proceedings of the Royal Society*, xlvii.

increase in the flow, without, however, augmenting the total daily excretion; while calomel brought about an actual diminution. Sodium salicylate and aspirin are said to increase the output of bile, and the administration of bile or bile acids by the mouth undoubtedly does so; but with regard to the latter the increase is probably to be explained chiefly by the excretion of that portion of the ingested bile which has been absorbed from the intestine. The excretion of bile pigments is increased by any agency which brings about an abnormal destruction of red blood corpuscles, since it is from the hæmoglobin of these that the bile pigments are derived. The pressure under which the bile is excreted is very low, not exceeding 16 to 24 millimetres of mercury, so that its flow is prevented and jaundice induced by a very slight obstruction. Contraction of the abdominal muscles and diaphragm, by compressing the liver between them, is believed to raise the pressure within the ducts, and for that reason various exercises, and particularly horse exercise, have been advised as a therapeutic measure in "torpid liver," etc.

The physical characters and chemical composition of bile vary in different animals and in some individuals. As secreted by the liver cells it is a clear limpid fluid, with a specific gravity of about 1·010. Owing to the absorption of water in the gall-bladder and the addition of "mucus" and epithelial cells, it there becomes viscid and cloudy, and its specific gravity rises to 1·030 or 1·040, the exact figure depending upon the length of its stay. Fresh bile taken during life is golden yellow in man, but becomes green on exposure to the air, and is normally that colour in herbivorous animals. After death human bile also undergoes changes which may cause it to assume a brown or green tint. It has a bitter, followed by a sweet, taste. It is alkaline to litmus, corresponding on the average to 0·2 per thousand of sodium carbonate and alkaline sodium phosphate. The following analyses show the composition of the bile flowing from a biliary fistula, and the fluid secreted by the gall-bladder, respectively: —

Analysis of bile drawn from biliary fistula (Mrs. V. B.), collected April 13, 10 a.m. to 10 p.m., and April 13 to 14, 10 p.m. to 10 a.m., 1889.

Columns I., II., III. refer to the whole bile and gall-bladder fluid: Column I., first twelve hours; Column II., second twelve hours; and Column III., the whole fluid collected during twenty-four hours. Column IV. gives the composition of the bile calculated without the gall-bladder fluid.

	I. 12 Hours, 10 a.m. to 10 p.m., April 13.	II. 12 Hours, 10 p.m. to 10 a.m., April 13–14.	III. 24 Hours, April 13–14.	IV. 24 Hours, corrected for Gall-bladder Fluid.
Quantity	570 c.c.	370 c.c.	940 c.c.	868 c.c.
Specific gravity	1·0085	1·0090	1·0087	1·0086
Reaction	Alkaline.			
The bile contains in 1000 parts—				
Water	982·10	981·79	981·98	981·76
Total solids	17·90	18·21	18·02	18·24
	1000·00	1000·00	1000·00	1000·00
The solid matter of the bile contains—				
Cholesterine	0·44	0·45	0·45	0·45
Fatty matter (free)	0·11	0·12	0·12	0·12
Fat combined (chiefly sodium stearate)	0·90	1·08	0·97	0·97
Sodium glycocholate	7·45	7·60	7·51	7·51
Sulphur equal to sodium taurocholate	0·087	0·094	0·09	0·09
Organic substances precipitated by alcohol, chiefly mucus and epithelium	1·31	1·29	1·30	0·85
Chlorides equal to sodium chloride	5·08	4·91	5·01	4·95

	I. 12 Hours, 10 a.m. to 10 p.m., April 13.	II. 12 Hours, 10 p.m. to 10 a.m.. April 13–14.	III. 24 Hours, April 13–14.	IV. 24 Hours, corrected for Gall-bladder Fluid.
Carbonates and phosphates of sodium, potassium, lime, magnesia, and iron . .	2·52	2·66	2·57	2·54
Copper	...	minute trace	...	trace
Silica	...	trace	...	trace
Sulphates, Urea, Sugar	...	none	...	none

The solid matter of the bile gave on ignition—

Ash, per 1000 parts . . .	8·15	8·68	8·36	8·34

Analysis of fluid from the gall-bladder (collected during twenty-four hours. Mrs. A.)—

Quantity	72 c.c.
Specific gravity	1·0095
Reaction	Alkaline.

The fluid contains in 1000 parts—

Water	984·64
Total solids	15·36

The solid matter contains—

Organic matter, chiefly "mucin," with trace of albumin . .	6·72
Chlorides equal to sodium chloride	5·73
Sodium carbonate	2·20
Other salts, containing phosphates, potassium salts, etc. . .	0·71

The chief constituents of bile are—1. bile acids combined with alkalies, and 2. bile pigments; in

addition there are—3. traces of lecithin, cholesterin, soaps and neutral fats; 4. mineral salts, including chlorides, and phosphates of calcium, magnesium, and iron, with sometimes traces of copper, arsenic, etc. Human bile contains traces of true mucin, but the viscid substance in ox bile is mainly nucleo-albumin. No coagulable proteids are present in the healthy secretion.

1. *Bile acids.*—From 1 to 2 per cent. of bile acids are present in the bile. They consist of combinations of cholic, or cholalic, acid with glycocoll and taurine, forming respectively glycocholic and taurocholic acids. In human bile an acid called fellic acid has also been described. The acids occur as alkaline salts, chiefly of sodium. The relative amounts of the bile acids vary in different animals, the bile of carnivora containing a high proportion of taurocholate of sodium, while in herbivora the glycocholate forms the greater part. In human bile there is between six and seven times as much glycocholate as taurocholate. The ultimate source of the bile salts is unknown, but they are not purely an excretion, like the other consituents of the bile, for, although some

30 to 40 per cent. appears in the fæces, the greater part is reabsorbed from the intestine, and, after circulating in the body, is again excreted in the bile. Their chief function is to assist in keeping in solution the otherwise insoluble cholesterin and lecithin of the bile, so that the arrangement by which the greater part is reabsorbed from the intestine is an economical one. They are also believed to aid digestion by assisting in the absorption of fats, and by dissolving the insoluble soaps of the alkaline earths, and, since semi-digested proteids in acid solution are precipitated by bile acids, it has been suggested that they may aid intestinal digestion by causing a precipitation of native proteids on the walls of the intestine, where they can be subjected for a longer time to the action of the intestinal ferments than they would if they remained in solution.

There is considerable divergence of opinion as to the toxic action of bile salts. They undoubtedly produce a slowing of the heart beat. This is generally attributed to a direct action upon the heart muscle and cardiac ganglia, but more recent observations suggest that an inhibitory action on the vagus

also plays an important part. The large soft dicrotic pulse met with in jaundice is probably to be ascribed to a paralytic effect of the bile salts on the blood vessels. Numerous experiments have been made upon the effects of bile salts on the nervous system, and while it is likely that the slighter nervous phenomena of jaundice, such as headache and general prostration, etc., are to be attributed to their action, the more serious complications of delirium, convulsions, and coma probably arise from bacterial poisons, or toxic substances of unknown composition, circulating in the blood. Although anæmia is not a feature of even the most marked cases of uncomplicated obstructive jaundice, it is usually stated that the bile salts produce an excessive destruction of red blood cells in jaundice. There is good evidence, however, to think that the bile salts never exist in the blood in jaundice in sufficient concentration to exert a destructive action on the red cells, and that the liver cells quickly lose their power of forming them, even in normal amounts, in such cases. The lengthened coagulation time of the blood, and inclination to hæmorrhage met with in some cases of jaundice,

have been attributed to the action of bile acids, but our own observations suggest that it is more probably due to the associated disease of the pancreas met with in so many instances.

2. *Bile pigments.*—The colour of human bile is due largely to bilirubin. This on oxidation passes into biliverdin, which, by a process of reduction, may be again converted into bilirubin. Putrefaction also readily brings about a reduction of the bile pigments. The exact colour of the bile, therefore, varies according to the conditions under which it is placed. In the intestine bilirubin is converted by the action of micro-organisms into urobilin (stercobilin), so that unchanged bile pigments do not occur in the fæces, unless the intestinal contents have been hurried through the gut before this reduction has had time to take place. Owing to the absence of micro-organisms from the intestine of newly-born infants, the meconium contains no urobilin.

Chemically, bilirubin and biliverdin have the characters of weak acids, combining with bases to form salt-like bodies. Their combinations with alkalies are soluble in water, but with the alkaline

earths they form insoluble compounds. The latter form the bulk of red gall-stones, and a combination of calcium with bilirubin is a common constituent of ordinary biliary calculi. Nothing is known of the exact chemical constitution of the bile pigments, and very little of the intermediate stages in their production. They are undoubtedly derived in the first instance from the hæmoglobin of the blood. It is believed that this is split up by the liver cells into hæmatin and a proteid, the hæmatin then loses its iron, which is retained in the liver, and the iron-free hæmatoidin forms bilirubin, with which it is nearly, if not quite, identical.

The phenomena of jaundice that have been attributed to the bile pigments are the yellow coloration and dryness of the skin, the itching, and the occurrence of yellow vision, or xanthopsia. The typical yellow colour of the skin and conjunctivæ met with in jaundice is undoubtedly due to the deposits of bilirubin, and the slaty-green pigmentation of the skin, seen in icterus gravis, arises from oxidation of this pigment to biliverdin, but it is questionable whether the itching is the direct result of the deposit

of bile pigment. The clinical fact that yellow vision may occur when the jaundice is slight, and be absent when it is profound, casts doubt on the explanation which would ascribe it to impregnation of the retina and ocular media with bile pigments.

3. *Cholesterin* is a monatomic alcohol, with the formula $C_{26}H_{43}OH$. It is usually present in the bile of the gall-bladder in a proportion ranging from 0·5 to 5 per cent. It is insoluble in water or dilute saline solution, and is held in solution in the bile by the bile salts, in solutions of which it is readily soluble. When the amount of bile salt present is insufficient, it is deposited on any particle of foreign matter in the bile, and so gives rise to one variety of gall-stone. Cholesterin is a constituent of all or nearly all animal cells, being formed as a cleavage product in their metabolism. It is found in the largest quantities in the myelin of the nerve fibres and in the blood corpuscles. It was consequently believed at one time that the cholesterin in bile was derived from the nerve tissues of the body, but although this may be so to a slight extent, it is now generally admitted that its chief source is the cells lining the gall-bladder

and bile passages. When these are affected by catarrhal inflammatory processes, the quantity of cholesterin produced is in excess of that which the bile can hold in solution, and gall-stone formation is favoured. It has recently been stated by Aschoff that cholesterin occurs in the bile as a cholestryl ester, and that when this is absorbed by the mucous membrane of the biliary passages its fatty constituent passes into the lymphatics, while the cholesterin is returned to the bile. Cholesterin appears to be quite devoid of toxic properties.

4. *Calcium* is the most important mineral constituent of bile, for it may be found in combination with bile pigments in gall-stones. The quantity normally present is very small. It is probable that it is derived from the cells lining the biliary passages. The administration of lime salts is said not to increase the quantity of calcium salts in the bile, although some observers have maintained that food rich in lime predisposes to the formation of biliary calculi.

The functions of the bile in the intestine are chiefly to assist the digestive powers of the pancreatic juice, and aid in the absorption of fats. The fact that the

whole of the bile may escape from the body by an external fistula for several years without the health of the individual being materially affected, shows that its presence is not essential, however. Beyond weak amylolytic and slight lipolytic properties shared with many body fluids and extracts, bile possesses no direct digestive powers; it appears, however, to have the power of reinforcing both the amylolytic and proteolytic action of the pancreatic juice, which are said to be doubled by its presence. Its most important action lies in the function which it possesses, by reason of the bile acids it contains, of bringing into intimate contact the fats of the food with the fat-splitting ferment of the pancreas by diminishing the surface tension of the watery and oily contents of the intestine, and thus promoting their mixture. It also dissolves the resulting fatty acids and soaps, even those of calcium and magnesium, which are insoluble in water, and promotes their absorption by the intestinal mucous membrane.

Another function attributed to bile is the stimulation of the peristalsis of the intestine. This has been ascribed to the irritant action of the bile acids on the colon. Although experimental diversion of bile from

the intestine has been shown to be followed by constipation in dogs, we have found that regular action of the bowels occurs in patients in whom the whole of the bile is escaping by a biliary fistula.

The supposed antiseptic action of bile is unimportant, and whatever little antiseptic power it may possess is probably to be attributed to its admixture with the secretion of the gall-bladder. It acts, however, indirectly on putrefaction in the intestine by promoting fat absorption, for the presence of a large amount of fat in the intestine favours putrefactive changes. The unpleasant smell of the fæces noticed in cases of biliary obstruction is due partly to this cause, and partly to the presence of volatile fatty acids.

CHAPTER III

THE COMPOSITION AND FORMATION OF GALL-STONES

POST-MORTEM records on persons of all ages, and both sexes, prove gall-stones to be present in from 5 to 10 per cent. of all Europeans. In Strasburg the record is 12 per cent. (Schroeder), in Kiel 5 per cent., and in Manchester 4·4 per cent. (Brockbank); but as these statistics are taken from hospital patients, representing the working-classes, who are the least subject to gall-stones, the estimate is probably below the mark. In tropical countries gall-stones appear to be less common than in higher latitudes.[1] Morehead saw only four cases during many years' practice in India, Rufz did not meet with a single case in Martinique, and

[1] It has recently been shown that gall-stones are really more common in the tropics than in some European countries, 233 cases being found in 4544 post-mortems, or 5·37 per cent. (Leonard Rogers, *Ind. Med. Gaz.* xliii. No. 11, 1908).

Borchgrevink had the same experience in Madagascar. Pruner says that in Egypt they are rather more common in Europeans and Turks than in natives and

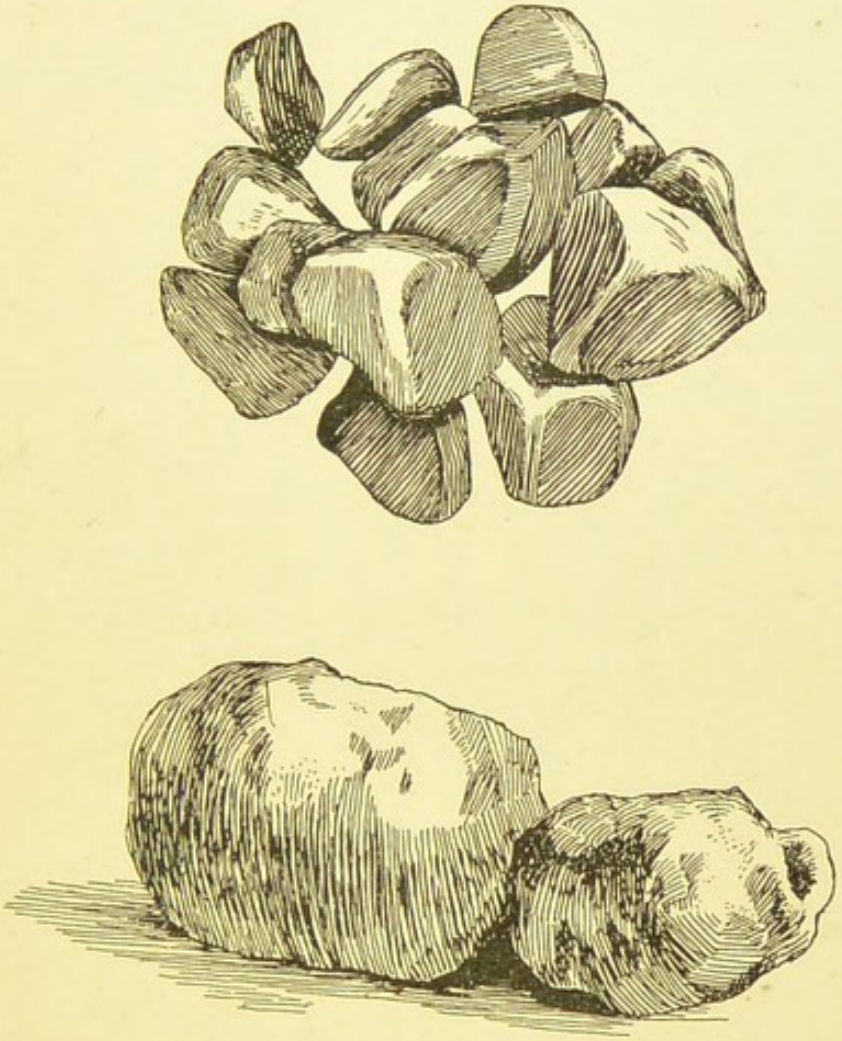


FIG. 9.—Types of gall-stones.

negroes, and Hartmann speaks of them as being very unusual in any class. Dr. Elliot Smith has recorded one case of gall-stones in a mummy of the New Empire.

Gall-stones may be spherical, oval, barrel-shaped (Fig. 9), elongated with pointed ends, or angular—the surface being smooth, mammilated, or irregularly faceted. When large they are often single, but when small or moderate in size are usually numerous, several

FIG. 10.—One hundred and forty-five gall-stones removed by cholecystotomy.

hundreds often being found (Fig. 10). For instance, in a case operated upon by one of us, 720 gall-stones were successfully removed from the gall-bladder and dilated cystic duct of a woman aged fifty-six, and cases are on record in which over a thousand gall-stones have

been removed. Dr. E. T. Davies has reported a

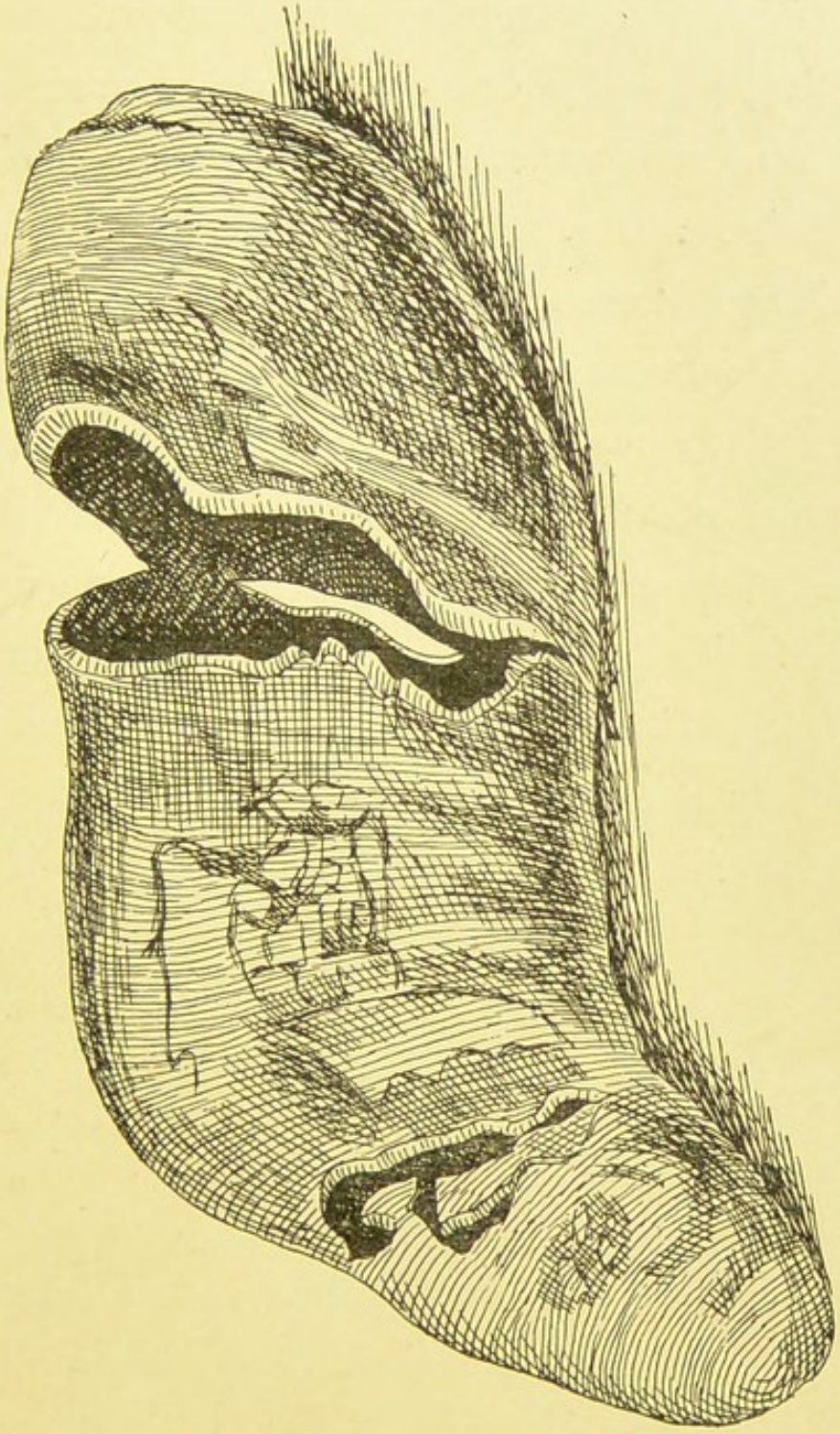


Fig. 11.—One of the largest gall-stones described. (Hutchinson's *Clinical Illustrations.*)

case in which 1754 were found in a woman aged

fifty-one.[1] and one of us recently removed 2300 bilirubin calculi from a female patient aged 27.

Gall-stones, which when small are spoken of as biliary sand, may vary in size from a concretion just perceptible to the naked eye up to a mass the size of a tennis ball, or even larger (Fig. 11). Richter has reported an enormous stone, weighing 3 ounces 5 drachms, lying in the common bile duct, with its thick end in the duodenum and its pointed extremity turned towards the neck of the gall-bladder; and Bartlett has recently described a case in which a biliary calculus, $2\frac{1}{2}$ ounces in weight, 4 inches long, and $1\frac{1}{2}$ inch broad, was successfully removed from the common duct. This stone was felt through the abdominal wall before operation.[2]

Their colour is variable; in some cases it is white or grey, in others dark brown or even black, but usually they are deep yellow or brown.

As a rule they are of firm consistency, but they can generally be fractured, without much difficulty, by pressure between the thumb and finger. They

[1] *Brit. Med. Journ.*, 1903, p. 201.

[2] *Ann. of Surgery*, Nov. 1908, p. 676.

may, however, be as hard as a uric acid calculus, or as soft as putty.

Gall-stones, like concretions occurring in other situations in the body, consist of a mixture of the constituents of the fluid in which they form. One or other of these constituents may, and often does, form the main bulk of the stone, so that it possesses particular physical and chemical properties, but they never consist of that one substance alone. Cholesterin is present in all gall-stones, and forms the greater part of most. Calcium salts of the bile pigments are also always present in greater or less amounts, and occasionally form the chief part of the stone. Inorganic salts of calcium, generally carbonates and phosphates, are usually present, while traces of fats, soaps, lecithin, mucus, and occasionally copper, iron, manganese, and even mercury, can be detected. For clinical purposes, however, gall-stones are classified according to their chief constituents, and the following groups described by Naunyn are generally recognised :—

1. "*Pure*" *cholesterin stones* (Fig. 12*c*).—These vary in colour from white to yellow, or more rarely brown or

greenish on the surface. They are oval or spherical, and are seldom faceted. They are translucent, and on section show a crystalline structure, but are not markedly stratified. The amount of cholesterin present is usually over 90, and may be as high as 98 per cent., but even the purest contain some pig-

a. *b.* *c.*

FIG. 12.—Types of gall-stones.

a. Section of common gall-bladder stone.
b. Bilirubin calcium stones.
c. Section of large cholesterin calculi.

ment, a nucleus, and a stroma, which go to make up the balance.

2. *Laminated cholesterin stones.*—These stones differ from the preceding in containing more calcium salts of the bile pigments, which are found in yellow, brown, or green layers, alternating with the white layers of cholesterin. The green portions consist of

calcium biliverdin, while the brown parts contain calcium bilirubin. Cholesterin, however, forms from about 75 to as much as 90 per cent. of the weight of the stone. A considerable amount of calcium carbonate is also usually present, especially in the green layers. In size and shape they resemble "pure" cholesterin calculi, but are often faceted.

3. *Common gall-bladder stones* (Fig. 12*a*).—As their name implies, these are the form usually met with in the gall-bladder. Their chemical composition differs but little from that of the preceding, but in structure they vary considerably. Externally there is a firm laminated non-crystalline crust which surrounds a softer pigmented nucleus, and this frequently contains a cavity filled with a yellow alkaline fluid. They vary considerably in size, shape, and colour, but are seldom larger than a cherry. The surface is generally yellow, but may be white or brown. They are usually distinctly faceted.

4. *Mixed bilirubin-calcium calculi.*—These stones are generally of large size and occur singly, but when present in groups are faceted. Their chief constituent is bilirubin calcium, but they always contain

much cholesterin, often 25 per cent. or more. A crystalline mass of cholesterin sometimes forms a nucleus round which the dark brown pigmented material is disposed in layers.

5. *"Pure" bilirubin-calcium calculi* (Fig. 12*b*.) Although bilirubin calcium is the chief constituent of these stones, there are always present in addition, biliverdin calcium, the more highly oxidised bilifuscin, and the still more highly oxidised bilihumin, the last-named occasionally forming over half their substance. There is always some cholesterin, although at times only traces can be detected. These calculi are always small, rarely larger than a pea, and occur in two distinct forms—

(*a*) A form of wax-like consistency, with rough, irregular surface, and of a brownish-black colour.

(*b*) A form that is hard and brittle, steel-grey or black in colour, and with a metallic lustre.

6. *Rarer forms.*—(a) *Amorphous and incompletely crystalline cholesterin gravel.*—These calculi have a nucleus of bilirubin calcium, surrounded by a coating of cholesterin, which gives them a pearly

lustre. They vary in size from a grain of sand to a pea.

(b) *Calcareous stones* consist chiefly of a mixture of calcium carbonate with bilirubin calcium. They are extremely rare in man, but are more common in cattle and other herbivorous animals.

(c) *Concretions with included bodies.*—Foreign bodies, such as ligatures, needles, plum-stones, or flukes, have been met with as the nucleus round which gall-stones have formed.

(d) *Casts of bile ducts* are rare and imperfectly formed in man, but are met with more frequently in cattle. They consist chiefly of bilirubin calcium.

Numerous theories have been advanced to explain the *formation of gall-stones*, and, owing to the very constant presence of cholesterin in biliary calculi, they have mainly resolved themselves into an attempt to account for its presence.

When it was discovered that normal bile contained a small proportion of cholesterin, and, while it was still believed that this was excreted by the liver, it was suggested that gall-stones arose from over-production or an excessive absorption of cholesterin.

The facts that the administration of cholesterin by the mouth, or even by subcutaneous injection, did not increase the quantity in the bile, and that this did not vary in disease, except when gall-stones were present, were, however, against such an explanation.

Stagnation of the bile was at one time believed to be the chief factor in gall-stone formation, but when it was shown that concentration alone caused no precipitation this theory also had to be abandoned.

A chemical explanation was advanced by Frerichs, Thudichum, and others. These observers found that cholesterin, bilirubin, and calcium salts were all soluble in alkaline solutions, especially of sodium glycocholate, and that concentration gave rise to no precipitate, but that the solution on undergoing decomposition, such as might occur in a stagnant secretion, gave a precipitate of cholesterin and bilirubin calcium, owing to the breaking down of the sodium glycocholate into glycocoll, cholalic acid, and a sodium salt. They therefore suggested that the presence of a large amount of bile salts and an alkaline reaction favoured the solution of cholesterin,

while a diminution of either caused its precipitation and the consequent formation of gall-stones.

Andy, on making a comparative analysis of liver bile and the contents of the gall-bladder after ligaturing the cystic duct, found in the latter a marked increase of calcium and diminution of sodium, and maintained that the excess of calcium brought about by stasis of the bile caused a precipitation of cholesterin and bilirubin calcium.

Beaumetz ascribed the formation of gall-stones to a desquamative cholangitis with stagnation of bile.

The most important advances were made, however, by Naunyn and his pupils, who reviewed the whole subject and advanced the theories which are now generally held. They showed that the cholesterin of the bile is neither a product of general metabolism nor a specific secretion of the liver, and, finding that the secretions from inflamed mucous membranes, such as the trachea and bronchi, contained as much, and often more, cholesterin than normal bile, suggested that the source of this substance in gall-stone formation was the desquamating and degenerating epithelium of the gall-bladder and bile ducts. The

large amount of cholesterin found in the contents of a gall-bladder shut off from the common duct, and the occurrence of gall-stones under these conditions, tended to support their contention. They therefore discarded the chemical theory, and maintained that, in cholangitis, the epithelial cell degeneration alone gave rise to the cholesterin and calcium salts. They believed that the calcium then combined with bilirubin to form a precipitate, the precipitation being favoured by the albuminous products of cell degeneration. On the nucleus thus formed, the cholesterin separated out partly on the surface and partly as an infiltration.

It is now considered that some injury of the mucous membrane of the biliary channels is the essential starting-point of gall-stone formation. Injury alone is, however, not of itself sufficient, some form of infection being also necessary, and it is to an infection of the bile ducts that the injury of the mucous membrane is also usually due. Cholesterin calculi introduced aseptically into the gall-bladder of dogs were found by Harley and Barratt to be slowly dissolved, but when the gall-bladder contents were at the same time infected with *B. coli* this did not occur.

The microbic origin of gall-stones was first suggested by Galippe, in 1886, who found bacteria in biliary calculi. In 1890, Welch demonstrated the presence of *B. coli* and *Staphylococcus pyogenes* in gall-stones, and Hanot, in 1896, found typhoid bacilli. Gilbert, Dominici, and Fournier found *B. coli* in twenty-eight out of seventy cases, and performed experiments which showed that *B. coli* and *B. typhosus* are capable of setting up cholecystitis. Mignot succeeded in producing typical gall-stones in animals by the employment of an attenuated virus, a virulent culture giving rise to purulent cholecystitis but no gall-stone formation. Other micro-organisms, such as staphylococci, streptococci, *B. subtilis*, and *Micrococcus tetragenus*, have also been stated to be associated with the formation of biliary calculi, but *B. coli* and *B. typhosus* are generally believed to be the most important. *B. coli* has most frequently been described as present, but in recent years there has been a growing tendency to ascribe to the typhoid bacillus an important rôle in gall-stone formation. For instance, Posselt [1] points out that Basle

[1] *Mediz. Klinik.*, Berlin, 2nd Aug. 1908.

and Strasburg, which are noted for the prevalence of typhoid, have nearly twice as many cases of gall-stones, according to the official post-mortem records, as certain other European cities where it is less prevalent. The now well-recognised occurrence of "carrier cases," in which typhoid bacilli have been isolated from the stools as long as thirty years after the attack of typhoid fever, and the apparent dependence of these upon persistence of the specific micro-organism in the gall-bladder, show that in seeking for an etiological connection between gall-stones and typhoid fever it may be necessary in many instances to look a long way back in the history of the patient. It is interesting to note that, according to Forster,[1] 79 per cent. of "carrier" cases are women, and 17 per cent. men, a proportion between the sexes which corresponds to that existing among those who suffer from gall-stones.

Paratyphoid processes, influenza, meat poisoning, and dysentery are also possible sources of the infection of the bile ducts responsible for cholelithiasis.

Infection of the bile ducts may take place by three

[1] *Münch. med. Woch.*, Jan. 7, 1908.

routes: (1) through the bile papilla from the intestine (2) by the portal vein from the intestine, (3) through the systemic circulation as part of a general septicæmia. Although entrance of bacteria into the bile is probably effected in some instances by way of the bile papilla, especially when there is a catarrhal inflammation of the mucous membrane of the walls of the duodenum, it is probable that in many the infection is carried by the blood. In this connection the statement by Adam and Ford that the portal vein normally contains intestinal bacteria is of interest. Cushing has demonstrated that if an easily recognised organism, such as *B. prodigiosus*, is given by the mouth to animals in which an enteritis has been induced by the administration of arsenic, they can often be recovered from the bile passages; but as Marjos has shown that *B. prodigiosus* placed in the anus appears after two hours in the mouth, and that particles of indigo carmine behave similarly, it is possible that their transit may be due to mucous currents in the intestine and ducts. Blackstein and Welch in 1899 showed that typhoid bacilli injected intravenously into rabbits passed into the

gall-bladder, where they remained alive as long as 128 days after the inoculation, although they had completely disappeared from other organs of the body. This was confirmed in 1905 by Forster and Kayser, who obtained pure cultures of typhoid bacilli from the gall-bladder six weeks after injection, and corroborated the statement that the bacilli survive longer in this region than in any other part of the body. Dorr published about the same time a series of experiments on animals which showed that typhoid bacilli arrive at the gall-bladder by way of the blood stream. When the bacilli were introduced into rabbits by intravenous inoculation, they were always found in large numbers in the gall-bladder even after the common duct had been ligatured. The shortest period after which the bacilli made their first appearance in the gall-bladder was eight hours. The time during which they persisted varied in different experiments, but abundant bacilli were demonstrable for as long as 120 days. According to this author, the bacilli only made a protracted stay when, as is frequently the case, their presence had set up inflammatory processes in the gall-bladder mucous membrane. It

is important to note that in two of his cases the infected and inflamed gall-bladder contained concretions in which typhoid bacilli were demonstrable.

In a more recent series of experiments, Joseph Koch has shown that typhoid bacilli injected into the veins of rabbits reach the gall-bladder even when the cystic duct has been previously tied. He claims to have been able to follow the transit of the bacilli through the wall from emboli in capillaries of the submucosa, and states that the walls of the larger bile ducts were also affected.[1]

In a paper on "The Pathogenesis of Gall-Stones," published in 1907,[2] Kramer has revived the chemical theory of Thudichum, and sought to harmonise it with the observations of Naunyn in the light of the bacteriological discoveries that have been made since Thudichum's paper was published in 1862. He acknowledges that the cholesterin and calcium of gall-stones originates from the degenerated epithelia-cells of the bile ducts, but points out that since both are usually soluble in bile it is difficult to see how

[1] *Centralbl. f. Bakt.*, 1908, xlii. (suppl.) 54.
Journ. of Expt. Med., 25th May 1907, p. 319.

the precipitation is brought about unless there is also some alteration in its chemical properties. On making cultures of *B. coli*, *B. typhosus*, and *Staphylococcus pyogenes aureus* in a clear mixture of bile and nutrient broth, he found that, although the staphylococci grew well, and formed a deposit at the bottom of the test tube, no change took place in the medium, but that with both the coli and typhoid cultures the medium became cloudy in a few days, and subsequently formed a precipitate at the bottom, which in four weeks had become a closely packed semi-solid mass. In six months the supernatant fluid could be poured off, and left a firm deposit resembling a very soft gall-stone. Microscopically the deposit was found to consist of amorphous calcium phosphate, magnesium phosphate, calcium carbonate, bile pigments, and a few crystals of cholesterin. Since the normal bile with which this first experiment was carried out contained very little cholesterin, a second sample, in which cholesterin had been dissolved, was tried and the same results obtained, except that the cholesterin crystals were very much more numerous. From the results of these experiments Kramer con-

cludes that gall-stones, like phosphatic calculi, are formed by the chemical decomposition of a diseased secretion by bacteria, and, since both the organisms that brought about the change give an acid reaction to the media in which they grow, whereas the staphylococcus that caused no precipitate gives an alkaline reaction, the precipitation of cholesterin and calcium salts in gall-stone formation is probably due to the change in reaction, as Thudichum maintained. Kramer also observed that specimens of the deposit obtained in his experiments, when allowed to dry, preserved the colon and typhoid bacilli in a viable condition for long periods, corresponding with the experience of Droba, who isolated living typhoid bacilli from a gall-stone seventeen years after the attack. More recently, Exner and Heyrovsky have reported the results of a research which demonstrated that certain bacteria have a decomposing action on the bile salts with precipitation of cholesterin.[1] Bachmeister[2] maintains that pure cholesterin calculi form in stagnant bile, independent of inflammation,

[1] *Arch. f. klin. Chir.*, Berlin, lxxxvi. No. 3.

[2] *Münch. med. Woch.*, Feb. 4, 11, 18, 1908.

from the fermentative action of protoplasmic substances such as epithelial cells and bacteria, and that the cholesterin of mixed calculi has a like origin, while the calcium alone is derived from the inflamed mucous membrane.

Pure cholesterin stones only appear in the gall-bladder when the cystic duct is completely obstructed and no bile can enter, while pure bilirubin-calcium calculi are produced as the result of a catarrhal inflammation of the small intra-hepatic bile ducts.

The time necessary for the formation of gall-stones has been variously estimated, but the experiments of Mignot and others suggest that about six months is the usual interval between the initiation of the process and production of a typical stone. The fact that gall-stones are sometimes found in groups of one or two large, ten or twelve medium, and fifty or more small calculi suggests that they are sometimes formed in batches, corresponding to recurrent attacks of cholangitis. When gall-stones are single they are usually ovoid, and either smooth on the surface or nodular, the nodules representing the pits in the walls of the mucous membrane in contact with which

they are formed. When multiple they are often faceted from mutual pressure while in a soft state. The faceting of gall-stones is of importance to the surgeon, as its presence in any particular instance indicates that other calculi are present.

The occurrence of gall-stones in the gall-bladder round a foreign body as a nucleus is chiefly of interest as bearing on the theory of gall-stone formation, for so long as the foreign body is smooth and aseptic, and the bladder wall is healthy, no calculus formation takes place; but when the mucous membrane is inflamed, either from antecedent disease or from attenuated organisms introduced with the foreign body, a precipitation of cholesterin occurs round the nucleus the foreign substance provides. A case of this description, which is also of interest because of its bearing on the time which gall-stones take to form, occurred in the practice of Dr. Hofman. In April 1895 he removed a number of stones from the gall-bladder, and used silk sutures; the symptoms returned at the end of 1896; cholecystotomy was again performed in June 1897, and several good-sized stones were removed. They were found to have the silk sutures as their nuclei. We

are also acquainted with a case where the silk sutures employed to stitch up the opening in the common duct in a choledochotomy led to the formation of a concretion which was passed naturally. An examination of the gall-stone showed a ligature to be the nucleus. Nauche and Eastman have reported cases in which a steel needle formed the nucleus of a gall-stone.

Intestinal parasites may find their way into the gall-bladder, and carry with them the necessary infection: Lobstein found round worms associated with gall-stones; Gautrelet reports bilharzia and intestinal flukes in connection with biliary calculi; Carless found pieces of hydatid membrane in the gall-bladder; and Buisson found *Distoma hepaticum* in a case of cholelithiasis.

Among the remoter causes of gall-stone formation we must consider age, sex, habits, dress, diet, diathetic condition, and disease.

Age.—Although gall-stones may occur at any age, even in the newly-born, they are rarely found under the age of twenty-five or thirty. Schroeder says that under the age of twenty the percentage is 2·4; from twenty to thirty, 3·2; from thirty to forty,

11·5; from forty to fifty, 11·1; from fifty to sixty, 9·9; and over sixty, 25·2 per cent. Judging from a paper[1] by Dr. G. F. Still, biliary calculi in young children are met with not infrequently, however. He gives three cases in which a necropsy had been performed within six months at the Great Ormond Street Hospital for Children, and gall-stones were found. In the first, a child aged nine months, there were vomiting and clay-coloured stools, but neither jaundice nor colic. After death (which occurred from other causes) there were found eleven small, black, friable calculi composed of pigment, three of which were impacted in the common duct. The second case was that of a girl, aged eight months, who died of tuberculous meningitis. There was neither jaundice nor abdominal pain; but at the post-mortem examination there were found three minute calculi of pigment in the gall-bladder. In the third case, a boy (age not given), there were abdominal pain and vomiting, but no jaundice; the calculi were of the same kind. He described a fourth case where there had been recurrences of vomiting, abdominal pain, and jaundice. Altogether he has

[1] *Brit. Med. Journ.*, 8th April 1899.

been able to collect twenty cases in children, ten of which were in infants. He was of opinion that biliary calculi might be formed during intra-uterine life, and thought that the viscosity of the bile in infancy was probably connected with the formation of such concretions.

Sex.—Gall-stones occur more frequently in women than in men. Schroeder states that in Germany they are found in 20 per cent. of female and in 4·4 per cent. of male necropsies. Out of 228 autopsies on women in the Manchester Royal Infirmary, Dr. Brockbank found 18, and out of 542 post-mortem examinations in men, 16 cases of gall-stones; which gives 7·9 per cent. in females, and 2·9 per cent. in male subjects. Pregnancy would seem to be a factor in the causation of gall-stones, as, in a large series of cases, 90 per cent. of the women had borne children. The wearing of corsets, which tends to force down the front of the liver, and to depress the fundus of the gall-bladder, is probably a distinct etiological factor, especially when combined with deficient exercise.

Habits.—Want of exercise, whether from lethargy

or from necessity, as in some forms of chronic heart disease, leads to stagnation of bile in the gall-bladder, and to the deposition of cholesterin, since the gall-bladder is unaided in its expulsive efforts by the contraction of the abdominal muscles.

Diet.—It has been stated by some observers that diet exercises a strong influence in the formation of gall-stones. If it is admitted that free cholesterin in the bile passages is due, in some cases, to a deficiency of its solvents in the bile, these solvents being the glycocholate and taurocholate of soda, and that these arise from the metabolism of nitrogenous foods, it follows that if the supply of nitrogen in the food be limited, the bile salts are likely to be diminished, and cholesterin may be precipitated. Such an explanation has been advanced to account for the presence of gall-stones in gouty persons, who, on account of their uric acid diathesis, limit their intake of nitrogen. The larger consumption of farinaceous food in Germany may also serve on the same theory to explain the greater prevalence of gall-stones there than in England, where meat enters more extensively into the dietary. In diabetes, where nitrogenous food is

prescribed, gall-stones are rarely found. Dr. Thudichum, in his work on gall-stones, states that he cannot find any recorded instances of the discovery of gall-stones in the wild carnivora, though on two occasions they have been found in the gall-bladders of domesticated carnivora. On the other hand, Dr. Brockbank could find no evidence of their occurrence in wild herbivora, though at times they are found in domesticated horses, cattle, and sheep, as well as in pigs. Moreover, in pampered dogs fed on farinaceous foods they are found occasionally. In man, who is omnivorous, they occur in from 5 to 10 per cent. It will thus be seen that in those who take an abundance of albuminous materials in their food, there is apparently less tendency to the deposition of cholesterin, whereas when little albuminous food is taken, gall-stones are more likely to form; this tendency is aided by insufficient exercise, as in stall-fed cattle, pampered dogs, and indolent men. The formation of some gall-stones containing lime has been attributed to the drinking of hard water, but this is by no means proved; an insufficiency of diluent drinks may, however, possibly act as a cause.

Gall-stones are most commonly met with in the gall-bladder (Fig. 13), where the necessary conditions for their formation occur in greater perfection than in other parts of the biliary system. A single large calculus may be present, or there may be many. They are usually loose in the bile, or, when the cystic duct is blocked, may be embedded in the mucous contents of the gall-bladder. Occasionally a large number of closely packed faceted calculi may distend the gall-bladder, which contains neither bile nor mucus, or a large stone may be adherent to the

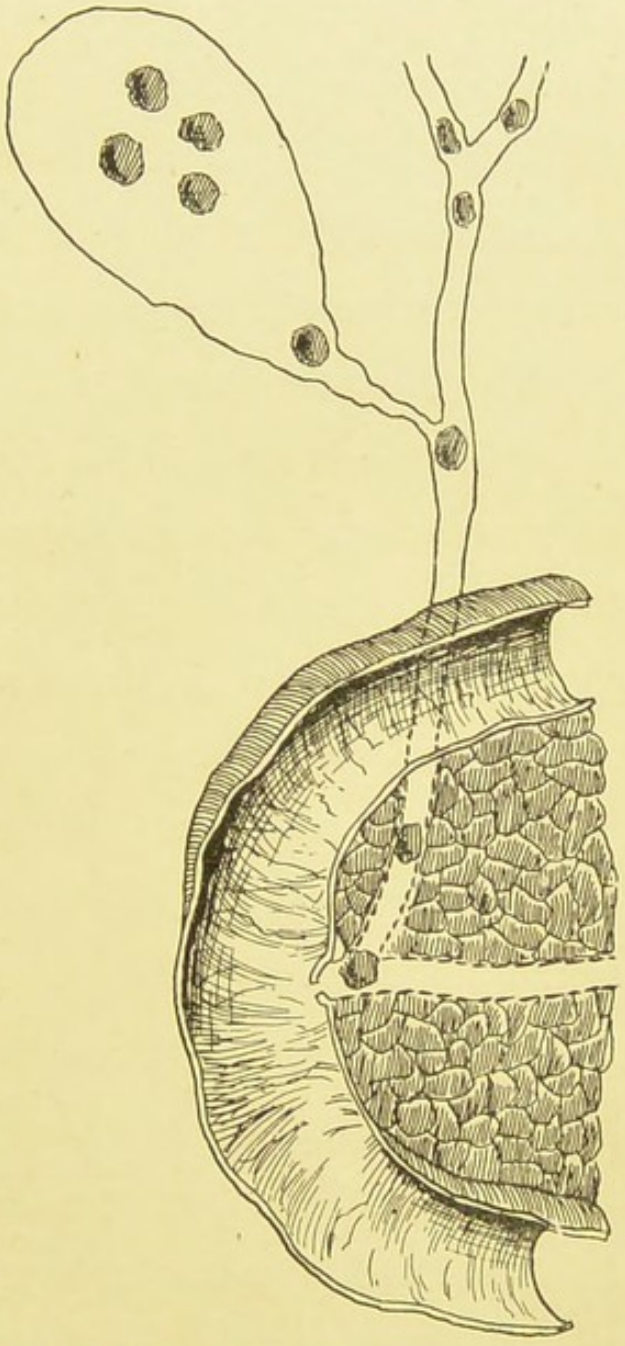


FIG. 13.—Common situations in which gall-stones are met with.

mucous membrane. The calculi may also be embedded in the wall, or lie in a diverticulum, particularly near the fundus or neck of the viscus. Gall-bladder calculi are usually of the "common" mixed variety, but, when the cystic duct is occluded, stones of "pure" cholesterin may form.

The gall-stones found in the common bile duct are formed in some cases in the duct itself, while in others they result from the enlargement of calculi which have originated in the gall-bladder, or hepatic, or intra-hepatic ducts. Their composition therefore varies very considerably. In the majority of cases a single calculus is present, but in a case operated on by one of us as many as eighty-eight were removed. Occasionally the common duct is found to be filled with a loose gritty mass of "biliary sand." Common duct stones are most commonly situated at, or near, the termination of the duct at the biliary papilla, but in this situation they are usually of small size, the large stones being found higher in the duct, particularly in the supraduodenal portion.

The small calcium-bilirubin calculi met with in the hepatic ducts are usually multiple. It is rare to meet

with stones in this situation unless they are also present in other parts of the biliary apparatus. It is, however, important to remember that hepatic calculi may give rise to symptoms resembling those of common duct cholelithiasis, and that occasionally they occur apart from stones in other situations.

The calculi met with in the intra-hepatic ducts are also of the calcium-bilirubin variety. They are usually elongated, and may be branched, representing the lumen of the duct in which they have formed. As a rule they are small, but are sometimes very numerous. They do not of themselves give rise to any symptoms, and may be found quite unexpectedly post-mortem. In some cases, however, the inflammatory changes which occur around them may, when infection is superadded, go on to suppuration, and end in abscess formation.

CHAPTER IV

SYMPTOMS OF CHOLELITHIASIS

It is generally stated that gall-stones may be present for many years without producing any symptoms, and it is pointed out in support of this that they are not infrequently found post-mortem in patients who have made no complaint during life. While it is true that a considerable proportion of people who suffer from cholelithiasis, probably much less than half, never have an attack of typical gall-stone colic or jaundice, a careful inquiry into their history will generally, if not always, reveal that they have not been without some signs of the disease, but that these have often been ascribed to other causes. The slight, irregular, and infrequent, or recurrent attacks of distress caused by the presence of gall-stones in the gall-bladder, and the consequent reflex disturbances

of digestion, are usually considered as a form of "indigestion," and the stomach is frequently treated in consequence. Such patients complain of a sense of weight, or distension, in the upper part of the abdomen, generally coming on a short time after a meal, and often noticed to be particularly liable to succeed indulgence in certain articles of diet, so that they learn to avoid them. Their sensations are relieved by eructations, or by vomiting, which sometimes spontaneously occurs. During an attack there is often considerable faintness and nausea, and the patient may complain of "a catch" in the breath, or an acute stabbing pain under the right costal margin on deep inspiration. A feeling of chilliness, or even a slight rigor, often accompanies the attack, and, although very characteristic, is usually regarded as merely a result of the pain or nausea. Such may be regarded as the inaugural or prodromal symptoms of cholelithiasis, and when a patient complains of them it is advisable to exclude cholecystitis and irritation of the gall-bladder before prolonged treatment for other supposed disorders is begun, since early recognition and treatment of the condition will avoid the

many, and often serious, complications that may subsequently arise.

The association of symptoms of "indigestion" with irritation of the gall-bladder is not difficult to understand, if the anatomical and physiological connections of the biliary apparatus are borne in mind, for the results of recent researches which have shown that branches of the vagus go directly to the gall-bladder, the normal contraction and expulsions of its contents by that viscus after the ingestion of food, and the different effects of the various forms of food-stuffs on the quantity and rate of the bile flow, explain the referred gastric symptoms, their occurrence within half to three-quarters of an hour after meals, and the constancy with which they are elicited by certain articles of diet.

The ordinarily recognised symptoms of cholelithiasis are paroxysmal attacks of pain, which, occurring at irregular intervals, and often without apparent cause, start in the right hypochondrium or in the epigastrium, and radiate thence over the abdomen and through to the right subscapular region. These attacks are often accompanied by sickness or vomiting, and, if severe,

by collapse. They may be followed by jaundice, with its well-known symptoms, but this is frequently absent. At times a feeling of fulness in the right hypochondrium accompanies the attack; but the formation of a tumour does not occur, as a rule, unless the ducts are blocked. Accompanying these special symptoms will usually be found depression of spirits, want of appetite, dyspepsia, and loss of weight.

The following symptoms will be considered in detail:—

(*a*) *Paroxysmal pain.*—For the most part the patient complains of pain under the right costal margin, or in the epigastrium, whence it radiates over the abdomen and to the right subscapular region; but in some cases the pain radiates to the left shoulder. These attacks come on suddenly, when the patient is quite well, and usually end by causing nausea or an attack of vomiting. The vomiting leads to relaxation of the duct, and, if the gall-stone be small, it may pass on and thus end the attack. The seizures come on without apparent cause, although at times they may appear to be brought on by exertion, or by

taking food. Not infrequently, after an attack has passed off, a dull aching is felt in the region of the gall-bladder for some time, perhaps until another seizure. In several cases we have noticed the pain to begin on the left side, over the stomach, and in these we have always found adhesion of the stomach to the gall-bladder or bile ducts.

The pain may be irregular, at times simulating angina pectoris, when it is almost limited to the precordial region; or it may be epigastric, when it simulates ulcer of the stomach; or genito-crural, when it resembles renal calculus. The absence of other cardiac, stomach, or renal symptoms, and the presence of tenderness over the gall-bladder, or in the line between the umbilicus and the ninth costal cartilage, will usually enable a diagnosis to be made.

It is not uncommon for the pain to commence in the epigastrium, and to radiate thence all over the abdomen, especially into both hypochondriac regions; it may then pass through to the midscapular region, and even pass up to the head and neck, or down to the loin.

(*b*) *Vomiting.*—Though, as a rule, the vomiting is

paroxysmal and associated with colic, it may be almost continuous, and so of itself prove dangerous. In one of our cases of this kind the patient was so weak from persistent vomiting that it was feared she scarcely could bear the operation it was necessary to perform. Even after the source of irritation had been removed, the vomiting persisted for days; ultimately, however, she made a good recovery. In another case, which was seen in the South of Ireland, the vomiting had been so incessant that the patient had been fed almost solely by nutrient enemata for six weeks before operation, and even afterwards, though the operation was satisfactory, and the after-progress in other respects all that could be desired, the emesis persisted for a fortnight, and ultimately caused the death of the patient from sheer exhaustion. The vomiting, as a rule, occurs towards the end of the seizure, and, in fact, frequently determines its cessation. In such cases the stomach contents are first rejected, after which, if the common duct be free, bile is vomited; at times, however, in the severe cases, the vomit becomes grumous, or even stercoraceous.

(*c*) *Collapse.*—Occasionally a patient becomes so

profoundly collapsed from an attack of gall-stone colic as to give rise to great difficulty in diagnosis, the case being more like one of perforation of some abdominal viscus or of intra-abdominal hæmorrhage; but the history of previous seizures and of the onset of the attack from which the patient is suffering will usually help one to arrive at a correct diagnosis. The acute, agonising pain may of itself cause death, as in the case of a lady seen by one of us in consultation, and where the presence of gall-stones was diagnosed. The next attack of pain unfortunately proved fatal, and at the autopsy a gall-stone was found half extruded into the duodenum.

Not only may the agonising pain of a single attack prove fatal, but repeated attacks of pain occurring without sufficient interval for recuperation may produce very serious deterioration of health, or even death from sheer exhaustion.

(*d*) *Tenderness with rigidity of the right rectus muscle.*—As attacks of gall-stone colic are usually associated with cholecystitis of greater or less intensity, and as the gall-bladder has a peritoneal investment that frequently participates in the inflammation, it

follows that tenderness over the gall-bladder region is seldom absent in well-marked cholelithiasis, and rigidity of the overlying muscle is also usually present. Another characteristic symptom of great diagnostic value is the existence of a tender spot an inch above the umbilicus, and in a line between it and the right costal margin. This tender spot is quite as constant as the M'Burney point in appendicitis, although in some cases it may be a little higher than that mentioned, but in the same line.

(*e*) *The formation of a tumour* in the region of the gall-bladder is seldom seen in acute cases; but it may be noticed with each attack, and is then due to the violent contraction of the muscular wall of the gall-bladder on its contents. It is, however, a frequent sign in the more chronic cases.

When the gall-bladder enlarges, it extends downward and forward toward the middle line, at a point a little below the umbilicus, and along a line drawn from the tenth costal cartilage to that point. The extent of the enlargement varies very considerably, ranging from a tumour in the position of the gall-bladder just perceptible to the touch, to

one of such a size that it may resemble an ovarian cyst.

When the gall-bladder is of normal size, the neck is opposite the ninth costal cartilage, whereas when the liver is enlarged, the gall-bladder will be pushed down, so that the neck of the tumour may be opposite to, or even below, the umbilicus. If uncomplicated, it will have a smooth, rounded, and pear-shaped outline; the larger end being below, quite free, and movable from side to side, the upper end being fixed and passing under the lower margin of the liver at the fissure of the gall-bladder.

A distinct sulcus between the liver and gall-bladder is nearly always perceptible to the touch, if the warmed flat hand be laid over the right side of the abdomen, and the patient be told to take a deep breath, when the tumour and the liver will descend together and pass under the fingers.

Bimanual palpation will frequently throw additional light on the case, the right hand being placed in front of the abdomen, and the left under the right loin, making gentle pressure forwards.

In other cases, additional information may be

obtained by placing the patient in the genu-pectoral position, and passing the right hand round the abdomen from behind, when a tumour of the gall-bladder will rest distinctly on it, and on deep inspiration the tumour can be felt to move just beneath the abdominal walls, the upper surface of the liver also being in this way capable of palpation.

The swelling is, as a rule, far too tense and hard for fluctuation to be elicited, though at times this sign may be obtained when the swelling is less tense.

In some of the larger swellings, a thrill, almost like the hydatid fremitus, may be felt on gently flicking the tumour with the finger-nail. Percussion by no means always elicits dulness co-extensive with the tumour, especially if the surrounding intestines be distended; so that dulness on percussion is a very variable sign, and palpation will be found more reliable.

Inspection of the abdomen with the patient recumbent will at times show the tumour descending on respiration, but this sign is usually only to be observed in thin patients, and in cases uncomplicated by inflammation. Where there is inflammation and

matting of the adjoining viscera, a fixed swelling may be seen over the right hypochondrium, with dulness on percussion and marked tenderness.

Tenderness on palpation is a variable symptom depending on the presence or absence of local peritonitis, it being as a rule absent in uncomplicated enlargements of the gall-bladder. Occasionally there may be a difficulty in recognising the true nature of these large swellings, and cases have been reported where a distended gall-bladder has been opened in the loin in mistake for a hydronephrosis. If the method of distending the colon with air, or carbonic acid gas, as suggested by Ziemmsen, be practised, however, it will be found that a swelling of the kidney is pushed further into the loin, while a distended gall-bladder will travel upward and forward. But even this test is not infallible, for occasionally the transverse colon may pass below a tumour of the kidney, and, on distension, displace it upward, as in a case of a solid tumour of the upper end of the right kidney operated on by one of us some years ago. Occasionally, too, the colon may lie in front of a distended gall-bladder. As a rule, however, when a tumour that is dull on

percussion, possibly with a feeling of fluctuation, with its upper margin starting at the gall-bladder notch, and a history of its having grown from above downward, is found on the right side of the abdomen, it will be found to be a distended gall-bladder, and Ziemmsen's test will usually clear up any difficulty in diagnosis.

Distension of the gall-bladder without jaundice indicates either stricture of the cystic duct or impaction of a stone in the duct, and may occur without other signs pointing to gall-stones than the somewhat indefinite prodromal symptoms above described, although cholelithiasis is the essential cause of the trouble. When closure of the cystic duct occurs, the prodromal symptoms will usually cease, for the gall-stones may then lie within the gall-bladder like inert foreign bodies.

A perceptible tumour formed by distension of the gall-bladder with gall-stones is rare, unless it happens that some have become impacted in the cystic duct, when a gradual enlargement from retained mucus will follow. As many as 720 gall-stones have been removed from the gall-bladder in a case under our

care, and yet no distinct tumour could be felt. Occasionally a single large stone may form a hard perceptible swelling below the liver.

Distension of the gall-bladder accompanied by jaundice is usually dependent upon malignant disease either of the head of the pancreas, or of the common bile duct, and is rarely associated with gall-stones. This statement is often referred to as "Courvoisier's law," but it had been observed and commented upon by one of us (A. W. M. R.) previous to a knowledge of Courvoisier's publication. The reasons given for the different behaviour of the gall-bladder in malignant disease and cholelithiasis are: (1) in the latter the stones do not produce complete obstruction, but act in the manner of a ball-valve, and so prevent dilatation; (2) owing to the inflammatory changes set up by the calculi previous to the onset of jaundice, the gall-bladder is frequently diminished in size, and adherent, so that when the common duct is obstructed it is unable to dilate; (3) Barker of Chicago has recently suggested that in malignant disease the folds of Heister, or their nervous mechanism, or both, are involved in the growth, so that their normal action is

prevented, and the gall-bladder consequently becomes distended with bile and its own secretion. Exceptions to this general rule are not infrequently met with, when, as in some cases that have been reported, there has been congenital absence of the gall-bladder in malignant disease, or the organ has been more or less completely obliterated by previous inflammation; or again, in the early stages of an impacted gall-stone in the common duct, the gall-bladder may be distended. The distension due to an impacted stone in the common duct is, however, usually of short duration, since the inflammatory softening of the walls of the duct ultimately allow of their distension and the passage of the retained bile and mucus.

A mere fulness of the gall-bladder does not necessarily form a tumour, hence, in the absence of obstruction, a gall-bladder may be larger than normal and be full of bile, yet not be felt through the abdominal wall. It is only when retention occurs under tension that a tumour is felt, and then it may be so hard that it gives the sensation of a pyriform solid on palpation.

(*e*) *The presence of gall-stones in the motions* after an attack is valuable evidence, but their absence does not negative cholelithiasis. It is quite usual in cases submitted to operation to find gall-stones where none had at any time been detected in the motions, although diligently looked for after attacks of colic.

The way to search for gall-stones is to let the patient pass the motion into a solution of carbolic acid, to have it well stirred, and then to pass it through a fine sieve with about $\frac{1}{16}$-inch mesh.

(*f*) *Jaundice.*—So long as the gall-stones are in the gall-bladder or cystic duct, there is nothing to prevent the bile passing down the common duct into the intestine. Jaundice is therefore absent in the greater number of cases of cholelithiasis, or, if present, shows only as a slight icteric tinge in the conjunctivæ, which is induced by catarrh spreading from the gall-bladder and cystic duct to the common and hepatic ducts. Should the gall-stones be impacted in the common duct, the passage of bile is obstructed, and jaundice ensues. Intermittent jaundice may also occur if a small gall-stone in the common duct acts as a ball-valve. In deeply jaundiced cases a decision

concerning operation is frequently difficult, since chronic jaundice too often indicates malignant disease; and not only do patients with cancer bear operations badly, but when jaundice is associated with it there is the same tendency to persistent oozing of blood from the wound after operation as there is to spontaneous hæmorrhage where no operative measures have been undertaken; and though this hæmorrhage tendency may be checked by the administration of calcium chloride, there is a want of healing power, and often a feeble resistance to shock, rendering operation in these cases more serious than in ordinary gall-stone subjects. Chronic jaundice may also be due to pressure on the common duct by the swollen head of the pancreas in cases where there is interstitial pancreatitis. The differential diagnosis of these conditions will be considered in detail subsequently.

(*g*) *Ague-like attacks.*—Ord drew attention to the production of intermittent pyrexia by gall-stones, and stated that his attention had first been called to this symptom by some remarks of the late Dr. Murchison, on the case of a distinguished medical officer, who, after his return to England, was at-

tacked at regular weekly intervals with paroxysms of shivering, followed by fever and sweating. He was supposed at first to have a recurrence of an old intermittent fever, and, later, to have hepatic abscess, but at last his symptoms indicated, and the necropsy proved, that his actual and only disease was a gall-stone so impacted as to produce great irritation, but not complete obstruction, of the common duct. Similar cases had been noticed by Charcot, who argued that the fever is due to the absorption of some poison into the blood. Dr. Murchison was of opinion that such attacks are not of a poisonous or septic origin, but are due to nervous irritation. From the cases we have seen, we should think that both explanations are admissible, the fever being not unlike that known as "urethral," in which the same contention as to causation arises; but seeing that the bile is always septic in these cases, we consider the chief cause of the fever to be ordinarily septic absorption from the damming back of the infected bile, which thus becomes absorbed by the lymphatics, and conveyed into the blood stream.

Professor Osler says that the combination of the

following symptoms is characteristic of the existence of gall-stones in the common duct, and is therefore valuable in distinguishing between this form of obstruction and that arising from malignant tumour alone :—

1. Jaundice of varying intensity, deepening after each paroxysm, which may persist for months or even years.

2. Ague-like paroxysms, characterised by chill, sweating, and fever, and followed by deepening of the pre-existent jaundice.

3. At the time of the paroxysm, pains in the region of the liver, with epigastric disturbance.

This opinion is fully borne out by our experience, and in a number of cases of jaundice of several months' duration, where there was this combination of symptoms, gall-stones were found in the common duct.

Cholelithiasis and enlargement of pancreas.—In common-duct cholelithiasis, especially where there is a small floating gall-stone, it is common to find the head of the pancreas enlarged and hard, the result of chronic pancreatitis. This may give rise to the sus-

picion of cancer of the head of the pancreas, and may lead to an unfavourable prognosis being given; but it is well to keep an open mind in such cases, as drainage of the bile ducts either by cholecystotomy or by cholecystenterostomy will prove completely curative if the enlargement be an interstitial pancreatitis

CHAPTER V

DIAGNOSIS OF UNCOMPLICATED CHOLELITHIASIS

In the diagnosis of uncomplicated cholelithiasis we have to consider the several ailments which may produce painful seizures in the right side of the abdomen. These are: hysteria or nervous spasms, locomotor ataxia, acute dyspepsia with flatulence, appendicular colic with appendicitis, right renal colic, acute and chronic pancreatitis, pancreatic calculus, gastric, pyloric, or duodenal ulcer, peritoneal adhesions to the pylorus or bowel, spinal neuralgia, malignant growth in or near the liver, pyloric stenosis, lead colic, angina pectoris, pneumonia and pleurisy, and the crisis of locomotor ataxia.

The diagnosis rests chiefly on paroxysmal attacks of pain, starting in the right hypochondrium and radiating thence over the abdomen and through to

the right scapula, the attacks being often accompanied by vomiting or collapse, and sometimes followed by jaundice, although this is frequently absent. If jaundice be persistent and intense, without variation, the presence of malignant disease should be suspected; if it be dependent on gall-stones, ague-like attacks will probably occur.

Just as in appendicitis there is tenderness over M'Burney's point, so in gall-stones, with very few exceptions, marked tenderness will be found on pressing the finger deeply over the region of the gall-bladder, or over some point in a line from the ninth costal cartilage to the umbilicus. In some cases the pain in the so-called "spasms" is referred to the left side, radiating thence to the left infra-scapular region; and in operating on such cases it will be found, as mentioned above, that the pylorus is adherent to the gall-bladder or cystic duct.

In *hysteria*, the irregularity in the character of the attacks, their association with other nervous phenomena, such as polyuria, globus hystericus, and so forth, together with the absence of collapse and of

the physical signs of gall-stones, will enable one to arrive at a correct conclusion.

The lightning pains of the abdominal crises of *locomotor ataxia* have led to errors in diagnosis, and we have heard of an operation having been performed in such a case, but the absence of knee-jerks and the well-known ocular and other nervous symptoms should prevent this mistake.

As a rule, there will be little difficulty in distinguishing cholelithiasis from *acute dyspepsia* with flatulence. The relief following on simple treatment, the pain over the stomach rather than over the gall-bladder, the discovery of a manifest cause, and the absence of serious symptoms, readily enable the distinction between so-called "stomach spasms" and gall-stones to be made.

In appendicular colic or *appendicitis*, the almost invariable sign of tenderness at a point midway between the anterior superior spine of the right ilium and the umbilicus (M'Burney's point); the presence of a swelling in the right iliac fossa, or near it; the presence of bowel symptoms in the shape of distension with rise of temperature; the characteristic

initial vomiting; the commencement of the pain around or just above the umbilicus, and subsequently its transference to the right iliac region; and the absence of right scapular pain—render the diagnosis of this condition free from serious difficulty, though in cases of phlegmonous cholecystitis with peritonitis, the latter has sometimes been attributed to appendicitis instead of to its actual cause. Confusion is most likely to occur in those cases in which the appendix, in consequence of the non-descent of the cæcum, lies in close relation to the gall-bladder. It must, however, be remembered that cholelithiasis and appendicitis may co-exist, and it has been pointed out by Dr. Ochsner, of Chicago, the one condition may excite the other.[1] During four months, out of eighteen patients operated on for gall-stones in the Augustina Hospital, six suffered at the same time from appendicitis. The explanation given by Dr. Ochsner is that the gall-bladder becomes infected from the appendix, either at the time of the acute attack or during the chronic manifestation of the disease; hence he advises an examination of the

[1] *Philadelphia Medical Journal*, 6th October 1900.

appendix in all cases when operating on the gall-bladder.

In right *renal colic* the associated urinary symptoms, together with the condition of the urine and the pain over the kidney, passing down the right genito-crural nerve into the testicle, are distinctive.

In *lead colic* the more or less persistent stomach-ache, the constipation, the absence of the usual gall-bladder paroxysms, and the presence of a blue line on the gums, will usually assist in the diagnosis; but in a doubtful case the result of treatment by iodide of potassium and saline aperients will soon clear up the diagnosis.

In *pyloric stenosis*, if accompanied by adhesions around the pylorus, the symptoms are not unlike those of gall-stones, with which, in fact, the affection may be associated, as in several cases related by one of us before the Clinical Society in 1889,[1] up to which time the subject had not attracted attention. The presence of dilatation of the stomach, the characteristic vomit, the visible peristalsis in the stomach wall, the pain on the left of the abdomen, the absence of the

[1] *Transactions of Clinical Society*, 1889.

characteristic gall-bladder pain, and the results of a microscopical and chemical examination of the stomach contents, will usually establish the diagnosis.

Pyloric or duodenal ulcer may simulate gall-stones, though the association of pain with food, and occurring two to four hours after it, the regular daily recurrence of pain, and the presence of stomach symptoms, generally render the diagnosis easy; but where perigastritis extends to and involves the common duct, the presence of jaundice may give rise to doubt that can only be settled by exploration. In duodenal ulcers the pain passes round the loin and does not radiate to the scapular region, and the tenderness is usually to the right of the umbilicus. A test meal will show an excess of acid and hyperchlorhydria.

Chronic pancreatitis frequently occurs as a complication of common duct cholelithiasis, and will be considered in more detail under that heading, but as it may also arise from a number of other causes, and may from its symptomatology cause difficulties in diagnosis, it is also mentioned here.

The pain in chronic pancreatitis radiates to the

midscapular region, or round the left side, and the tenderness is in the epigastrium rather than in the gall-bladder region. The presence of jaundice depends on the anatomical relation of the head of the pancreas to the common bile duct, for in some cases it embraces the duct, while in others it only lies close to it. Jaundice, therefore, is not a symptom unless there be at the same time a gall-stone in the common duct, or the inflamed gland compresses the duct as it passes through. In some cases the swollen pancreas can be felt on deep pressure in the epigastrium, especially if an anæsthetic be employed. Rapid loss of flesh is suggestive of pancreatitis. The most characteristic sign, however, is obtained by examining the urine by the "pancreatic" (Cammidge) reaction, and confirmatory evidenceis also frequently afforded by an analysis of the fæces.

In *acute pancreatitis* the symptom of acute peritonitis starting suddenly in the epigastric region, and followed by distension, at first in the upper half of the abdomen, and later becoming general, may simulate acute cholecystitis due to gall-stones, but the site of the pain, the preceding history, the pre-

sence of a tumour of the gall-bladder, and the less severe collapse in cholecystitis, as a rule enable a diagnosis to be made. In such cases early treatment by exploration is called for; the diagnosis is therefore of theoretical rather than practical value. It is interesting to note that gall-stones have been present in some 40 per cent. of the published cases of acute pancreatitis, and that there is probably some connection between the two conditions.[1]

In *spinal neuralgia* the presence of tenderness over the spine, the course of the pain along the branches of the corresponding spinal nerves, and the absence of collapse or of vomiting, put aside all difficulty in most cases.

In *malignant disease* the absence of pain at the onset, or, when present, its continuous character, the gradual and persistent loss of flesh, and the more marked failure of strength, usually indicate the serious nature of the affection. The persistence and gradual deepening of the jaundice when once it supervenes, the frequent absence of ague-like attacks, and, if the disease involve the head of the pancreas, the

[1] Egdahl, *Bull. Johns Hopk. Hosp.*, April 1907.

almost constant presence of a palpable tumour due to enlargement of the gall-bladder, and the absence of stercobilin from the fæces, afford signs which, as a rule, prove true guides; but in many cases gall-stones exist along with malignant disease, and then these distinguishing symptoms become unreliable, though the rapid wasting and loss of flesh will often lead to a successful diagnosis of the co-existence of the two conditions. If nodules form in the liver, and ascites with œdema of the feet supervene, the condition becomes manifest at once. The presence of small angiomata on the skin, especially on that of the abdomen, though not absolute proof, is a point in favour of cancer. Leser[1] drew attention to it, though Freund and Hollander had previously noticed it without laying great stress on its importance.

From *right-sided pleurisy* and *pneumonia* the physical signs afford positive evidence, and the symptoms are usually so distinct and definite as to leave no doubt.

Angina pectoris, by its sudden and irregular onset and the presence of collapse, may give rise to the

[1] *Münch. med. Woch.*, December 17, 1901.

suspicion of gall-stones, and we have seen the mistake made in practice; but the situation of the pain in the pre-cordial region, and its passage down the left arm, together with the usual circulatory disturbances, and maybe the presence of organic disease in the heart or vessels, will usually afford a sufficient guide to prevent a mistake being made.

Slight jaundice is very frequently present in true gall-stone seizures, even when the concretions are in the gall-bladder or cystic duct, but it may be so slight as to only show a mere doubtful tinge in the conjunctivæ. In some doubtful cases of so-called "spasms," as in other manifestations of cholelithiasis, it may be of importance to be able to discover mere traces of bile, for if definitely present in the blood or urine it would render the diagnosis of cholelithiasis more probable.

The *identification of bile pigments in the urine* is a clinical detail of considerable importance. The pigment met with in fresh urine is bilirubin, although others may form from it if the specimen is allowed to stand for some time. The tests for bile pigments usually employed depend upon the oxidation of this

into the characteristic green biliverdin. The most frequently used are the following:—

(1) *Gmelin's.*—The suspected urine is gently floated on to a few cubic centimetres of nitric acid containing a trace of nitrous (made by exposing nitric acid to sunlight, or heating it with a small piece of wood until red fumes are given off). A play of colours, of which the green is alone characteristic, will be obtained at the zone of contact. The objections are that the test is not very delicate, albumin obscures the play of colour, the blue given by much indican, combined with the yellow of the urine, tends to give a green tint that may mislead; a urine of dark colour from urobilin requires to be diluted with water, or the colours are not seen.

(2) *Rosenbach's modification.*—The delicacy of the above test is increased, and the difficulty from albumin avoided, if a large quantity of urine is filtered through the same filter-paper, and a drop of yellow nitric acid is then allowed to fall upon it. A series of coloured rings is formed, and if bile be present the characteristic green zone at the periphery is well seen.

(3) *The iodine test* (Maréchal, Trousseau, Rosin, Smith, etc.).—A 1 per cent. solution of iodine (Gram's iodine solution diluted ten times with alcohol, or about equal parts of the B.P. tincture of iodine and rectified spirit may be used) is floated on to the urine. A green ring forms at the line of contact, and the whole urine becomes green on being shaken if bile pigment is present. If the urine is alkaline, it must be acidified with a few drops of acetic acid before employing the test. The absence of other colours than green renders this test more distinctive and delicate than Gmelin's, but occasionally a similar reaction is given by normal urines.

(4) *Krokiewicz' test.*—Three solutions are required: (A) a 1 per cent. solution of sulphanilic acid in water; (B) a 1 per cent. solution of sodium nitrite; (C) pure concentrated hydrochloric acid. Equal quantities of A and B are poured into a test tube, and well shaken. One or two drops are then mixed with the same quantity of the urine to be tested, considerably diluted if a large quantity of pigment is present, and well shaken. After a few seconds the mixture becomes ruby red. On adding a few drops of pure

hydrochloric acid, and diluting many times with water, the colour changes to amethyst violet.

Although this test is more delicate than those previously mentioned, showing 1 in 500 of bile as compared with 1 in 200, and has the advantage of requiring only a small quantity of the fluid to be tested, the test solutions, and particularly the sodium nitrite, do not keep well, so that unless they are freshly prepared a negative result is of no value.

A number of more elaborate tests have been devised, in which the bile pigments are precipitated from the urine and then examined, but, as they require a considerable expenditure of time and a certain amount of apparatus, only two of them will be mentioned.

(5) *Huppert-Salkowski test.*—10 or 20 c.c. of the urine are made faintly alkaline with sodium carbonate, a solution of calcium chloride (1 : 10) is then dropped in so long as a precipitate forms, the precipitate is filtered off, washed with water, and then dissolved in about 10 c.c. of alcohol containing a little hydrochloric acid. If the clear solution contains bile pigment, boiling will turn it green to blue; if not, it

will remain unaltered. On cooling, the addition of nitric acid will change the green to blue, violet, and red.

(6) *MacAdie's modification of Gmelin's test.*—The urate precipitate produced by adding a saturated solution of calcium chloride to the faintly acid urine is separated by centrifugalisation, dissolved in one part of hydrochloric acid (D. 1.16) and three parts of alcohol, and, while still in the centrifuge tube, 5–6 drops of nitric acid (D. 1.42) are added. If bile pigment is present, a play of colours the same as that seen in Gmelin's test is obtained.

Even with the use of the more delicate and elaborate tests, it is not always possible to detect bile pigment in the urine when the patient is obviously jaundiced. This is particularly the case when the pigmentation of the skin and conjunctivæ is clearing up, and in the early stages of an attack. An examination of the blood serum may then be of considerable use in arriving at a correct conclusion. The method of procedure is very simple. A small capillary tube is filled with blood obtained from a puncture of the skin, and sealed at both ends. After

standing for a few hours in a vertical position, the serum separates from the clot, and should be examined against a white background in a good light. Normal serum is colourless, but the slightest trace of bile is revealed by a yellowish tint, varying in degree with the intensity of the jaundice.

The so-called diagnostic operations of sounding for gall-stones and aspiration of a distended gall-bladder are not only futile, but dangerous; a small exploratory incision is safer and far better, whether for information or treatment.

The diagnosis of gall-stones by means of the Röntgen rays has not led to any constant or even promising results, except in the case of those concretions containing lime salts.

The presence of the pancreatic reaction in the urine in some 70 per cent. of cases of common duct cholelithiasis is a diagnostic point that should not be neglected in any doubtful case; we have found it most useful in many instances. The probable explanation is the frequent association of catarrhal pancreatitis with cholelithiasis.

CHAPTER VI

THE PATHOLOGICAL CHANGES AND COMPLICATIONS DUE TO GALL-STONES

Inflammatory Changes in the Gall-Bladder and Bile Ducts

According to Naunyn, there is an irregular as well as a regular form of cholelithiasis. The latter occurs where the calculi are simply lodged in the gall-bladder, or pass along the ducts; the former is seen when there is infectious angio-cholitis with abscess of the liver, fistula, or other complications. We have already considered the symptoms of uncomplicated cholelithiasis, and we now propose to deal with the complications to which gall-stones may give rise, and the additional signs that these produce. In some instances these, of which the following are the most important, may constitute the prominent conditions threatening life, and requiring treatment, the original

cause having perhaps disappeared or become masked by its more serious sequelæ :—

1. Ileus due to atony of the bowel, leading to enormous distension, and to the symptoms and appearances of acute intestinal obstruction, apparently the consequence of the violent pain.

2. Acute intestinal obstruction, dependent on—

(*a*) Paralysis of the gut due to local peritonitis in the neighbourhood of the gall-bladder.

(*b*) Volvulus of the small intestine.

(*c*) Stricture of the intestine by adventitious bands originally produced as a result of gall-stones.

(*d*) Impaction of a large gall-stone in some part of the intestine after ulcerating its way from the bile channels into the bowel.

3. General hæmorrhages, the result of long-continued jaundice, dependent either on gall-stones alone or on cholelithiasis associated with malignant disease, or chronic pancreatitis.

4. Localised peritonitis, producing adhesions, which may then become a source of pain even after the

gall-stones have been got rid of. We believe that nearly every serious attack of biliary colic is accompanied by adhesive peritonitis, as experience shows that adhesions are found practically in all cases where there have been characteristic seizures.

5. Dilatation of the stomach dependent on adhesions around the pylorus.

6. Ulceration of the bile passages, establishing a fistula between them and the intestine.

7. Stricture of the cystic or common duct.

8. Abscess of the liver.

9. Localised peritoneal abscess.

10. Abscess in the abdominal wall.

11. Fistula at the umbilicus, or elsewhere on the surface of the abdomen, discharging mucus, muco-pus, or bile.

12. Empyema of the gall-bladder.

13. Infective and suppurative cholangitis.

14. Septicæmia or pyæmia.

15. Phlegmonous cholecystitis.

16. Gangrene of the gall-bladder.

17. Perforative peritonitis due to ulceration through, or to rupture of, the gall-bladder or the

ducts, leading to extravasation of infected bile into the general peritoneal cavity.

18. Pyelitis on the right side due to a gall-stone ulcerating its way into, or an abscess of the gall-bladder bursting into, the pelvis of the kidney.

19. Cancer of the gall-bladder or ducts.

20. Subphrenic abscess.

21. Pleurisy or empyema of the gall-bladder.

22. Pneumonia of the lower lobe of the right lung.

23. Chronic invalidism and inability to perform any of the ordinary business or social duties of life.

24. Suppurative pancreatitis.

25. Chronic interstitial pancreatitis.

26. Infective endocarditis.

27. Cirrhosis of liver.

Since gall-stones, according to the modern view of their formation, are the result of degenerative changes set up in the lining membrane of the biliary channels by the injury arising from infection, a certain amount of inflammatory change must accompany their formation. This may, in the course of time, subside, but any fresh infection, whether carried by the blood or passing directly along the

ducts from the duodenum, and possibly also the irritation of the gall-stones themselves, may give rise to a recrudescence. The course and effects of the primary, or secondary, inflammatory changes will vary according to the conditions under which they occur, and it will here be convenient to consider them under the following heads:—

(*a*) *Acute catarrh of the gall-bladder and bile duct.*—Although extension of a catarrhal inflammation from the duodenum to the bile and pancreatic ducts is the most frequent cause, this condition is also occasionally associated with the presence of gall-stones.

The onset is gradual, with malaise, loss of appetite, and headache. Sometimes severe abdominal pain and cramps in the calves of the legs occur. Usually vomiting comes on after two or three days. Diarrhœa is occasionally present. The temperature generally ranges between 100° F. and 101° F.; severe rigors are sometimes met with, while chilliness and shivering are always present. Jaundice usually comes on a day or two after the vomiting, though it is sometimes delayed for a week; occasionally it is observed earlier. As a rule the temperature falls to

normal with the onset of jaundice, and remains so afterwards. The liver is, as a rule, tender, but is not often enlarged. The spleen is frequently enlarged.

(*b*) *Chronic cholangitis* (Fig. 14), or chronic catarrh of the bile ducts, may be simply a sequel to the acute form, and may then give rise to a more or less persistent jaundice, leading to a suspicion of serious organic disease.

Fig. 14.—A thick-walled gall-bladder, the result of chronic cholecystitis, containing numerous gall-stones. (Leeds.)

Although there are dyspeptic symptoms, due to the associated gastro-intestinal catarrh, with jaundice and some loss of weight, the retention of strength and the absence of serious sequelæ, such as ascites and hæmorrhage, generally enable a good

prognosis to be given, especially as the symptoms usually yield to proper treatment.

Catarrh of the bile ducts probably always accompanies jaundice from whatever cause, and, as Dr. Moxon has pointed out, a colourless mucus is always found in the bile ducts when an obstruction in the common duct is complete.

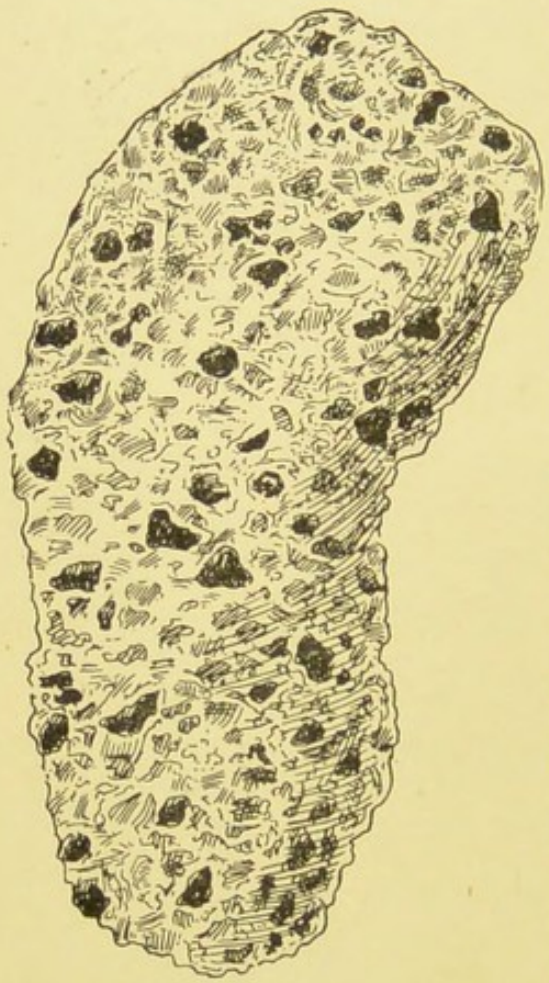


Fig. 15.—Bilirubin-calcium calculi imbedded in the gelatinous contents of the gall-bladder. (R.C.S.)

Gall-stones are probably always accompanied by catarrh, giving rise to the formation of thick ropy mucus (Fig. 15), which leads to attacks of pain when passing. Some of the minor seizures of pain not followed by jaundice—or if so, only to a slight extent—are of this nature, thus accounting for the relief that frequently follows purely medical treatment in cholelithiasis, giving rise to the erroneous idea that the

cause is removed, whereas the gall-stones generally remain, and at some future date may cause complications. It is quite a common event in sudden and severe gall-stone seizures occurring in middle life, or in advanced age, to have a history of "spasms" five, ten, or even twenty years before, which were supposed to have been cured by olive oil, or Carlsbad waters, or some other general treatment, so that in all sudden seizures in the upper abdominal region it is advisable to carefully consider the history long antecedent to the attack in question.

Although the jaundice in cholelithiasis is usually produced by a gall-stone obstructing the common or hepatic duct, it is undoubtedly true that in some cases jaundice is present when the concretion is in the gall-bladder or in the cystic duct; thus in sixty cases specially examined, where gall-stones were removed from the gall-bladder or cystic duct at operation, we have been able to detect bile pigment in the urine of ten. The obstruction to the flow of bile in these circumstances is caused either by pressure of the swollen head of the pancreas on the common bile duct, or by an inflammatory swelling of the mucous

membrane of the bile channels, brought about by extension from the seat of obstruction; in other words, the jaundice is dependent on catarrhal inflammation of the pancreas or bile passages. The latter occurs also in many cases where, after cholecystotomy has been performed and gall-stones have been removed from the gall-bladder and cystic duct, and the common duct has been shown to be free of all concretions, all the bile flows for several days through the tube introduced into the gall-bladder,—that is, until the inflammatory swelling of the mucous membrance of the common duct has had time to subside. Riedel (Gumprecht, *Deutsch. Med. Woch.*, 1895, No. 15) states that about two-fifths of the cases of jaundice in cholelithiasis arise in this way.

(*c*) *Catarrhal cholecystitis*, or chronic catarrh of the gall-bladder without jaundice, forms a distinct and definite disease, and we have seen several cases in which cholelithiasis had been diagnosed and operation advised, but where neither the gall-bladder nor ducts contained anything firmer than thick ropy mucus, which was apparently the cause of painful con-

tractions of the gall-bladder simulating gall-stone seizures.

This catarrh may be the sequence of gall-stone irritation, but in other instances may probably be due to the dependent position of the fundus of the gall-bladder, or to chronic constipation and accumulation of fæces in the hepatic flexure of the colon interfering with the regular emptying of the gall-bladder.

In all probability, in not a few of the cases where adhesions are found around a contracted gall-bladder and no concretions are met with, the attacks are kept up by catarrh of the gall-bladder and ducts, which it is next to impossible to diagnose from the ordinary gall-stone seizures.

In these cases the gall-bladder is usually distended, but it rarely forms a distinct tumour, and there is an absence of pain on pressure over it. Unless gall-stones have been present at some time, there are usually no adhesions of the gall-bladder or ducts to the neighbouring viscera, proving that the inflammation has not extended through to the peritoneal coat, as it usually does when dependent on cholelithiasis.

The diagnosis from cholelithiasis may usually be

made by observing that the attacks are less severe and less prolonged than in true gall-stone seizures; that no gall-stones are found in the evacuations after an attack; that jaundice seldom supervenes, and if it does is only very slight; that there is no tenderness on pressure between the ninth costal cartilage and the umbilicus; and that the affection will usually completely yield to treatment. Should medical treatment fail to relieve, it may be difficult to distinguish chronic catarrh of the gall-bladder from cholelithiasis; but if, under the belief that the case is one of gall-stones, the gall-bladder be exposed, and no concretions found, cholecystotomy, followed by drainage, will be likely to effect a cure.

Those cases of catarrh of the gall-bladder producing attacks resembling cholelithiasis without gall-stones, but associated with movable right kidney, probably owe their origin to kinking of the bile-ducts due to dragging by the displaced kidney.

Obliterative Cholecystitis and Cholangitis

It is now well recognised that repeated attacks of appendicitis may ultimately lead to obliteration of

the vermiform appendix, which may be discovered as a simple cord without any lumen in the centre of firm adhesions.

The same state may be brought about in the gall-bladder and bile-ducts by repeated attacks of inflammation, so that it is not very uncommon to find the gall-bladder and cystic duct represented by a mere fibrous cord, surrounded by adherent viscera, and unless carefully sought for it may be thought that they have been congenitally absent (Fig. 16).

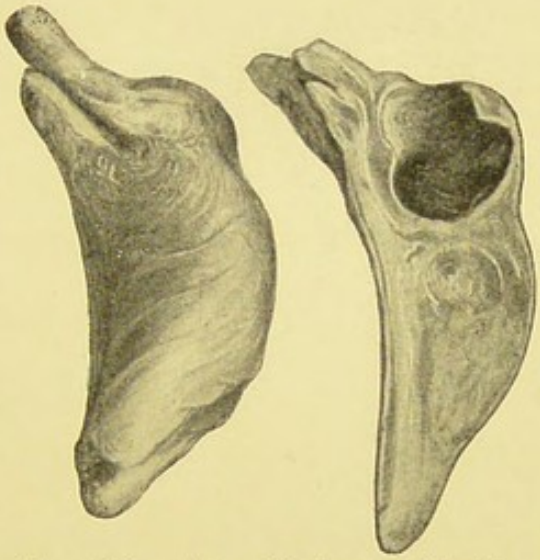


FIG. 16.—Atrophied gall-bladder, due to gall-stone cholecyst-duodenal fistula. (R.C.S.)

Between this form, which may be conveniently termed obliterative cholecystitis, and the ordinary contracted gall-bladder so frequently seen in operating for gall-stones, every degree of deformity may exist.

The gall-bladder may be only partly obliterated, and the small amount of mucous membrane left may continue to secrete a little mucus, and keep up

a constant state of irritation resembling true gall-stone seizures, or the cystic duct may be obliterated, and the gall-bladder may form a cyst containing mucus quite separated from the bile channels proper. In nearly all these cases the recurring pains call for operation, and unless the apparently insignificant and almost obliterated remains be taken away the attacks of pain, often associated with fever, will continue, and lead to serious deterioration of health.

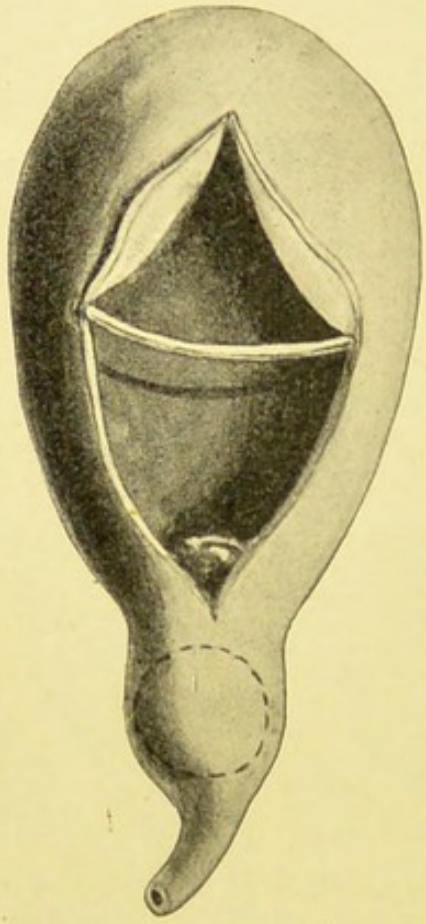


FIG. 17.—Gall-bladder containing a calculus blocking the entrance of the cystic duct, and a second calculus in the duct. (Leeds.)

Hydrops and *dropsy of the gall-bladder* are terms used to denote distension of the gall-bladder by mucus. It may result from any obstruction in the cystic or common ducts, whether due to gall-stones, stricture (Figs. 17 and 18), or growth in the ducts, or to cancer of the head of the pancreas, provided that the gall-bladder has not atrophied as the result of previous

gall-stone irritation. It is due to the gradual accumulation of the natural secretion of the mucous lining, and may attain such a size as to be mistaken for an ovarian cyst, though it is uncommon to find the tumour of greater size than 15 to 20 ounces capacity. If the obstruction be associated with inflammation, the contents of the gall-bladder may become purulent, and an empyema of the gall-bladder may result.

Croupous Inflammation of the Gall-Bladder and Bile Ducts

It had been noticed as far back as 1820, by Dr. Richard Powell (*Medical Transactions* of the College of Physicians), that membranous or croupous enteritis was frequently associated with attacks simulating gall-stone seizures; and Sir Jonathan Hutchinson, in his *Archives of Surgery*, in commenting on this paper, suggests that in some of these cases a *bonâ-fide* attack of gall-stone colic may have been the cause of the membranous enteritis.

From a number of cases that we have seen and observed, some of them having been submitted to operation without finding gall-stones, but where

there was abundant evidence of inflammation of the gall-bladder and bile ducts, we have formed the opinion that the cause of the painful attacks, followed by slight jaundice in these cases of membranous enteritis, is the formation of membrane in the bile passages, which, partly obstructing the bile flow, sets up spasm of the gall-bladder, just as a gall-stone or even a lump of tenacious mucus will do.

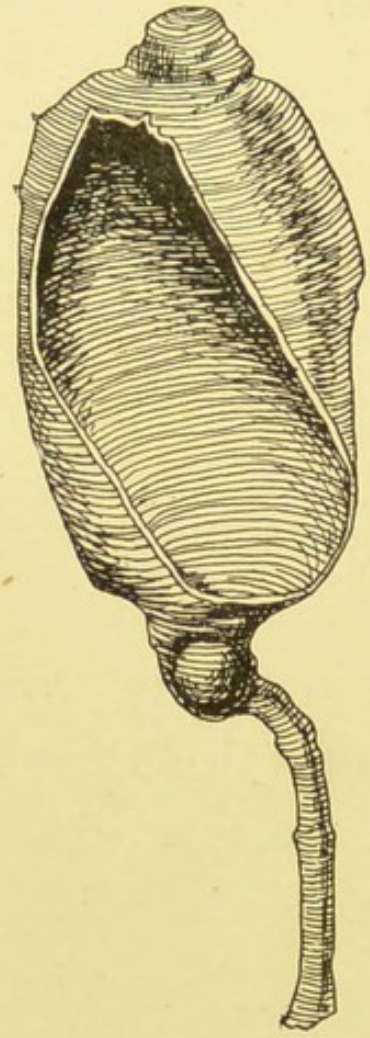


FIG. 18. — Distended gall-bladder with pouch at fundus, caused by a calculus obstructing the cystic duct. (R.C.S.)

Owing to the disintegrating effect of the bile and of the intestinal secretion, it seldom happens that a true cast of the gall-bladder or bile ducts is discovered.[1]

Diagnosis.—As the symptoms so exactly resemble gall-stone attacks, the disease can only be differentiated by an examination of the evacuations,

[1] For illustrative cases see *Diseases of the Gall-Bladder and Bile Ducts*, by Mayo Robson (Balliere, Tindall & Cox), 1904, p. 876.

when the discovery of membranous intestinal casts will raise the suspicion of croupous cholecystitis or choledochitis. Should a cast of the gall-bladder be discovered, the diagnosis will be rendered certain, but in the absence of such positive evidence the possibility of gall-stones being also present will be entertained.

Suppurative Inflammation of the Bile Passages

When the flow of bile along the ducts is arrested, micro-organisms often invade the gall-bladder either from the blood or the intestine.

Charcot and Gombault demonstrated organisms within it after ligaturing the common duct in dogs. This was confirmed by Netter in 1886, who found that, twenty-four hours after aseptic ligature of the common duct in dogs, organisms (both staphylococci and *B. coli communis*) could be cultivated from the bile.

Ehret and Stolz[1] performed several experiments to explain the sudden occurrence of inflammation in connection with chronic cholelithiasis. Sterilised hollow glass balls were inserted into the gall-bladders

[1] *Berl. klin. Woch.*, 5th January 1902.

of dogs. About three months afterwards, some of the animals were fed on decomposing food. They began to suffer from diarrhœa, and died within a few weeks, purulent cholecystitis being found post-mortem. In another series of animals, small fragments of sterilised cotton-wool were inserted into the gall-bladder. Eight to ten months afterwards, two of the animals, apparently in perfect health, were examined by laparotomy. The gall-bladder was thickened, and contained a number of organisms, chiefly *B. coli*. The other dogs died in from eight to sixteen weeks, and suppurative cholangitis and cholecystitis was found. Ehret and Stolz thought that, as the illness appeared suddenly long after the operation, it was probably due to auto-infection, very likely from the intestine, and they emphasise the fact of the temporarily increased virulence of the *B. coli* during an attack of diarrhœa.

Simple Empyema

Suppurative catarrh, or simple empyema, of the gall-bladder, or suppurative cholecystitis, is, as a rule, associated with gall-stones; but tumours of the bile

ducts, typhoid and other fevers, and other unexplained conditions, may also be the predisposing factors, though infection by pyogenic organisms is probably in every case the true exciting cause.

When we bear in mind Charcot and Gombault's experiments on ligature of the common duct in dogs,[1] just referred to, the wonder is that all impacted gall-stones are not associated with empyema; yet such is not the case, and it is only in a certain small percentage that the catarrh passes on to suppuration.

When there is an obstruction, or any irritation, in the cystic duct, a simple empyema may result (Fig. 19), but when the obstruction is in the common duct, it may be associated with infective, or with suppurative, cholangitis, an extremely serious disease, rapidly followed by general symptoms, and, unless treated by operation, usually ending fatally.

In simple empyema the *symptoms* will at first depend on the cause, and as this is, in the great majority of cases, cholelithiasis (Courvoisier found empyema to be caused by gall-stones in forty-one out of fifty-five cases), there will be the usual history

[1] *Progrès, Médical*, 1886, p. 996.

of gall-stone seizures, followed by a swelling under the right lobe of the liver and by a continued instead of an intermittent pain.

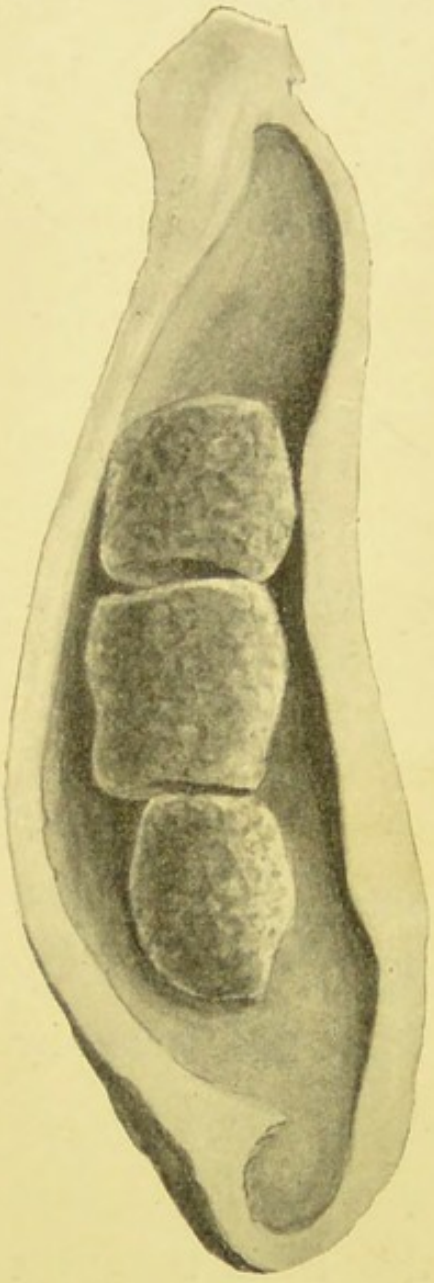


Fig. 19.—Empyema of the gall-bladder. The gall-bladder was originally full of pus. (Leeds.)

At first the constitutional symptoms may be only slightly marked, and there may be no increase of temperature, though in the later stages, and in some from the commencement, rigors or chills with fever will point to the formation of pus. The different effects seem to be determined by the absence or presence of ulceration of the mucous membrane.

The patient is, as a rule, driven to bed at an early stage on account of the pain on movement. The loss of appetite, fever, and general malaise, usually lead to loss of flesh and weight. As

a rule, there is no jaundice, or only a slight icteric tinge, dependent on associated catarrh of the bile ducts. Tenderness is always present, in consequence of the local adhesive peritonitis. The most tender spot is at some point in a line between the ninth costal cartilage and the umbilicus, but in many cases the tenderness is diffused over the right upper half of the abdomen.

The tumour, if seen at an early stage, will move with respiration, descending with the liver, and be felt as a rounded swelling. After a time the swelling may become more diffused and general, and the movements during respiration will be less marked, or may cease, owing to inflammation extending to the abdominal walls. If the suppuration extends beyond the gall-bladder and remains local, the pus may make its way through the parietes, and an abscess may form under the right costal margin.

The abscess may even burst at a distance from its origin—for instance, over the pubes or over the cæcum—or it may, after setting up adhesions to adjoining viscera, be discharged into the duodenum, colon, stomach, or pelvis of the kidney; or, passing

into the liver, it may lead to abscess of that organ; or, perforating the diaphragm, it may discharge into the pleura and set up empyema, or into the pericardium and incite pericarditis, or into the peritoneal cavity and produce acute general peritonitis.

There are generally peritoneal adhesions which prevent extravasation into the general peritoneal cavity; but the pus may make its way into neighbouring organs.

Needless to say, an abscess of the gall-bladder only requires treating on general surgical principles by opening and drainage; but the cause must not be overlooked, as it may often be removed at the same time that the abscess is evacuated.

Acute Phlegmonous Cholecystitis and Gangrene of the Gall-Bladder

Although the condition is usually associated with gall-stones (Fig. 20), acute cholecystitis may arise quite independently—in this way resembling appendicitis, which may occur without the presence of concretions or foreign bodies. Typhoid and typhus

fevers, cholera, malaria, sepsis after operation, puerperal fever, and other unknown conditions may give rise to it.

Symptoms. — Whatever be the cause, the disease usually manifests itself somewhat suddenly, with pain on the right side of the abdomen, rapidly becoming general. A rapid and feeble pulse, quick thoracic breathing, fever, intense depression, marked tenderness on pressure (especially over the right side of the abdomen), rapidly developing tympanites, vomiting, and an extremely anxious expression of countenance, are usually present.

FIG. 20.—Acute cholecystitis with sloughing of the mucous membrane. The gall-bladder was full of stones. (R.C.S.)

The acute peritonitis, which is significant of the disease, may be localised at first, but later becomes general.

Jaundice may or may not be present, and although an elevation of temperature is usual, it is by no means constant, and affords only slight assistance in the diagnosis or prognosis.

If the disease be of the very acute or gangrenous variety and early surgical treatment be not carried out, death may speedily occur; but if of the subacute form, an abscess may develop around the gall-bladder, and the peritonitis may become localised, the disease then resembling a perityphlitic abscess in its course.

Diagnosis.—The diagnosis of phlegmonous cholecystitis practically resolves itself into the diagnosis of the cause of acute peritonitis, starting on the right side of the abdomen.

Although this may be due to perforation of the stomach at, or near, the pylorus, to perforation of the duodenum or ascending colon, to perforation of the gall-bladder or bile ducts, and to other suchlike peritoneal catastrophes, the chief affection for which it is likely to be mistaken is acute appendicitis.

In some cases the normal descent of the cæcum into the right iliac fossa does not take place, the cæcum and colon, with the appendix, being found in

the right hypochondrium in close relation to the gall-bladder. A few cases have been recorded in which this relation was present, and an attack of appendicitis led to the development of an abscess beneath the right costal margin. Such a case would give rise to great difficulties in diagnosis, and it might be impossible to say until the abdomen was opened whether the condition was due to gall-bladder trouble or to appendicitis. In appendicitis the pain usually begins around the umbilicus, and is subsequently referred to the right iliac fossa, or it may start at a lower point in the abdomen and pass towards the umbilicus; whereas in gall-bladder trouble it begins below the right costal margin, and passes towards the epigastrium and back to the right scapular region.

In gall-bladder inflammations there is almost invariably a tender spot a little above and to the right of the umbilicus, or, to be more exact, at the junction of the upper two-thirds with the lower third of a line drawn from the ninth rib to the umbilicus, or it may be all along this line or at any point of it, though at the point named it is the most frequent.

It will be found that this point is tender both to

touch and to pressure, it being in reality the site of a reflected pain passing along the splanchnic to the eighth and ninth right dorsal nerves, and thence reflected to the surface termination of these nerves. Even when the gall-bladder is displaced, owing to deformity or enlargement of the liver, so that it is placed at a distance from its usual position, we have found this spot to be tender on pressure, thus affording a valuable means of diagnosis.

As a rule, besides this point of tenderness, a peculiar sickening pain will be felt on direct deep pressure over the gall-bladder itself, usually just below the right costal margin, but in case of displacement of the gall-bladder the pain on deep pressure may be as low as the iliac fossa.

When gall-stones are in the common duct, the pain on deep pressure is generally above the umbilicus, nearer to or even in the mid-line.

In appendicitis there is in the same way a tender spot at the junction of the outer third with the inner two-thirds of a line drawn from the umbilicus to the anterior superior spine of the ilium, known as M'Burney's point.

The symptoms of acute peritonitis and paralytic obstruction of the bowels are common to both. Fortunately, the treatment by exploratory incision is appropriate to both; but it is important to distinguish between them, as if the incision is made over the gall-bladder in a case of appendicitis, or *vice versa*, an abscess may be opened through the unaffected peritoneum, and give rise to general peritonitis.

Treatment.—Relief of pain by subcutaneous injections of morphia will probably always be demanded as a preliminary measure, and as it is often impossible to make a diagnosis of the serious condition within the first few hours, warm applications should be used, and absolute rest enjoined, all feeding by the mouth being stopped, and the relief of symptoms as they arise being attended to; but as soon as the diagnosis of phlegmonous cholecystitis can be established, and it is found that the patient is getting worse, an exploratory incision should be made, and the gall-bladder incised and drained, the cause, if found, being removed.

Cholecystectomy, if the patient's condition will permit of it, is the best operation, as it completely removes the focus of disease.

If gangrene be discovered, the gall-bladder should be excised, the indications for that measure being as distinct as in the case of a gangrenous vermiform appendix.

If, in the subacute cases, the inflammation becomes localised, and a swelling with tenderness be found beneath the right costal margin, incision and drainage is called for, when at the same time cholecystotomy may be performed, and if gall-stones be present in the gall-bladder or ducts, they may be removed. If the patient be too ill to bear a prolonged operation, the latter procedure may be left to a subsequent occasion.

Gangrene of the gall-bladder is an extreme degree of phlegmonous cholecystitis.

The comparative frequency of gangrene in the vermiform appendix might lead one to suppose that gangrenous inflammation of the gall-bladder would not be uncommon; yet it is apparently rarely seen.

In order to explain the occurrence of gangrene, three factors have to be borne in mind:

(*a*) Thrombosis of the nutrient vessels.

(*b*) Bacterial infection.

(*c*) Absence of drainage (and therefore tension).

The two latter are present in both gall-bladder and appendix inflammation, but the first factor is more frequent in the vermiform appendix, which is only supplied by one nutrient artery, whereas the gall-bladder has a very free blood supply, not only through the branches of the cystic artery, but also through their anastomoses with the hepatic vessels, where the gall-bladder is fixed to the liver.

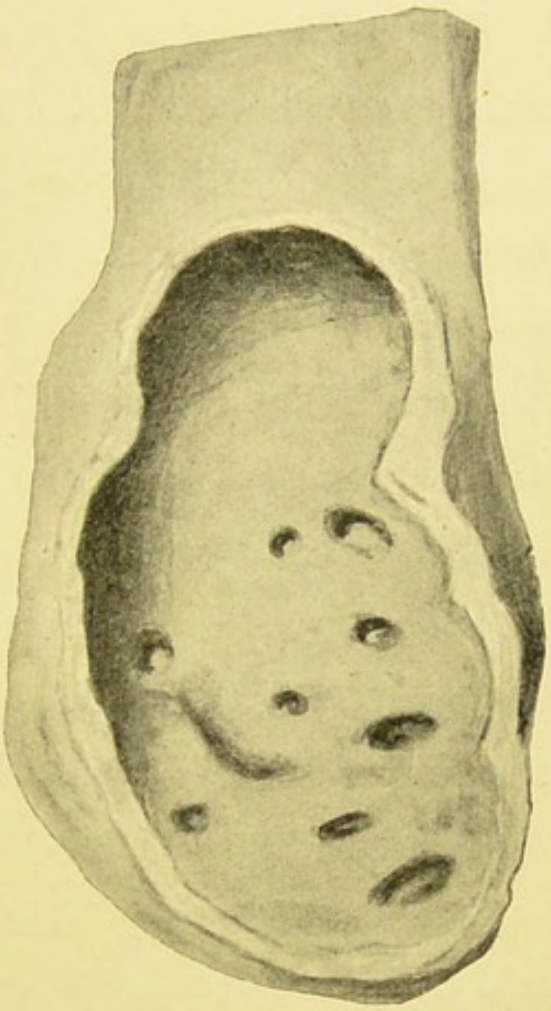


FIG. 21.—Hypertrophy and dilatation of the gall-bladder, with pouches formed by the mucous membrane bulging between the muscular fasciculi. (R.C.S.)

Hypertrophy of the gall-bladder forming a large tumour is not infrequently seen as a result of cholelithiasis. The contents may be mucus or muco-pus, and gall-stones may, or may not, be present when the tumour is removed, though probably in every case biliary concretions have actually

initiated the trouble by obstructing the outlet and producing cholecystitis (Fig. 21).

Firm adhesions to the neighbouring organs, the result of local peritonitis, form a distinct feature of these tumours, and though their separation may be tedious, this should be done, and should be followed by cholecystectomy.

Distension of the gall-bladder by gas.—We have on two occasions found the gall-bladder to be a resonant swelling due to its being distended with gas. In both cases there was a small fistula between the cavity of the gall-bladder and the duodenum left by the passage of gall-stones through an ulcer that had perforated into the intestine. The evacuation of the contents had taken place long antecendent to the operation, and serious trouble had not arisen until the fistula had become too small to permit of the passage of mucus and pus from the inflamed sac. The cases were both cured by cholecystectomy and closure of the intestinal opening.

Infective Cholangitis

Infective cholangitis, or infective catarrh of the bile ducts, was first described by Charcot under

the name of "intermittent hepatic fever." It is usually due to gall-stones in the common duct, which favour the entrance of organisms from the intestine through the duodenal orifice; but anything causing obstruction of the common or hepatic ducts may lead to infection of the retained bile. Thus, we have known infective cholangitis to follow on chronic pancreatitis, cancer of the pancreas, cancer of the common bile duct, hydatid disease, lumbrici in the bile duct, pancreatic calculus and stricture of the common duct, besides general ailments such as typhoid fever and influenza.

Courvoisier, Osler, and Fenger have each described the ball-valve action of gall-stones in a dilated common bile duct, thus accounting for the intermittent character of the jaundice and the irregular course of the disease.

Although this condition, in which the gall-stones are freely movable or even floating in the common duct, does give rise very frequently to infection of the bile ducts, the fixed concretions, single or multiple, are, in our experience, equally potent in

setting up infection, for in the latter case ulceration is frequently associated.

The usual history is one of "spasms" for several years, without jaundice; then comes a more severe seizure, followed by temporary icterus. If the gall-stone passes, there is an end of the trouble; but if not, the next attack of pain is probably immediately followed by a shiver, and by all the symptoms of an "ague fit," the temperature frequently reaching 104° or 105° F. After it has passed off, the skin is more deeply tinged, and the jaundice may persist, though it varies in degree; it rarely, however, completely disappears between the attacks, there being usually a slight icteric tinge of the conjunctivæ, even though the interval between the attacks may be one of weeks or months. The rigors may be repeated daily, or at irregular intervals.

The gall-bladder may be felt as an enlargement below the right costal margin; but this is not usual, as where there are gall-stones it is more common to find the gall-bladder contracted. The liver at first is not enlarged, but later its lower margin may descend considerably.

Tenderness over the gall-bladder, or in the epigastric region, can generally be elicited. There is usually well-marked loss of flesh and strength, and if unrelieved by Nature or art, the disease may run on into suppurative cholangitis and its complications.

Infective cholangitis may persist, off and on, for years, and may end in recovery; but, on the other hand, it may assume an acute form, and lead to death from pain, biliary toxæmia, and exhaustion. The complications which may follow are suppurative cholangitis, diffuse hepatitis, abscess of the liver, cirrhosis of the liver, pylephlebitis, cholecystitis and empyema of the gall-bladder, perforation of the ducts, acute, subacute, or chronic pancreatitis, diabetes, endocarditis, pleurisy, pneumonia, and other septic diseases.

Diagnosis.—Ague, being rare in England, is not so readily thought of as it is in countries where malaria is endemic; but the regularity of the chills, and the slight jaundice and enlargement of the spleen in some cases, will usually suggest it, though the pain and tenderness, the history of cholelithiasis, and the absence of relief by large doses of quinine,

and an examination of the blood, soon settle the doubt. As infective diseases in the bile passages are prone to end in suppuration, abscess of the liver and suppurative cholangitis may supervene; but the more prolonged course of infective cholangitis, the comparative good health between the attacks, the irregularity in the course of the disease, and the absence of rapid and progressive deterioration of health, will usually enable a diagnosis to be made, though the loss of flesh may be remarkably rapid, especially if the pancreas becomes involved. When suppuration exists, there are usually increased tenderness over the liver area, continued or irregular intermittent fever, and intense and persistent jaundice.

Treatment.—If possible, the cause should be removed; but should this prove impossible, the ducts can be drained. Fortunately, this may be accomplished with every prospect of success if, as is commonly the case, the disease be due to gall-stones.

There can be no doubt in the minds of those who have observed many of these cases, that it is better to anticipate the complication, and as soon as medical treatment has been fairly tried and failed, the removal

of gall-stones by surgical means should be resorted to before infection of the bile passages has occurred.

Suppurative Cholangitis

Suppurative cholangitis, or suppurative catarrh of the bile ducts, is a subject of deep interest, and a disease of serious import, from the combined effects of biliary obstruction and stagnation, with septic infection, and their local and constitutional effects.

Etiology.—Cholelithiasis is by far the most common cause, but hydatid disease, ascarides, cancer of the bile-ducts, typhoid fever, and influenza may also cause suppurative cholangitis, and it is probable that the disease not infrequently complicates other acute infectious ailments.

The causes mentioned may truly be termed predisposing, since the true exciting cause is the presence of pyogenic organisms.

The *B. coli communis* produces an exudative inflammation of the ducts, and may actually cause abscesses within the walls of the biliary passages.

Hepatitis and liver abscess frequently follow on

cholangitis, and these are usually succeeded by general and fatal infection of the system.

Endocarditis is at times set up, and as it has been known[1] to follow cholangitis without hepatitis, and cholangitis without abscess, this possible cause should never be lost sight of in any case of ulcerative endocarditis. The bacillus in the vegetations on the inflamed endocardium in these cases has been found to be identical with that found in the bile. Jaccoud and Aubert[2] also found endocarditis present in cases of cholangitis.

Symptoms.—In suppurative cholangitis there is progressive enlargement of the whole liver, which may descend as low as the umbilicus, the swelling being uniform, smooth, and tender to pressure; but the enlargement may be masked by cirrhosis. If the cause be in the common duct, and the gall-bladder has not previously become contracted, there will be the additional enlargement caused by its distension; but when contraction has taken place, and also when the obstruction is in the hepatic duct, there will be

[1] Netter and Martha, *Archives de Physiologie*, vol. ix. 1886.

[2] *Clin. Med.* de Lariboisière.

an absence of the signs of empyema of the gall-bladder.

Pain may be entirely absent where the disease is associated with cancer of the common duct; but where it is dependent on gall-stones, the pain may be severe and paroxysmal, each attack being accompanied by ague-like seizures and an intensification of the jaundice.

Jaundice is always present, and is usually both persistent and intense, though, where the obstruction is a floating gall-stone acting like a ball-valve in the common duct, the jaundice may vary from time to time, and may almost disappear between the attacks of pain. Fever, with occasional rigors and profuse perspiration, forms a feature of the disease, and with this there is rapid loss of flesh and strength.

Pneumonia and pleurisy, ending in empyema, are serious and not infrequent complications are suppurative cholangitis. The disease is an extremely serious one, and usually proves fatal, though, if the cause can be removed at an early stage, recovery may occur.

If the course be less acute, the inflammation may

concentrate itself in some part of the liver, leading to abscess, which may form a distinct tender swelling, and give rise to the usual symptoms and signs of hepatic abscess.

Treatment.—Unless free evacuation and drainage of the infected contents of the bile passages can be accomplished, either naturally or artificially, treatment is practically useless. Therefore, if practicable, cholecystotomy or choledochotomy should be performed, and free drainage estalished and continued until the bile is sterile, or nearly so.

Although good results cannot be expected in all cases, an amelioration of the symptoms may be looked for in a fair proportion, and complete relief in others.

If a localised abscess be discovered in the liver, it should be opened and drained, and though it is scarcely to be expected that operation can be always successful in these more serious cases, the chance of permanent benefit is worth snatching at, even in the most desperate conditions.

Of general means, warm applications to the hepatic regions, an initial mercury purge followed by milder laxatives, the employment of intestinal

antiseptics, such as bismuth and salol, the relief of pain by sedatives (if called for), and the treatment of symptoms as they arise, will afford some amelioration, though they will probably only give temporary relief.

Cholecystotomy, or choledochotomy, and drainage of the bile ducts is the operation called for, and at the same time the obstruction, if one be present, should, if possible, be removed; though in some cases, where the patient is extremely ill, the latter part of the operation may be deferred until the drainage has cleared away all the infective material.

Thanks to the opening in the gall-bladder, a certain number of important therapeutic results follow:

First. The septic contents of the gall-bladder are evacuated.

Second. Calculi, which are most frequently present there, are removed.

Third. The other biliary passages, more or less obstructed either by calculi or by swelling of their walls, are rendered as free as possible.

Fourth. The septic bile is allowed to escape, and

mechanically washes out the lower passages, carrying away through the drainage-tube many of the infective elements.

Fifth. The relief of pressure prevents absorption of the septic matter.

Sixth. The relief to the kidneys, by allowing the bile to escape freely, is also of importance, as they are thus enabled to perform their function more freely in relieving the system of septic and other materials.

Seventh. The swelling of the head of the pancreas, "chronic pancreatitis," so often present where the common bile duct is obstructed, subsides owing to the indirect drainage of the pancreatic ducts.

CHAPTER VII

ULCERATION, FISTULÆ, AND INTESTINAL OBSTRUCTION

Ulceration of the Gall-Bladder and Bile Ducts

Ulcers of the gall-bladder or bile ducts vary greatly in number, size, and depth, as also in clinical importance.

They may be quite superficial, being mere abrasions of the epithelial lining of the mucous membrane, then being as a rule numerous and widespread, or they may be single and deep, extending into, or through, the muscular and serous coats. Between these extremes every variety may be found.

Although cholelithiasis is the most frequent, typhoid fever and cancer are quite common causes, and cholera is also said to produce ulcers.

The slighter cases of erosion are seldom seen,

though doubtless they frequently exist in cases operated on for gall-stones, and in others where the concretions are passed naturally; but the severer forms of ulceration are more frequently met with as the immediate cause of death.

Ulceration is chiefly of importance on account of the serious sequelæ—stricture, perforation, fistula, peritonitis (local or general), hæmorrhage, septicæmia, and pyæmia.

The inflammation accompanying ulceration usually extends to the peritoneal coat at the site of the ulcer and leads to a plastic peritonitis, which causes the adjoining organs to adhere to the inflamed surface, thus in the greater number of cases keeping the peritonitis local.

Adhesions.—Some years ago we pointed out that in nearly every case of gall-stones there are adhesions of the gall-bladder or ducts to neighbouring organs, showing that peritonitis is a frequent or nearly constant accompaniment of cholelithiasis. It is doubtless a salutary phenomenon, as otherwise general peritonitis would be much more common, especially in the many cases where the adhesions permit of

fistulæ quietly forming between the contiguous viscera, and where localised abscesses form without general peritonitis.

The adhesions may, either by the anchoring of normally mobile organs, or by subsequent contraction, themselves become sources of inconvenience or danger.

Peritonitis, though usually local in cases of cholelithiasis, may become general, either from perforation, or by extension to the peritoneum through the non-perforated walls.

Under such circumstances prompt surgical treatment will be required, or death will speedily follow.

It is important to note that in perforative peritonitis from diseases of the gall-bladder or bile ducts the effusion is at first limited to the larger pouch on the right side of the abdomen; these cases are therefore very amenable to treatment if operated on within a short time of the catastrophe, whereas in case of delay the fluid, which is infective, tends to pass into the pelvis and to produce general infection of the peritoneum.

Hæmorrhage.—As the ulcer extends, the vessels

usually become thrombosed, but occasionally severe hæmorrhage results, leading either to hæmatemesis or melæna.

It is to be borne in mind that hæmorrhage is predisposed to in these cases by the aplastic condition of blood occurring in long-standing jaundice.

As ulceration is always associated with the presence of pyogenic organisms, septic absorption usually occurs, leading to constitutional disturbances in the shape of septicæmia and pyæmia, as described under infective cholangitis.

Stricture of the Gall-Bladder and Bile Ducts

Stricture may only render itself evident after the original cause has passed away, as in several cases of stricture of the cystic and of the common duct on which we have operated, where the cause in the shape of gall-stones was removed, and the strictures which developed had subsequently to be treated (Fig. 22).

If the stricture be in the hepatic duct, it will lead to jaundice without distension of the gall-bladder; if in the cystic duct, to distension of the gall-bladder

without jaundice; but if in the common duct, both to jaundice and distended gall-bladder, unless the latter be contracted as the result of previous gall-stone trouble.

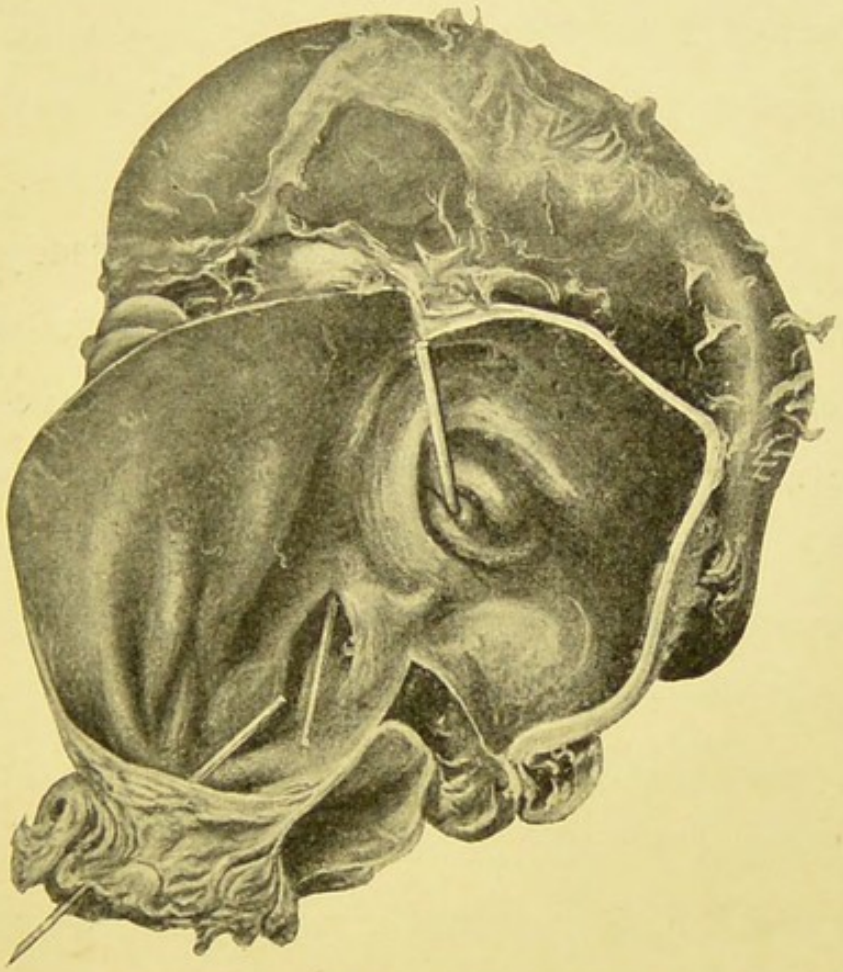


FIG. 22.—Dilated common bile duct, forming a thick-walled cyst 6 inches in diameter. (Guy's.)

Armeus (*Thèse de Paris*, 1896) has shown that it is possible for the contents of the gall-bladder to remain aseptic in cases of obliteration of the cystic duct, and that in this condition atrophy of the organ results.

In the majority of the cases, however, where the stricture of the cystic duct is due to ulceration following the impaction of gall-stones, extensive changes will have already taken place in the gall-bladder. It may be contracted, the walls being composed merely of cicatricial tissue. In such a case the contracted gall-bladder remains quiescent.

Where extensive changes have not already taken place in the wall of the gall-bladder, and where the mucous membrane is still active, distension of the organ with mucus or muco-pus will take place. If relief is not afforded by operative measures, of which cholecystectomy is chiefly indicated, suppurative or phlegmonous cholecystitis may occur, or the distended organ may rupture into the peritoneum, or discharge its contents by the formation of a fistula between the gall-bladder and duodenum, stomach, or colon; or the gall-bladder may gradually dilate so as to form a tumour resembling an ovarian cyst.

Symptoms.—If in the cystic duct, stricture leads to a gradual enlargement of the gall-bladder, which may be quite painless, or give rise to considerable distress.

If in the common duct, jaundice supervenes, at first being only slight, but ultimately becoming severe, and being associated with all the usual distressing and dangerous symptoms of chronic icterus. The liver enlarges, and may descend to the level of the umbilicus; the gall-bladder may also enlarge, though, if gall-stones have been the cause, the gall-bladder may have become contracted, and so be incapable of distension.

Stricture of the hepatic duct is probably extremely rare.

A form of stricture, not common, may be found in the gall-bladder, converting that ordinarily pear-shaped cavity into the form of an hour-glass.

Needless to say, stricture of the bile passages will scarcely call for diagnosis apart from its cause, though different treatment will be demanded when the disease is recognised at the time of operation. In stricture of the cystic duct the gall-bladder should be removed, otherwise a recurrence of the symptoms will occur when the wound closes, or there will be a permanent mucous fistula.

In stricture of the common duct the operation

of cholecystenterostomy will short-circuit the obstruction. If the stricture be narrow it may be possible to divide it longitudinally and bring the edges together transversely, as in the operation of pyloroplasty.

Perforation of the Gall-Bladder and Bile Ducts

Perforation of the gall-bladder or bile ducts must always be serious, on account of an escape of the visceral contents into the peritoneal cavity; the imminence of the danger, however, depending on two factors: first, the nature of the extravasated fluid; and, secondly, the time allowed to elapse before surgical relief is afforded.

The presence of healthy bile in the peritoneum, due to an injury such as a stab, a bullet wound, or a blow, in a healthy individual, may be tolerated for some time without serious damage. It is of far more serious moment when the extravasated bile is pathological, as it for the most part is where there is distension of the gall-bladder or any disease of the bile ducts; for in such cases the bile is infective, and rapidly sets

up a diffuse peritonitis, which, unless speedily operated on, ends fatally. If the diagnosis be made at once and early operation done, the prognosis is good.

In rupture of the gall-bladder from sudden pressure, induced by straining at stool, vomiting, sneezing, efforts in parturition, or even by blows over the hepatic region, there is in all probability in the greater number of such cases a predisposition to rupture, in the shape of thinning by ulceration or by long-continued distension, otherwise the accident would be much more common.

In the greater number of cases, perforation occurs slowly.

It is highly dangerous to permit patients with distended gall-bladders to go unoperated on even though symptoms be only occasionally present. A careful operation in these cases is almost devoid of risk, but rupture is hazardous in the extreme.

Massage in cases of distended gall-bladder we look on as the height of folly. Attempts to force impacted calculi onward by pressure are well calculated to rupture the thinned wall of the gall-bladder or bile

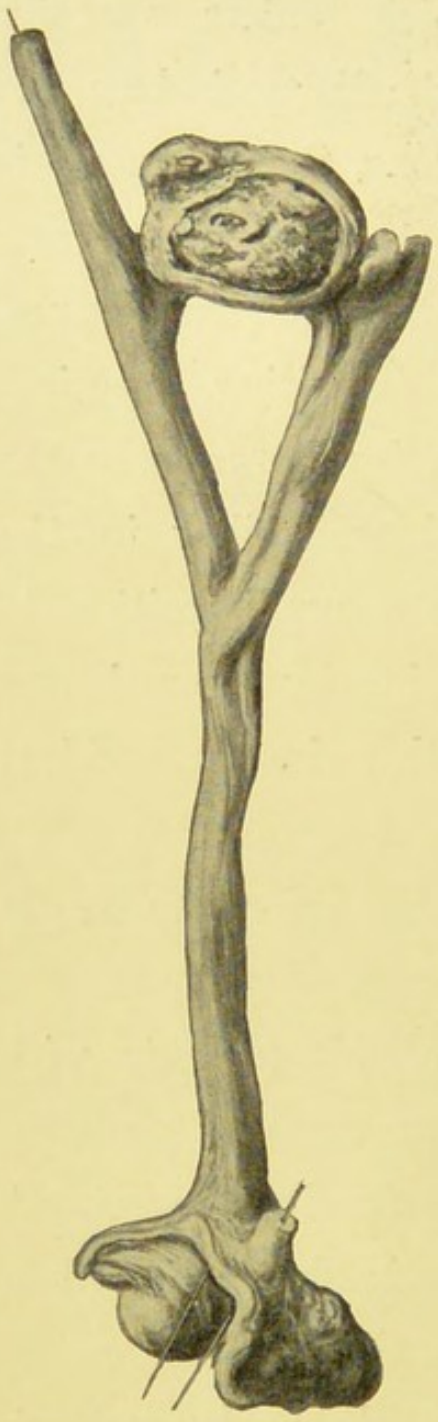


FIG. 23.—Adventitious sac containing a gall-stone situated between the hepatic and cystic ducts. (R.C.S.)

ducts, or to cause perforation through the base of an ulcer, leading to extravasation of infective matter into the general peritoneal cavity, and probably to fatal peritonitis.

Gall-stones may perforate the mucous membrane and become encysted in the wall of the ducts (Fig. 23).

In some cases the primary perforation may lead to the formation of a second cavity bounded by plastic lymph, which may again rupture, and lead to a fatal peritonitis.

Erdman strongly advocates cholecystectomy, and does not approve of cholecystotomy or of repair of the perforation by suture. He gives a record of thirty-four cases, with four recoveries. Of these thirty-

four cases, twenty-seven were not operated upon, and all died. Of the seven cases in which an operation was performed, four recovered and three died.

The perforation may also take place into adjoining parenchymatous organs. On several occasions we have removed gall-stones from cavities in the liver produced by ulceration and perforation of the gall-bladder or bile ducts, and direct passage of the contents into the liver tissue. In such cases there are the usual signs of liver abscess following on the ordinary symptoms of gall-stones, which may have been present for years.

If the ulceration and perforation occur from the common duct into the substance of the pancreas, an abscess may develop or acute pancreatitis may follow; but even without perforation, an infective inflammation may pass from the common bile duct to the pancreas.

If the ulceration advance towards the adjoining hollow viscera, stomach, duodenum, or colon, adhesions as a rule form, and the perforation is effected quietly. In several cases we have known

large gall-stones to ulcerate their way quietly, and to perforate the intestine, only producing serious symptoms from mechanical intestinal obstruction.

Rarely gall-stones have perforated into the pelvis of the right kidney, producing symptoms of renal calculus. Michel[1] has recorded a case in which four gall-stones were removed from the urinary bladder three years after an attack of peritonitis on the right side of the abdomen. Perforation probably took place into the right ureter.

Not infrequently perforation may occur after adhesions to the parietal peritoneum have formed, and then a superficial abscess may follow, discharging gall-stones.

Specimens in the museums show that, although adhesions may have formed, the process of ulceration into a neighbouring cavity is by no means always free from danger of perforation into the general peritoneal sac.

There is also another danger, which should by no means be despised, and that is the fear of absorp-

[1] Michel, *Zentralblatt f. Gynaek.*, 1909.

tion of toxins, with subsequent septicæmia or pyæmia.

The symptoms of perforation of the bile passages are those of perforative peritonitis from other causes, but there will usually have been premonitory symptoms pointing to the origin of the disease.

A sudden pain beneath the right ribs, and collapse, usually succeeded by vomiting, general distension of the abdomen, and a rapid pulse, form the prominent features of the disease.

If the extravasation is extensive, there will be signs of free fluid in the peritoneal cavity.

Jaundice, if not present before the accident, usually comes on from absorption of biliary pigment by the peritoneum, and if the bowels can be moved, the motions will usually be clay-coloured.

If the case be not operated on, death will probably ensue within a few days from toxæmia and paralysis of the bowels, though in some cases life has been prolonged into the second or third week.

Treatment.—In these cases medical treatment is useless, and to give opium for the relief of pain so disguises the symptoms that a fatal sense of security

is given for a time, and when the mistake is discovered it may be too late to operate.

As soon as it is clearly made out that perforation has occurred, or even if it be suspected that such is the case, the abdomen should be opened in the right semilunar line.

If pus and bile be found, they should be rapidly wiped away with gauze or wool sponges, and if the extravasation has gone beyond the local area of disease, the abdomen should be flushed with hot sterilised saline solution.

The patient may be too ill to bear a prolonged operation, and if so, free drainage will probably do all that is necessary.

In draining, it should be borne in mind that the right kidney pouch forms a distinct peritoneal pocket, and that a drainage tube applied through a stab opening in the right loin affords a free exit for extravasated fluids coming from the neighbourhood of the gall-bladder. If the whole peritoneal cavity has been soiled, a puncture above the pubes large enough for a tube to be passed into the pouch of Douglas may be an advantage.

If the patient be in sufficiently good condition to permit a search for the rupture, and it can be found, it may be closed by fine silk or catgut sutures, but as a rule it will be wise to open and drain the gall-bladder at the same time.

Should marked cholecystitis be found, the question of cholecystectomy may be worth considering; but when the patient is in a critical condition it is a mistake to attempt too much, and, as a rule, cleansing and free drainage will be all that are necessary or advisable at the time, the removal of the cause being left until the patient is better able to bear a more prolonged operation.

Fistula of the Gall-Bladder and Bile Ducts

Fistulæ in connection with the bile passages are by no means uncommon, and their variety is considerable. They result from operation, or from disease, and in the latter case they are due to ulceration resulting from gall-stones or cancer (Fig. 24).

The fistulous channel may either be direct or indirect, in the former being caused by an advancing

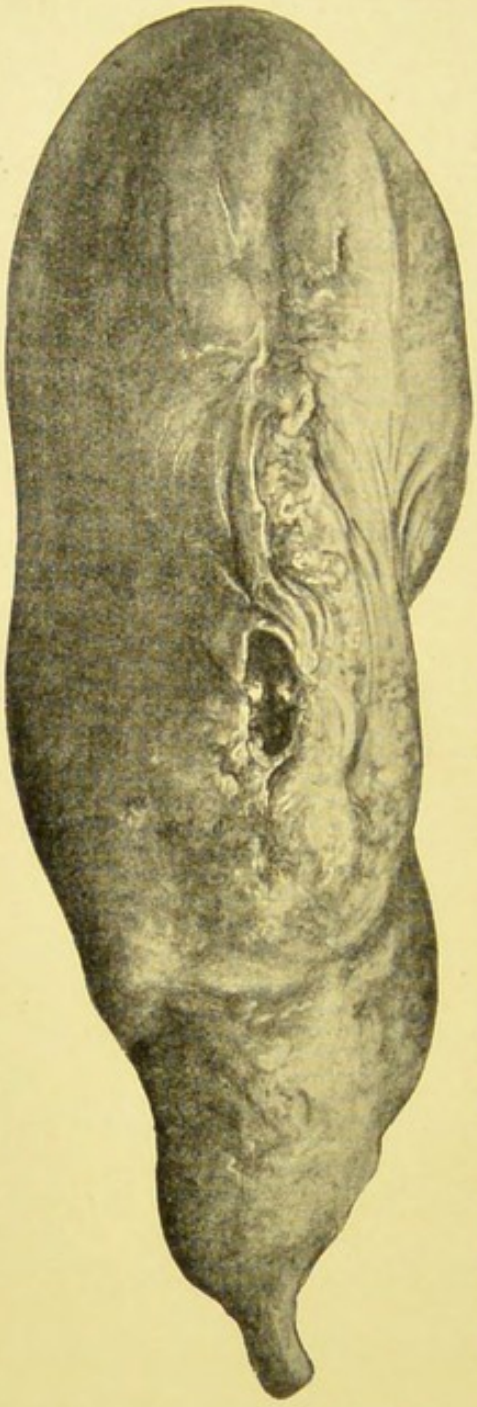


FIG. 24.—Fistula of the gall-bladder.

ulcer setting up local peritonitis, and causing adhesion of the gall-bladder or bile ducts to one of the neighbouring hollow viscera, or to the parietal peritoneum. The extension of the ulcer continuing, a communication is established with the contiguous channel or with the surface. In the indirect variety the perforation occurs first into an adjoining parenchymatous organ, or into a localised abscess, and then into an adjacent hollow viscus, or on to the surface of the body at some part.

A fistula may also arise from a local abscess forming outside the biliary passages around the primary focus of inflammation, and then

bursting into the adjoining cavities, which are thus made to communicate.

Although the establishment of a fistula is at times dangerous, and at others excessively annoying or uncomfortable, in many cases it forms one of Nature's methods of relief, and the surgeon, in forming a permanent biliary fistula in otherwise incurable jaundice, or in making an anastomosis between the bile passages and the intestine for the like purpose, is taking a leaf from Nature's book.

Many of the fistulæ are mere pathological curiosities, quite undiagnosable, and only capable of being discovered post-mortem. Many must form and heal, leaving the patient cured, and thus not only are they not discovered, but they are probably not even suspected; for, contrary to what one might suppose, fistulæ between the bile passages and other hollow viscera in the majority of cases heal spontaneously, leaving only visceral adhesions; so that fistulæ are comparatively rarely found post-mortem.

Biliary cutaneous fistula.—Courvoisier's statistics gathered from reported cases would seem to prove

that this is the commonest form of fistula. It may be pathological or post-operative.

(*a*) *Post-operative fistulæ* may be mucous or biliary.

Mucous fistulæ are occasionally seen after the operation of cholecystotomy, where the obstruction in the cystic duct has not been overcome, or where that duct is the seat of stricture.

A mucous fistula, as a matter of fact, causes very little inconvenience, as only about 1 ounce of fluid is discharged daily; but if the opening be allowed to close, the accumulation produces pain, and it is therefore necessary for a patient under these circumstances either to wear a small tube and a pad of absorbent wool, or to submit to operation.

The operation of cholecystotomy will not be followed by fistula (except in the case of stricture) if the bile ducts have been cleared, and if the opening in the gall-bladder be sutured to the aponeurosis and not to the skin.

Biliary fistula following on operation is quite a different matter from mucous fistula, as although in some cases it is compatible with good health, the inconvenience caused by 30 ounces of bile

flowing from the fistula daily produces so much discomfort that in all the cases which have come under our notice the patients have preferred to accept the risks of operation rather than to retain their disability (Fig. 25).

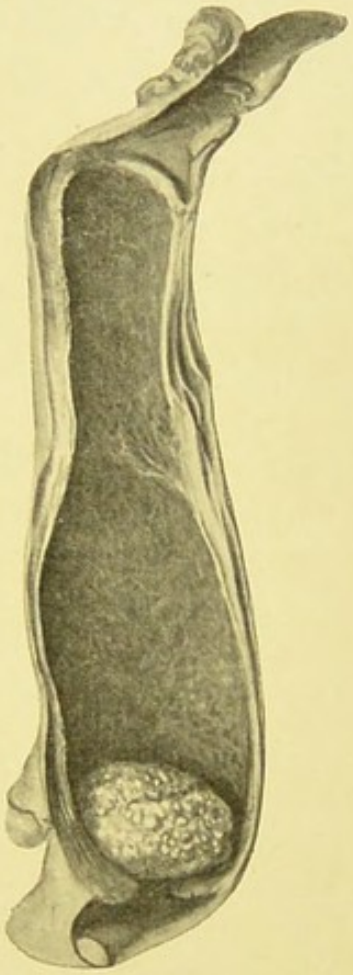


FIG. 25.—Persistent abdominal fistula due to a gall-stone left in the gall-bladder at a previous operation. (R.C.S.)

The treatment of biliary fistula should, where possible, be effected by removing the cause; but as in certain cases this is impracticable or impossible, other means have to be considered.

If the ducts be clear, and the fistula be small, the application of the actual cautery to the margin of the fistula will frequently result in its closure. That failing, the method of opening the abdomen, detaching the gall-bladder, and suturing the opening, may be followed. Or the less severe method may be first tried, of dissecting the fistula from the skin margin, without opening the peritoneum, afterwards doubling in the

mucous edges, suturing them accurately, and over this applying one or two layers of buried sutures before bringing together the skin.

Where, however, the ducts cannot be cleared, and the gall-bladder is large enough to permit of it, the operation of cholecystenterostomy may be performed.

(*b*) *Pathological surface fistulæ* usually open at the umbilicus, the abscess following the course of the remains of the umbilical vein, but they may form at any part of the abdominal wall, even near the pubes, or on the left side of the abdomen.

Calculi of various sizes and numbers, from a single one 3 inches in diameter, reported by Gutteridge, to multiple small faceted concretions, the size of shot-corns, may be discharged in this way, leading to recovery and permanent cure, but until all the calculi are discharged the fistula is liable to remain open.

In operating on these cases, it is advisable to purify the fistula as far as possible, and to scrape away all granulations before opening the peritoneal cavity to get at and clear the bile ducts. By adopting these precautions no untoward results are likely to occur.

Biliary intestinal fistulæ, as might be expected from the contiguity of the gall-bladder to the duodenum and colon, are the most common, and as a rule they are due to ulceration produced by gall-stones. Usually the ulceration proceeds quietly, and produces very few symptoms, until, it may be, the gall-stone sets up obstruction in its passage down the intestinal canal, or after the formation of the fistula all the symptoms of gall-stones may pass away, and the patient make a complete recovery. If, however, any gall-stones have passed into the cystic or common ducts, the symptoms are likely to recur as the fistula contracts.

The process of ulceration, though at times performed quietly and without serious illness, is not always accomplished without symptoms, such as pain over the liver, more or less jaundice, and fever of an irregular type, to be subsequently followed by signs of more or less complete obstruction of the bowel. Hæmorrhage into the stomach or intestines may occur in these cases.

If the fistula is between the gall-bladder and duodenum, "the most common variety," the whole

length of the intestinal canal has to be traversed by the concretions; hence such cases are found to be more frequently associated with obstruction than when the fistula is between the gall-bladder and colon, for in the latter case the passage to the anus is usually accomplished without difficulty, though occasionally the concretions may lodge and cause trouble.

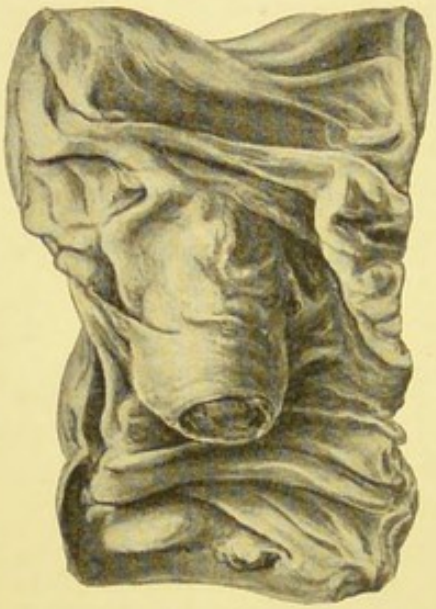


FIG. 26.—Gall-stone in the act of extrusion into the duodenum. From a woman æt. 70 years. (R.C.S.)

When the gall-stone is impacted in the common duct just before entering the duodenum, ulceration and perforation of the duct are apt to occur, the concretion thus escaping into the duodenum by an enlargement of the ostium of the common bile duct from ulceration or sloughing (Fig. 26).

Roth, who has paid special attention to this condition, found it five times in twenty-five cases of biliary fistula.

These gall-stones are usually smaller than those

causing gall-bladder intestinal fistula, are seldom larger than filberts, and do not often cause intestinal trouble.

Gall-bladder colic fistulæ are less common in the museums, probably because they do not often cause death. There are, however, a sufficient number of examples to show that even this method of discharging gall-stones is not altogether safe.

Biliary gastric fistula is less common than might be thought, for the pylorus is not infrequently adherent to the gall-bladder.

For the *rarer forms* — biliary urinary, biliary vaginal, biliary thoracic, biliary pulmonary, biliary pericardial, biliary mediastinal, biliary pleural, biliary retroperitoneal, biliary portal, hepato-gastric —which are pathological curiosities, reference may be made to cases collected by Courvoisier, Naunyn, Murchison, etc.

Intestinal Obstruction

So much has been written about obstruction from gall-stones that at first sight it might seem to be a common ailment. Such, however, is not the case,

as may be gathered from the fact that, on inquiring of the registrars and pathologists, it was found that only four such cases had been treated during a

FIG. 27.—*a*. Gall-stone weighing 238 grains, causing acute intestinal obstruction, removed at operation. (*Clin. Soc. Tr.*, xii. p. 106.)
b. Gall-stone weighing 228 grains, causing acute intestinal obstruction, passed after five days' duration of symptoms.

period of twelve months in some of the largest hospitals in the kingdom, representing 80,000 in-

patients and several hundred thousand out-patients attended in that time.

There are clearly four classes of obstruction of the intestines depending primarily on gall-stones, though by intestinal obstructions from gall-stones is usually understood the impaction of a large concretion in some part of the intestinal tract, producing a mechanical block.

1. Obstruction depending on the mechanical occlusion and the injury to the bowel produced by the passage of a large gall-stone along the intestinal canal (Figs. 27 and 28).

2. Obstruction due to volvulus, dependent on the violence of the colic caused by a gall-stone attack, or induced by the passage of a large concretion down the intestinal canal.

3. Obstruction depending on adhesions left after local peritonitis in the gall-bladder region, or on stricture due to the healing of a fistulous opening between the gall-bladder and intestine.

4. Obstruction dependent on local peritonitis in the gall-bladder region, leading to paralysis of the intestine.

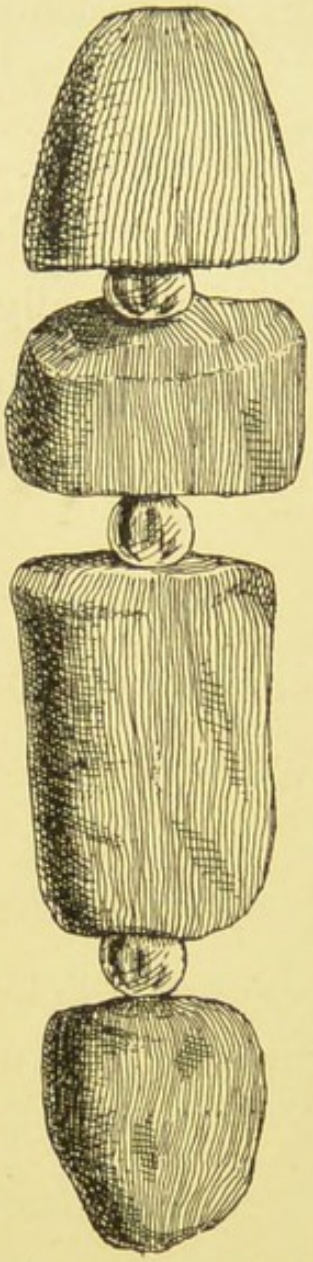


FIG. 28.—Large gall-stone producing acute intestinal obstruction, passed per anum as four separate calculi. (Leeds.)

The first class is the most important variety of obstruction dependent on gall-stones, and is the one furnishing not only the greatest number of cases, but a considerable number of museum specimens. It is dependent on the mechanical obstruction and damage to the bowel produced by the passage of a large concretion through the intestine or by its impaction.

Impaction of a gall-stone may occur at any point in the intestinal canal, though it happens most frequently in the small intestines at, or near, the ileo-cæcal valve. As the intestinal canal lessens in calibre from above downwards, until at the ileo-cæcal valve the narrowest point is reached, we may expect the largest gall-stones to produce high obstruction, and the smaller ones to pass into

the ileum or to the valve before setting up any disturbance.

The occurrence of obstruction depends not only on the size of the stone, but also on spasm of the bowel above and below the obstruction, and on inflammatory changes in the wall of the bowel and in the mucous folds; hence it follows that obstruction does not necessarily follow immediately on the entrance of the calculus into the lumen of the gut, but may be delayed for some time.

It is a curious fact that, although the calculi usually produce intestinal trouble within a few days of reaching the intestine, in some cases they remain in the bowel for long periods—*e.g.*, in a case[1] of Mr. Eve's, ten years, and in one[2] of Mr. Smith's, probably fifteen years.

Sir Frederick Treves, in connection with this matter, says that the concretions are liable to grow by deposition of salts and fæcal matter during their stay in the intestine.

In making a study of the reported cases, and

[1] *Transactions of Clinical Society*, 1895.

[2] *Lancet*, December 3, 1887.

especially of museum specimens, one cannot help feeling astonished at finding fatal obstruction depending on quite small concretions, and the comparatively easy passage of very large gall-stones.

Schuller (Strasburg, 1891), in reviewing 139 published cases, found that the subjects were women in 74·3 per cent., and out of these 75 per cent. of the cases occurred in women over fifty, though instances were found from eighteen to ninety-four.

Lobstein, of Heidelberg,[1] gives the most common age between forty and sixty; Mr. Eve gives it as sixty-four, and Sir Frederick Treves as fifty-seven.

In Courvoisier's elaborate statistics, out of fifty-three cases examined, he gives the site of obstruction as 21·4 per cent. in the duodenum and jejunum, 65·4 per cent. in the ileum, 10 per cent. at the ileo-cæcal valve, and 2·4 per cent. in the sigmoid flexure.

Museum specimens amply demonstrate that the gall-stones producing obstruction of the intestine in nearly every case enter the bowel through a gall-bladder duodenal fistula. They rarely enter through the colon: only two specimens of the latter condition

[1] *Annals of Surgery*, January 1896.

were found in the London museums, Specimen No. 864, Charing Cross Museum, being one.

The disease is a peculiarly fatal one (Fig. 29). Out of 280 cases collected by Schuller, Dufort, and Courvoisier, 156 died—*i.e.*, 52 per cent.

Kermisson and Rochard,[1] out of 105 collected cases, gave the mortality as 50 per cent.

The cases that recovered lasted on the average eight days, those that died ten days, but the duration of obstruction may vary from one to twenty-eight days.

As more than one large concretion may be present in the gut at the same time, the symptoms of obstruction may recur once, twice, or three times after the first concretion has been parted with.

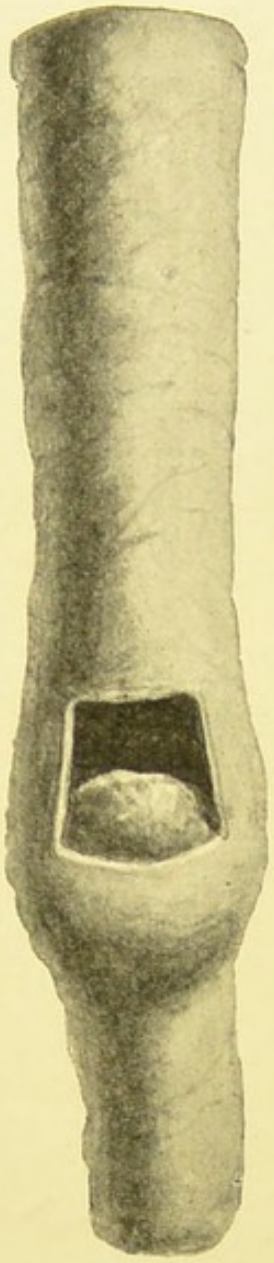


FIG. 29.—Large gall-stone impacted in the ileum and producing fatal obstruction. (Middlesex.)

Symptoms. — The symptoms are

[1] *Archives Générales de Médecine*, February 1892.

those of acute intestinal obstruction from other causes, with early fæcal vomiting and severe abdominal pain. Though the onset is sudden, the pain and collapse are frequently not severe until later in the attack, and the constipation may not be well marked, flatus and even fæces passing after the onset of acute symptoms.

Vomiting is always a marked symptom, and bile may be vomited in great quantity. The higher in the gut the impaction, the more violent, as a rule, will be the symptoms and the less marked will be the distension. The obstruction can only very rarely be felt through the abdominal walls.

Although it is sometimes possible to make a probable diagnosis from the history of previous gall-stone attacks extending over several years, yet in many cases there is absolutely no previous history to guide one, and it is quite impossible to say whether or not the attack is one dependent on the cause in question, or on a volvulus, or band, or internal hernia, which, if left, must inevitably lead to death, and that speedily. The age and sex, together with the history of chronic dyspepsia and pain in the hepatic region,

are, however, well worth bearing in mind, as well as the early and persistent vomiting and visible peristalsis, limited to the small intestines.

Treatment.—If the diagnosis could always be made with certainty, this is a condition in which medical and expectant treatment might be fairly given a trial since we have ample evidence of large gall-stones having safely passed without other treatment.

But we must not forget that 52 per cent. of cases treated on medical and expectant lines are fatal, and although surgery has not yet shown a much greater percentage of recoveries, it is because surgical means are frequently only resorted to when the case is hopeless, and after all other means have been tried.

When it is borne in mind that there are no symptoms peculiar to this form of obstruction, and that the course pursued by an obstruction by a band or by an internal hernia may be exactly the same as in gall-stone obstruction, the surgeon who waits beyond the period when an operation may be undertaken with every hope of success is incurring a very serious responsibility.

With regard to the method of treatment after the

abdomen is opened and the cause found: if the gall-stone can be easily crushed through the intestinal coats, without too much force being required, it may possibly be justifiable, though it should be borne in mind that the bowel may be ulcerated and softened at the place of impaction, and that even the slight force required to crush a soft stone may produce so much additional damage as to lead to gangrene and subsequent perforation. On the whole, therefore, we would urge enterotomy, either at or above the seat of impaction, and removal of the stone, as it can be done very quickly and with very little damage to the bowel.

Should the patient be too ill to bear a search being made for the obstruction, enterostomy, or perhaps short-circuiting, might be performed, in order to give temporary relief, the cause of the obstruction being afterwards removed, if this be not effected naturally.

As to *when* operation should be done, that is part of a general question which each surgeon will have to answer for himself in every individual case, as no definite rule can possibly be formulated which will apply to all cases. The surgeon will, as a rule, not

be called in before decided symptoms of intestinal obstruction have manifested themselves, and until medical means have been fully tried. In such cases it would seem to be idle waste of time to delay surgical intervention until the patient is so exhausted that operation is only undertaken as a last resort, when the subject is almost moribund. If, however, the case be seen at an earlier stage, morphia will have to be given to relieve the pain, and it will be well to recommend ext. belladonnæ in ¼-grain doses every four hours, the stoppage of all feeding by the mouth, and the administration of one or more large siphon enemas, given slowly with the buttocks elevated. If relief does not speedily follow, and the diagnosis is not clear, chloroform anæsthesia may assist in two ways: in the first place, it enables a thorough examination of the abdomen, and at times a diagnosis of the cause to be made; and secondly, the manipulation, if made methodically, may reduce a hernia or volvulus, or may possibly help onwards an obstruction. This failing, and the symptoms persisting, resort to operation should not be delayed, and at this comparatively early stage there will be every prospect of success.

The second variety, volvulus of the small intestine, dependent on the violence of the colic caused by an attack of gall-stones, or on the contortions induced by the passage of a large concretion through the small intestine, is probably uncommon, though we have had personal experience of two cases that recovered after laparotomy and unfolding the twisted bowel.

Diagnosis.—In this class of cases (volvulus) a positive diagnosis is probably, for the most part, out of the question, except after the abdomen is opened, as volvulus of the small intestine is an extremely rare event, and we know that a large gall-stone may quietly ulcerate its way into the gut without any preliminary warning, the symptoms only arising when the concretion is passing through the small bowel; but in our cases, in addition to the signs of acute obstruction, there was a well-marked localised swelling near the umbilicus, becoming hard during the paroxysms, pointing to the site of the obstruction; and in the second case, there was not only the previous history of cholelithiasis, but the characteristic onset of a gall-stone attack, followed by acute symptoms.

Treatment.—In this form, operation holds out the

only hope of success, as, the obstruction being mechanical, nothing short of remedying the cause can be of use.

The *third class* is characterised by obstruction coming on after the original cause has disappeared, and depends on adhesions left by local peritonitis due to gall-stone attacks; or on narrowing, caused by the healing of a fistula through which a gall-stone has made its way into the intestinal tract; or on chronic inflammation and ulceration of the bowels set up by the presence of a gall-stone.

In the *fourth variety* the symptoms may be so severe as to resemble strangulation by a band or acute intussusception. The *diagnosis* will not, as a rule, be difficult, as the history of the occurrence of previous attacks of spasms, though not of necessity followed by jaundice, the similarity to these of the commencement of the attack in question, the severe and persistent pain, at first localised to the right side of the abdomen, the absence of distension at the commencement, and then the occurrence of distension on the right side only, becoming general later, the lateness of the onset of fæcal vomiting, and only after

continued retching, the existence of collapse at an early stage owing to the severity of the pain, which is usually relieved by a morphia injection, the usual absence of visible peristalsis, and lastly, the onset of jaundice, if the concretions have reached the common duct, afford so much guidance that error will not often occur, especially if the patient be a woman of middle or old age.

Treatment.—These cases will, as a rule, yield to general and medical treatment, and it will only occasionally be necessary to resort to operation during the seizure if the symptoms are not subsiding, though subsequent surgical treatment may be required.

CHAPTER VIII

MALIGNANT DISEASE

Cancer of the Gall-Bladder

The very frequent association of cancer of the gall-bladder with gall-stones is an undoubted fact, and in all probability there is a connection between the two diseases.

In a series of 56 operations for cancer of the biliary passages (not including cancer of the pancreas), published by one of us,[1] 41, or 73·2 per cent., were associated with cholelithiasis, and although gall-stones were not found at the time of operation in the other 15, the history of intermittent pain extending over a long period suggested that some of these may also have owed their origin to the irritation of biliary concretions.

[1] *Bradshaw Lecture*, 1904.

Zenker[1] found gall-stones in 85 per cent. of cancers of the gall-bladder, and Musser, from an analysis of 100 cases, gives the proportion associated with gall-stones as 69 per cent., which may, however, be an underestimate, as it is well known that gall-stones may produce serious irritation and then pass into the alimentary canal, so that their effects may remain although the cause may not be discovered.

Courvoisier found gall-stones present in 74 out of 84 cases of primary cancer of the gall-bladder; Brodowski (Naunyn, p. 153) in 100 per cent.; Jayle (Soc. Anat., 1893) in 23 out of 30; Bertrand in 14 out of 15; and Siegert in 95 per cent. of primary, but only in 15 or 16 per cent. of secondary, carcinoma of the gall-bladder. Haberfeld,[2] investigating a series of 20,000 autopsies in Vienna, found that carcinoma of the biliary tract was the cause of death in 164, and that in 119 (73 per cent.) gall-stones were present. He also found that there was exactly the same predominance of cancer of the bile ducts in women, 73 per cent. of all cases, as there was of gall-stones in

[1] *Deutsch Arch. f. Klin. Med.*, 1899.

[2] Haberfeld, *Ztschr. f. Krebsforsch.*, 1908, vii. 190.

the same series of post-mortems, which yielded 265 cases of cholelithiasis, and of these 195, or 73 per cent., were females. That the gall-stones were not secondary to the malignant disease, as has been suggested, is shown by the fact that whereas in 99 cases of primary carcinoma of the gall-bladder gall-stones were present in no less than 95, yet in 13 cases where the gall-bladder cancer was secondary to a growth elsewhere, gall-stones were found only twice. In our own experience malignant disease has been found in a little over 5 per cent. of cases of operation for gall-stones.

According to Schroeder, 14 per cent. of all cases of gall-stone patients suffer at some time from cancer of the biliary passages, and Naunyn is of opinion that half the cases of chronic jaundice diagnosed as cholelithiasis are complicated with cancer or are due to cancer alone, but the correctness of the observations is, in our opinion, somewhat doubtful. The frequent association of malignant disease is, however, of extreme importance, since operation in the presence of cancer and chronic jaundice is attended with more danger than in simple cases.

The two theories which have been current to explain the co-existence of gall-stone with cancer of the liver are: first, the "irritation" theory, that gall-stones are formed first, and, by acting as foreign bodies, set up irritation, which leads to malignant growth; and second, the "concentration" theory, that gall-stones arise as a secondary result, from stagnation of bile in the ducts and infection of the bile passages, caused by their obstruction from malignant growth.

It is, however, doubtful whether, apart from a catarrhal condition of the mucous membrane, gall-stones are formed, and it should be remembered that the cholesterin in gall-stones is derived, not from that present in the normal bile, but from the mucous membrane.

The statistical investigations of Haberfeld and others are also against the second theory. Mr. C. Beadles, in a paper[1] before the Pathological Society of London, stated that out of 100 post-mortem examinations at the Cancer Hospital, 4 were cases of primary carcinoma of the liver, and all had calculi in the gall-bladder; 36 had secondary

[1] *Lancet*, 9th March 1895.

carcinomatous growths in the liver, but there were no gall-stones present in any of them. Of 9 cases of primary carcinoma of the liver at Colney Hatch, 5 were males and 4 females, and gall-stones were present in 7, being absent in 1 male and 1 female. These facts support the theory of irritation, as does also the fact that the disease occurs much more frequently in women than in men, and in much the same relative proportion as gall-stones. It is, however, interesting to note that, according to Colwell, gall-stones are two and a half times as common in patients suffering from carcinoma as in patients of similar ages suffering from other diseases, and that this frequency is independent of the site of the primary growth.[1]

Symptoms and signs of cancer.—If the growth be primary there will be the history of a more or less rapidly growing tumour developing under the right costal margin, accompanied at first by a sense of discomfort, shortly changing to pain, which is often worse at night, and which, though at first localised

[1] *Arch. Middlesex Hosp.*, vol. v., "Rep. of Cancer Res. Lab., 1905," p. 142.

to the right hypochondrium and epigastrium, usually before great advance has been made extends round the side to the right infrascapular region. When the enlargement is first noticed it is felt as an egg-shaped swelling beneath the liver, descending on inspiration. The tumour is hard to the touch, and very slightly, or not at all, tender to pressure. At a later stage it becomes more fixed and more diffused, and nodules may develop and be felt on its superficial surface. As the growth extends it invades the liver, and sometimes the duodenum, colon, and stomach. Dissemination is rare. When it occurs nodules may be found in the liver, and generally over the peritoneum. In such cases ascites develops. The lymph glands in the hilum of the liver usually become affected.

According to the invasion or not of the hepatic or common bile ducts, so will be the presence or absence of marked jaundice; but in nearly half of the cases some degree of icterus will be found as the disease advances, owing to the presence of catarrh of the bile ducts.

Interference with the action of the bowels, even to partial or complete obstruction, at times occurs.

General failure of health, continued wasting, with loss of strength, ascites, and marked cachexia, characterise the later stages.

Perforation may occur and hasten the end by the onset of general peritonitis. If gall-stones be present, there will be the usual antecedent history of cholelithiasis. Where gall-stones with jaundice complicate cancer of the gall-bladder, exacerbations of pain will usually be accompanied by rigors and fever, "ague-like attacks" with an intensification of the icterus, and in such cases petechiæ in the skin with hæmorrhage from the nose and rectum generally supervene.

Diagnosis.—Cancer of the gall-bladder may usually be diagnosed by the progressive character of the disease, and by the presence of the characteristic hard tumour; but it is by no means always easy to diagnose cancer from a tumour formed by matted intestines, due to local peritonitis in the neighbourhood of the gall-bladder.

Since there may be secondary deposits of growth in the pancreas, or even a direct invasion of the gland by way of the common bile and pancreatic ducts, as

occurred in one of our cases,[1] a positive "pancreatic" reaction in the urine may be obtained, and show that the disease is not localised to the gall-bladder or its neighbourhood. There is usually more or less stereobilin in the fæces, even when the jaundice is well marked.

Treatment.—Surgical treatment on the earliest manifestations of the disease is well worth considering, as in a number of cases in which we have removed the gall-bladder affected with cancer, great relief has been afforded, and two cases have been apparently cured, since the patients are both living and well seven and eight years subsequent to the operation.

Diagnosis of tumours of the gall-bladder.—Tumours of the gall-bladder may have to be diagnosed from—

1. Movable right kidney.
2. Tumour of the right kidney, or of the suprarenal capsule.
3. Tumour of intestine or fæcal impaction.
4. Tumour of liver.
5. Pyloric tumour.
6. Abnormal projection of liver.

[1] *Lancet*, August 24, 1907, p. 508.

The diagnosis of enlargement of the gall-bladder from movable right kidney is, as a rule, easy in thin persons; but in those who are stout, or have tense or strong muscular abdominal walls, difficulties may and do arise, which can, however, usually be overcome by examination under an anæsthetic.

They resemble one another in that each forms a moderate sized, distinctly defined, rounded, and movable tumour on the right side of the abdomen, which is found to descend on inspiration.

The previous history may throw light on the case, especially if there have been definite cholelithic attacks or the presence of jaundice.

By inspection of the abdomen a gall-bladder tumour is often apparent, moving rhythmically with the respiratory movements when the patient is recumbent; but a floating kidney can rarely be so detected.

The general outline of the tumour as detected by palpation may afford valuable assistance; thus in distension of the gall-bladder the tumour formed is pear-shaped, with the apex towards the fissure of the gall-bladder, and its long axis in a line from about the tip of the ninth costal cartilage downwards, for-

wards, and inwards towards a point a little below the umbilicus. In floating kidney, especially in patients with lax abdominal walls, the tumour may be grasped and its characteristic shape made evident.

Should adhesive peritonitis accompany the gall-bladder condition, there will be tenderness and pain on pressure over the tumour, especially near its apex. These signs are rarely, if ever, present in floating kidney.

The gall-bladder tumour can easily be moved to a limited extent inwards and outwards by manipulation, but under no circumstance can it be depressed into the pelvis. On relieving it of pressure, it tends to resume its old position under the liver.

Floating kidney has a generally wider movement, can at times be depressed into the pelvis, and when relieved of pressure tends to pass towards the right loin, especially when the patient is recumbent.

A valuable diagnostic sign is the sulcus often felt between the lower margin of the liver and the gall-bladder tumour; this can usually be felt when the warm flat hand is placed over the upper part of the swelling and the patient is asked to breathe deeply.

In the case of renal tumour, as well as in movable kidney, by distending the intestine with gas the kidney will be pressed back into the loin, but the gall-bladder will be pushed up towards the liver and made more prominent. The last test is usually also sufficient to enable a diagnosis to be made between a distended gall-bladder and a tumour of the right suprarenal body.

In tumour of the intestine, or of the pylorus, the associated stomach or bowel symptoms are usually sufficient to enable a diagnosis to be made, but when in doubt, distension of the stomach or bowel with gas will help to clear it up, or examination under an anæsthetic will afford assistance.

Tumour of the liver itself, either cancer or hydatid disease, may be almost indistinguishable from one of the gall-bladder; though the presence of nodules in the liver, with the history and other symptoms of malignant disease, will usually be sufficiently distinctive in cancer, while the less localised and more generally fluctuating swelling, together with the longer history and absence of pain or tenderness, will distinguish hydatid tumour.

It should not be forgotten that the right lobe of the liver may have an abnormal projection, either in the site of the gall-bladder or to the right of that position, which may at first be mistaken for an enlarged gall-bladder; but the absence of symptoms, together with careful bimanual palpation, will usually enable a correct diagnosis to be made, and, as Professor Riedel has pointed out, the gall-bladder may frequently be felt apart from the swelling.

Puncture with an exploring syringe would, of course, give valuable information, but this should not be lightly undertaken, as it is not devoid of risk, death having occurred on more than one occasion as a direct result of this apparently slight operative procedure.

If it is decided to employ an exploring needle, the aspirator should always be used, in order that the tense cyst may be completely emptied, otherwise leakage from the puncture is almost certain to occur. In cases where the abdomen has been opened, we have seen a puncture of the tumour by a small exploratory syringe to pour out fluid in a forcible stream, showing what would have occurred had

the puncture been made through an unopened abdomen.

In case of doubt, especially where the symptoms demand interference, exploration of the tumour through a small abdominal incision can be undertaken with very little risk, and at the same time further treatment where called for can be carried out.

Tumours of the Bile Ducts

Cystic tumours.—Tumours of the bile ducts, *per se*, only occasionally form a projection so large as to be distinguished through the abdominal walls. A tumour is, however, in some cases, present sooner or later on account of the obstruction in the ducts and secondary distension of the gall-bladder. The common duct has been found dilated to such a size as to form a cystic tumour, presenting all the characteristics of a distended gall-bladder, the gall-bladder itself being atrophied.

Terrier describes four cases in which an external fistulous opening was established in the common bile duct. In three of these the duct was much distended, and formed a distinct abdominal tumour.

In his comments on these records, Terrier points out that in two of these cases the distension of the bile duct, though clearly due to obstruction, was not associated with lithiasis. In the third case the duct was found to be completely obstructed at its intestinal orifice by a small calculus. In each instance of distended bile duct the gall-bladder was much shrunken, and its walls were sclerosed and surrounded by cicatricial tissue.

In June of 1903 one of us saw a case with Dr. Griffiths, of Swansea, where there were two swellings, one of which was diagnosed as distended gall-bladder, and the other, internal to the gall-bladder, as a pancreatic cyst; both were apparently dependent on chronic pancreatitis, and were drained separately. The sequel appeared to prove that the apparent pancreatic cyst was in reality an enormously dilated common bile duct, as after operation from 20 to 30 ounces of bile drained from it daily, whereas only clear mucus came from the gall-bladder, and pancreatic fluid came away with the bile. The nutrition of the patient could not be maintained until Benger's liquor pancreatici was given after each meal. Chole-

dochenterostomy was subsequently performed, and the patient is now well.

Another case was that of a man of twenty-five, who had suffered severely from gall-stone symptoms associated with a tumour, supposed to be a dilated gall-bladder. The gall-bladder, however, was found to be small, and situated external to the cystic tumour, which proved to be a dilated cystic and common duct, at the lower end of which was a gall-stone the size of a pigeon's egg, which broke into fragments as the duct was about to be incised for its removal. The fragments were removed, and the dilated duct was opened and stitched to the aponeurosis, in the same manner as one fixes the gall-bladder in cholecystotomy.

Solid tumours of the bile ducts may be simple or malignant.

Simple tumour is so rare that it does not practically enter into the question for diagnostic purposes.

Cancer may be primary or secondary, the former arising most frequently as the result of gall-stone irritation, the latter by extension from neighbouring organs.

Primary malignant disease of the bile ducts is most frequently situated in the common duct towards its lower end; but the cystic or hepatic ducts may be first affected.

As is the case in malignant disease of the gall-bladder, so here, systemic infection is rare; but, by extension, the growth may infiltrate the neighbouring structures, the liver being most frequently involved. The lymphatic glands in the gastro-hepatic omentum are, of course, involved sooner or later in all cases.

Dr. Rolleston draws attention to the fact that, out of the thirty-six cases collected, gall-stones were present only in half the number. He thinks that calculi are less frequently associated with primary cancer of the bile ducts than with cancer of the gall-bladder. The same arguments apply, however, as in cancer of the gall-bladder, where the matter is fully discussed. In all probability the carcinoma is usually secondary to gall-stones, though these may not always be found, having passed into the bowel before the operation.

These growths are usually found between the ages

of fifty and sixty, and, unlike cancer of the gall-bladder, where rather more than 75 per cent. of the cases occur in women, the disease attacks both sexes about equally. Out of thirty-six cases, twenty-one occurred in males and fifteen in females.

Secondary carcinoma may occur from extension of malignant disease into the bile ducts. Thus, one may find cancer of the bile ducts supervening on cancer beginning in the liver, gall-bladder, pancreas, or intestine.

Symptoms.—If forming in the cystic duct, jaundice will be absent at first, only coming on when the growth advances so far as to press on the common duct and obstruct the passage of the bile, or when, as is not uncommon, catarrh of the bile ducts supervenes. The gall-bladder enlarges at an early stage, and this will probably be the earliest sign; pain may be absent, unless gall-stones exist, when the usual spasmodic pains will occur so long as the muscular coat of the gall-bladder retains its contractile power.

When the growth is in the common duct, jaundice comes on at an early stage, and persists throughout, the liver gradually increasing in size, and the gall-

bladder also enlarging ultimately; in the later stages, the changes in the character of the blood bring about a condition rendering the subject prone to hæmorrhages from the nose, bowel, etc., to a petechial eruption in the skin, and to a tendency to bleed from wounds, thus rendering operation extremely hazardous.

Associated with the absence of bile from the intestine, there are usually, to a greater or less extent, gastro-intestinal symptoms, especially constipation or constipation alternating with diarrhœa.

Sometimes paroxysmal attacks of pain resembling that due to gall-stones are met with either before or after the development of jaundice, and may be due to associated calculi. Similar attacks of pain may be met with in carcinoma of the head of the pancreas or in growth involving the portal fissure.

The gall-bladder becomes distended, and is palpable in a number of cases. Enlargement of the liver is slight, and secondary growths are comparatively seldom felt during life.

As biliary toxæmia appears, the symptoms are aggravated, ascites and œdema may supervene, and

the condition of extreme depression may terminate in exhaustion, coma, or delirium.

Suppurative cholangitis is apt to follow, the case then taking on a more acute course, and being accompanied by fever, ague-like attacks, and rapid loss of flesh and strength. If the tumour form in the hepatic duct, jaundice will be the earliest symptom, and the case will resemble one of obstruction in the common duct, with the exception of an absence of enlargement of the gall-bladder. Needless to say, the disease is uniformly fatal, though operation may delay the final catastrophe.

Cancer of the ampulla of Vater.—The clinical characters of biliary carcinoma of the ampulla of Vater are the same as those of primary carcinoma of the common bile duct — namely, progressive jaundice and wasting, the patient finally passing into a condition of cholæmia or biliary toxæmia. It thus very closely resembles cases of carcinoma of the head of the pancreas, the only difference being that jaundice is, exceptionally, absent in the latter condition.

Diagnosis.—The diagnosis of a primary growth of

the bile passages is frequently a matter of the greatest difficulty. Even in cases in which one can reasonably infer that the symptoms are not due to impaction of calculi in the ducts, it will be impossible to exclude malignant disease in adjacent organs, such as the head of the pancreas or the duodenum. The chief symptoms commonly found in cancer of the head of the pancreas are those of cancer of the common bile duct, and also of the ampulla of Vater —namely, progressive emaciation and jaundice, of painless onset, with enlargement of the gall-bladder. Impaction of a gall-stone in the common duct is usually indicated by a distinct history of biliary colic immediately preceding the onset of jaundice. Where, however, the cystic and common ducts are dilated as a result of the previous passage of gall-stones, impaction of a calculus may occur without any great pain. On the other hand, obstruction due to malignant disease may be accompanied by attacks of pain resembling biliary colic.

The distension of the gall-bladder which is supposed to be the rule in obstructive jaundice, other than that due to gall-stones, may be absent, owing

to contraction of the gall-bladder following previous cholelithiasis.

As time goes on and the case progresses, it becomes obvious that the cause of the jaundice is malignant disease, but in the early stages it is almost impossible, in the majority of cases, to make a certain diagnosis. The difficulty can be cleared up by an exploratory operation, which should be performed at an early period. If gall-stones are present they can be removed, and if the condition is due to malignant disease it may be possible to remove the growth, or, if this be impracticable, to perform cholecystenterostomy.

Cystic dilatation of the bile ducts is often indistinguishable from enlargement of the gall-bladder, for which indeed it is usually mistaken. It may also resemble a cyst of the pancreas, but, as the treatment in all these conditions is abdominal section, no harm will be done if the diagnosis is only completed when the abdomen is opened.

Treatment. — The operative treatment of these tumours is in its infancy. If the cause be a removable one, such as a gall-stone, it should be taken

away. Choledochostomy has not yielded good results in cystic dilatation of the bile-ducts, our own cases being, we believe, the only examples of complete recovery after the operation; whereas the experience of performing an anastomosis between the cyst and the intestine, though as yet slight, has been so satisfactory as to establish the claim of its being considered the best method of treatment.

In malignant disease, an accurate diagnosis can often only be made after the abdomen is open. In some cases the condition of the patient or the extent of the growth may only permit a palliative operation. In such a case, the dilated gall-bladder, or ducts, may be opened and drained or short-circuited into the duodenum or colon.

CHAPTER IX

COMMON DUCT CHOLELITHIASIS AND DISEASES OF THE PANCREAS IN RELATION TO GALL-STONES

Calculi in the Common Bile Duct

According to Courvoisier, this condition occurs in about 4 per cent. of all cases of cholelithiasis. A reference to the cases that have come under our care shows this to be an under-estimate, as, out of 380 cases of cholelithiasis operated on, there were gall-stones in the common bile duct on 150 occasions, which equals 39·4 per cent.

Fenger, in the *Annals of Surgery*, quoted Conrade, who said that in 97 cases, he found gall-stones in the gall-bladder alone in 82, in the gall-bladder and common duct in 10, and in the common duct alone in 5.

Courvoisier says that in two-thirds of the cases there is only one gall-stone, and in the remaining third they are multiple, six being the largest number. Our experience shows a much larger proportion of multiple calculi in the common duct, and we have removed as many as eighty-eight calculi at one choledochotomy.

In 67 per cent. the stone is in the duodenal end of the duct, in 15 per cent. in the hepatic, and in 18 per cent. in the middle portion, where it is most easily reached. In about a quarter of the cases the duct was greatly dilated, and in many the gall-stones were floating and acting like a ball-valve.

Fenger has dwelt on the great importance of the ball-valve action of floating stones in the common bile duct, as explaining the remission of jaundice in many cases, where it might have been supposed that the jaundice would be persistent. In the greater number of cases of gall-stones in the common duct, the concretions are, though easily moved by the fingers, too fixed to be called floating.

Fenger explains the contracted condition of the gall-bladder, which is almost universally found in

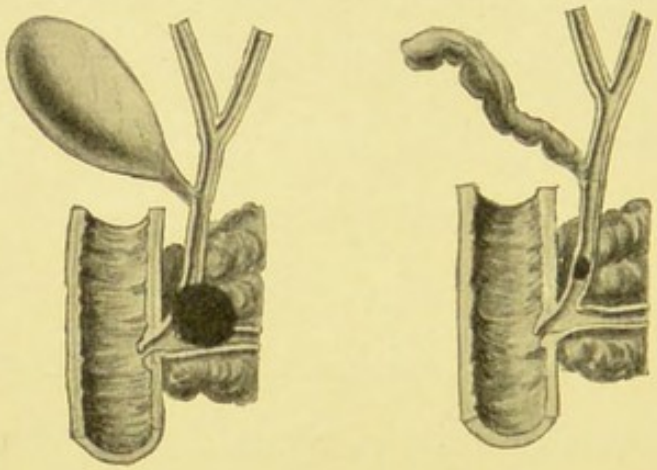
cholelithiasis by this floating of gall-stones in the ducts; but as the same condition occurs where the gall-stones are fixed, this explanation must be only a partial one.

In a paper communicated by one of us to the Clinical Society in 1888, attention was drawn to this contraction of the gall-bladder as an important diagnostic point, and this has been borne out by other observers independently. It was then pointed out that jaundice with distended gall-bladder was presumptive evidence in favour of malignant disease, but that jaundice without distended gall-bladder favoured the diagnosis of cholelithiasis (Fig. 30).

Of 35 operations for obstruction in the common duct, Courvoisier found that 18 were due to causes unconnected with gall-stones, such as cancer, stricture, or tumour; out of these, the gall-bladder was dilated in 16, whereas only 17 were dependent on gall-stones, and out of these 17 the gall-bladder was atrophied in 13.

The special symptoms pointing to stone in the common duct are: absence of enlargement of the gall-bladder, with frequent attacks of pain, which is

usually less severe when the gall-stones are in the common duct than when they are in the cystic duct, followed by intensification of the jaundice, which in many cases never quite disappears. The seizures are often associated with intermittent feverish attacks, accompanied by rigors and loss of weight and



a. *b.*

FIG. 30.—Diagrams to illustrate the effects on the gall-bladder of—

a. Malignant disease of the head of the pancreas.
b. A gall-stone in the common bile duct.

strength. The pain is in the epigastric rather than in the right hypochondriac region, and passes through to the right dorsal or lumbar, rather than to the right infrascapular, region, and the tender point is found between the umbilicus and ensiform cartilage, rather than between the ninth costal cartilage and

umbilicus, as in ordinary cholelithiasis. The "pancreatic" reaction was given by the urine from 69 per cent. of our cases of common duct cholelithiasis, indicating an associated pancreatitis, and chemical analysis of the fæces has generally shown a disturbance of the normal relations between the unsaponified and saponified fats, with frequently an excess of total unabsorbed fat. The fæces, on chemical examination, nearly always contain stercobilin, although in cases of recently impacted stone there may be only traces.

Jaundice in connection with gall-stones in the common duct is a very variable symptom. In some cases it is so slight as to be barely noticeable, while in others the jaundice is the most marked feature. In all cases of common duct cholelithiasis it varies from time to time. A more or less marked reaction for bile pigment was given by the urine of 70 per cent. of our cases.

Where jaundice is continuous and intense without much variation, especially if the gall-bladder be enlarged, there is usually malignant disease, or some other cause than gall-stones. All the other symptoms characteristic of gall-stones may have been present

for some time previously, or may co-exist with those above mentioned.

Diseases of the Pancreas

The association of diseases of the pancreas with morbid conditions of the biliary passages has been pointed out by a number of observers, and since, in most individuals, the common bile duct and pancreatic duct unite to form a common channel before entering the duodenum, and, in many persons (62 per cent. according to Helly), the common duct is embedded in the tissue of the pancreas for a part of its course, such a connection is probable on anatomical grounds (Fig. 31).

In an autopsy on a case of acute pancreatitis under Halstead's care, Opie found a small gall-stone impacted in the duodenal orifice of the ampulla of Vater, which, while too large to pass into the duodenum, was too small to fill the diverticulum and close the opening of the pancreatic duct. The bile and pancreatic ducts were thus converted into a continuous channel, and that the contents of the former had passed into the duct of Wirsung was

shown by its walls being deeply bile-stained. Investigating the literature of the subject, Opie collected thirty-nine cases of acute pancreatitis associated with gall-stones, and in eight of these he

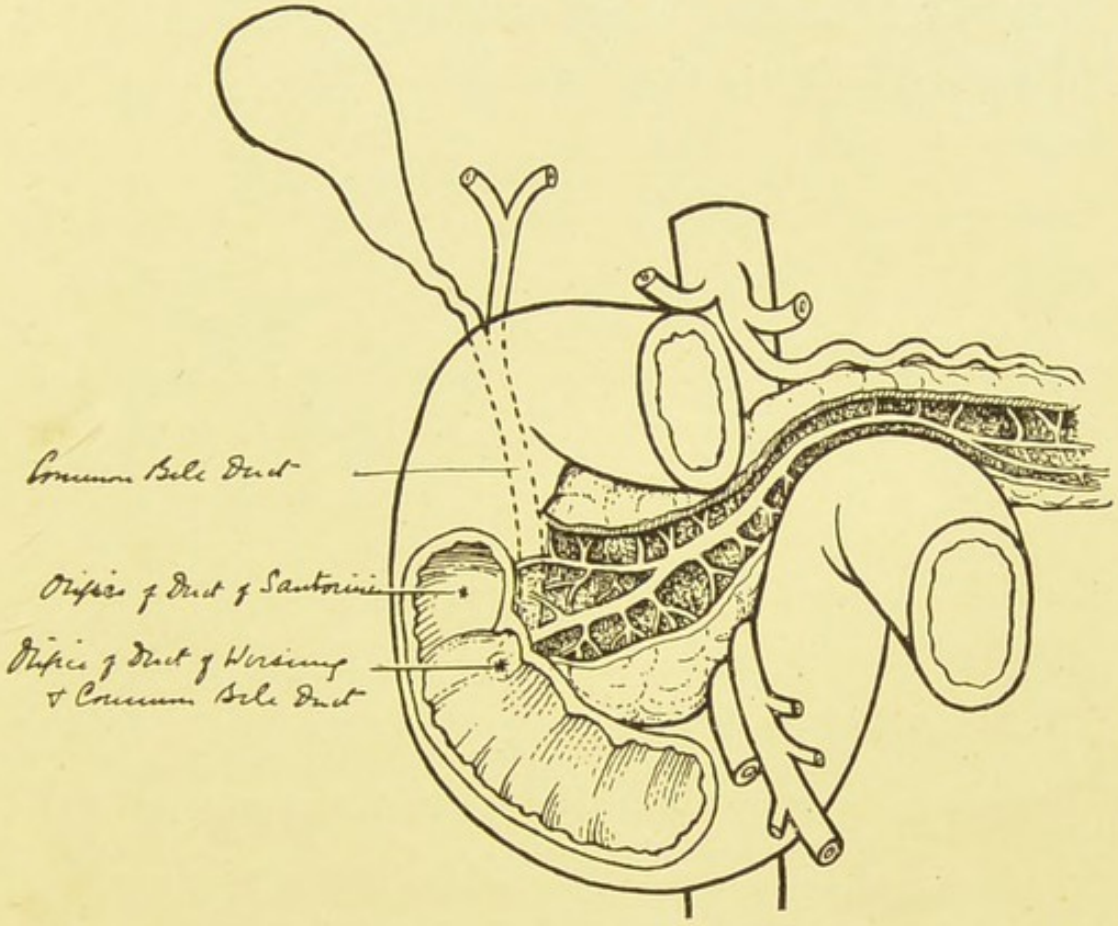
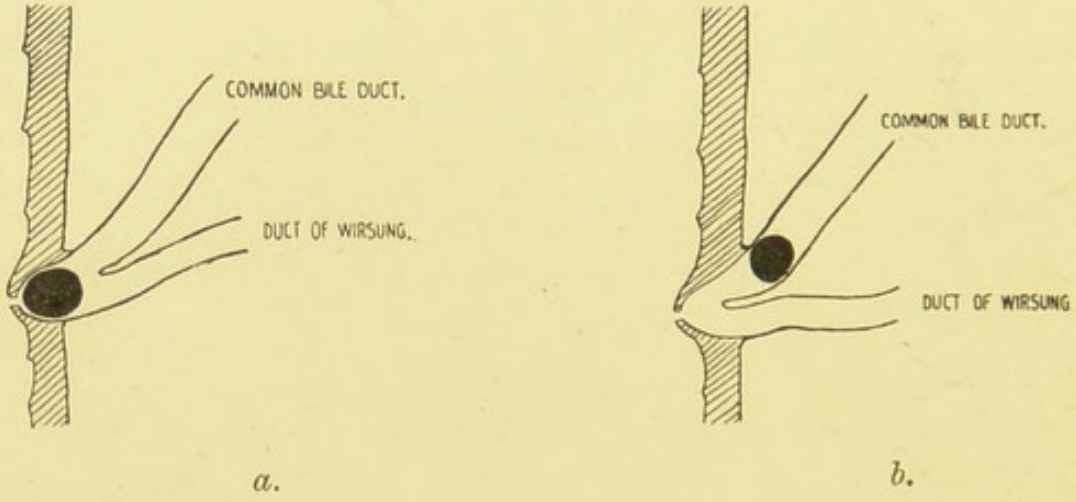


FIG. 31.—Diagram to show the course of the common bile ducts and the excretory ducts of the pancreas. (After Testut.)

found that there was a calculus in the diverticulum of Vater. It appeared possible, therefore, that the entrance of bile into the pancreatic duct was the cause of the pancreatitis in a considerable proportion of cases

(Fig. 32). In attempting to verify this experimentally, Opie showed that the injection of 5 c.c. of bile into the pancreatic duct in dogs set up acute inflammatory changes which in some instances was fatal within twenty-four hours. While claiming that bile diverted into the pancreatic duct by a biliary calculus had thus



a. *b.*

FIG. 32.—*a*. Diagram to show how a small gall-stone may obstruct the papilla and convert the common bile duct and duct of Wirsung into one canal, thus predisposing to acute pancreatitis.

b. Diagram to show a method of termination of the ducts which will not predispose to pancreatitis.

been shown to be capable of producing acute pancreatitis, Opie pointed out that it could not be demonstrated that all cases of acute pancreatitis were dependent upon this cause, for such an effect can only take place when the gall-stone is very small, and

the anatomical conditions of the duodenal orifice and diverticulum of Vater are favourable. Measurements of the diverticulum proved that in only about 30 per cent. of cases could a small calculus probably lodge in the opening of the diverticulum and yet only partially fill the cavity, and, as in about 10 per cent. of individuals the bile duct joins the lesser pancreatic duct while the larger duct enters the duodenum at the site of the lesser papilla, the necessary anatomical conditions are present in but a small proportion of cases, and the rarity of acute pancreatitis from this cause when compared with the relative frequency of cholelithiasis is not difficult to explain. Trevor has suggested that the experimental injection of bile, and other substances, into the pancreatic duct may produce the effects described by lowering the resistance of the walls of the duct, and allowing the easy entrance of the pyogenic bacteria normally present in the lower part of the biliary passages of the dog. But experiments by Flexner have shown that the inflammatory changes are directly due to the action of the bile salts upon the pancreatic cells in bile injections, and that on mixing the separated bile salts with mucin, or by

diminishing their concentration, a less intense inflammatory reaction is induced. Flexner concludes from his observations that, while the entry of fresh unaltered bile into the duct of Wirsung sets up acute changes, the passage into the pancreatic duct of bile which has been modified by a loss of diffusible salts and an increase of colloidal material, such as takes place in obstruction of the biliary passages, is likely to set up chronic pancreatitis.

Recently Williams and Busch[1] have suggested another way in which biliary calculi may bring about acute pancreatitis. They point out that, according to their own and Egdahl's[2] researches into the literature of the subject, gall-stones are met with in about 40 per cent. of cases of acute pancreatitis, that is at least twice as frequently as in autopsies in general, and consequently a connection between the two is probable. Granting that the mechanism described by Opie operates in some instances, as it undoubtedly does, it does not, however, afford an entire explanation of the relation between gall-stones and pancreatitis that statistics

[1] *Journ. of Med. Research*, xvii. Oct. 1907.

[2] *Johns Hopkins Med. Bull.*, April 1907.

show. They therefore suggest that the passage of gall-stones may so dilate the diverticulum of Vater that intestinal contents may pass into the pancreatic duct and give rise to inflammation and necrosis of the pancreas. In a series of experiments designed to prove this hypothesis, they injected duodenal contents into the pancreatic duct, and also dilated the diverticulum of Vater by the passage of artificial gall-stones through the common duct into the duodenum, and obtained results that tended to support their view.

Chronic Pancreatitis.—Although obstruction of the common bile duct due to the pressure of tumours, stenosis of the duodenal orifice following ulceration, growth in the duodenal papilla or ampulla of Vater, and the presence of impacted pancreatic calculi, intestinal worms, or portions of hydatid membrane in the duct, as well as infections and circulatory disturbances of different kinds, may give rise to chronic pancreatitis, cholelithiasis is one of its most common causes. The reason for the association of the two conditions is not difficult to understand when the anatomy of the parts is borne in mind. Under ordinary circumstances when a gall-stone passes

along the common bile duct and reaches the ampulla of Vater it will not only occlude the bile passage but also the chief excretory duct of the pancreas, the secretion of which will be retained. An infection of the retained secretion, of the walls of the duct, and of the parenchyma of the gland is then likely to occur, and this will continue so long as the obstruction persists. In some cases also a direct entry of modified bile into the pancreatic duct may also take place, and by its action in the tissues of the pancreas set up a chronic inflammation, in the manner suggested by Flexner. As the common bile duct is embraced by the pancreas in about 62 per cent. of cases, the passage of a stone down the duct is likely to exert pressure on the gland in about that proportion of cases and give rise to some inflammatory reaction. The resulting swelling of the head of the pancreas may in its turn cause compression of the duct and so cause jaundice which may persist long after the gall-stone itself has passed.

The reasons why gall-stones in the common bile duct do not always produce pancreatic inflammation are—(1) some gall-stones are so large that they never

reach the pancreatic portion of the duct, but remain in the supra-duodenal segment, producing jaundice but no pancreatitis; (2) in some cases the bile and pancreatic duct open by separate orifices and a gall-stone passing down the common duct will not therefore necessarily compress or occlude the pancreatic duct; (3) in exceptional cases the duct of Santorini is the principal outlet for the pancreatic secretion, and is of such a size as to afford a safe outlet even when the duct of Wirsung is obstructed.

Symptoms.—If the pancreatitis is due to obstruction of the common duct by gall-stones, there will be a history of painful attacks in the right hypochondrium, and in the epigastrium, associated with jaundice, and possibly accompanied by fever of an intermittent type. Tenderness at the epigastrium with some fulness above the umbilicus will usually be noticed. Loss of flesh soon becomes marked, and, if the pancreatic symptoms predominate, the pain will pass from the epigastrium round the left side, even to the renal and scapular regions. Physical examination will reveal in some few cases a swelling of the pancreas due to tumefaction of the head of the

gland, but as the recti are often rigid from pain and tenderness it may be discovered only when the patient is anæsthetised. Pain and tenderness, though usually present, may be little marked, but in some cases the pain is paroxysmal and severe, and epigastric tenderness is pronounced. By distending the stomach with gas the relations of the stomach to the swelling can be made out. Resonance on percussion, owing to the position of the stomach, unless this organ is empty, communicated non-expansile pulsation, and very slight movement on deep inspiration are characteristic of a swelling of the pancreas. Jaundice is frequently very marked when chronic pancreatitis is due to obstruction of the common duct by a gall-stone, but a similar condition may also be met with when the duct passes through, or deeply grooves, the head of the pancreas and the gland is inflamed from other causes. An increase of temperature is as a rule associated with acute and sub-acute pancreatitis, but is only rarely met with in the more chronic forms of inflammation, except in those cases where there is associated infective cholangitis such as accompanies obstruction of the common duct by gall-stones or

infection of the retained secretion, when there may be fever of an intermittent type and ague-like paroxysms. Dyspeptic symptoms are constantly complained of. They take the form of anorexia, with discomfort and flatulency, sometimes offensive eructations, heartburn, nausea, distaste for fats and for meat.

The urine will give a more or less marked "pancreatic" reaction according to the extent and intensity of the active inflammatory changes going on in the pancreas, and a quantitative chemical analysis of the fæces[1] will show an excess of unabsorbed fat, of which an abnormally high proportion will consist of unsaponified fat if there are advanced interstitial changes in the parenchyma of the gland.

Diagnosis.—The most important conditions to differentiate from chronic pancreatitis due to biliary obstruction are cancer of the head of the pancreas, cancer of the common bile duct, cancer of the liver, gall-stones in the common duct, chronic catarrh of the bile ducts, and chronic pancreatitis due to other causes.

[1] See *The Pancreas, its Surgery and Pathology*, 1907, pp. 206 *et seq.*

In cancer of the head of the pancreas the onset is usually gradual and painless, and the disease usually occurs later in life, generally after forty years of age. It is preceded by general failure of health, and when jaundice supervenes it becomes absolute and unvarying. The gall-bladder is nearly always distended and may attain a large size (Fig. 33), but is not tender on manipulation. The liver enlarges from biliary stasis, but there are no nodules to be felt. In rare cases a hard nodular tumour may be discovered on the inner side of the distended gall-bladder.

The fæces are usually acid in reaction and contain a very high percentage of unabsorbed fat, of which often only a comparatively small proportion consists of saponified fat. Microscopically many undigested muscle fibres are usually met with when the patient is on a diet containing meat. No trace of stercobilin can usually be discovered, contrary to what is met with in simple chronic pancreatitis and gall-stone obstruction of the common duct, where, although the fæces may appear quite white to the naked eye, chemical examination shows stercobilin to be present

in nearly all cases. The fæces also often contain more or less occult blood. The "pancreatic" reaction by the improved or C-method is negative in about

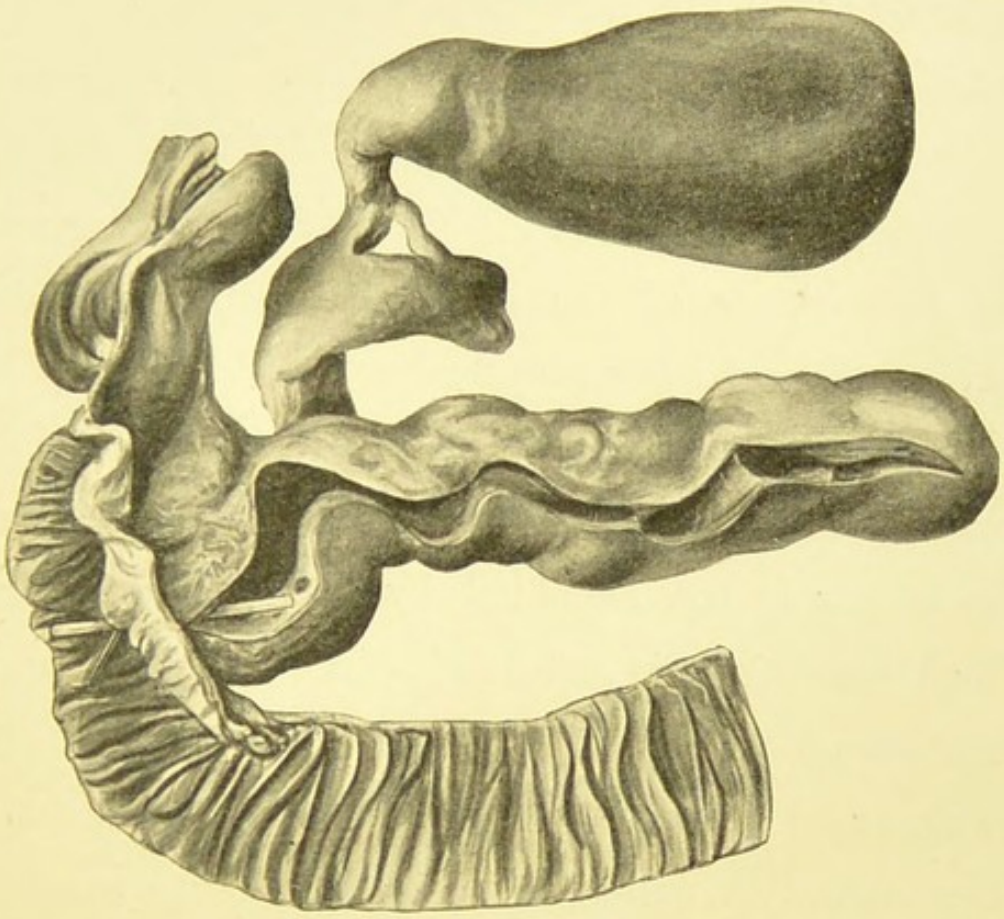


FIG. 33.—Carcinoma of the head of the pancreas, causing dilatation of the pancreatic duct, common bile duct, and gall-bladder. (St. Thomas's Hosp.)

75 per cent. of cases, but in the remaining 25 per cent. a more or less marked reaction, probably due to the associated inflammatory changes, is obtained.

The extremely rapid loss of weight and strength,

with increasing anæmia, but without ague-like attacks, are very characteristic. There is commonly an absence of fever, indeed there is usually a sub-normal temperature, with a slow, feeble pulse. Later, ascites and œdema of the feet supervene.

The great importance of an accurate diagnosis between cancer of the head of the pancreas and chronic pancreatitis with jaundice, which it so closely resembles, is that while the latter is eminently a curable disease, when submitted to early operation, the former is not benefited by surgical treatment, which, moreover, is attended with no little danger from various complications.

Cancer of the common duct is rare, and is usually associated with gall-stones. If the disease involves the duodenal papilla, the symptoms are indistinguishable from those of cancer of the head of the pancreas, except that the pancreatic reaction in the urine is more likely to be of the inflammatory type, owing to the changes in the gland due to the damming back of the secretion. If the growth is situated above the opening of the pancreatic duct, it will not interfere

with the functions of the pancreas, but there may be a pancreatic reaction in the urine from involvement of the gland in the growth or the presence of secondary deposits. The loss of flesh will be rapid, and the fæces will contain a large excess of unabsorbed fat, of which the greater part will consist of combined fatty acids, as in blocking of the common bile duct by gall-stones without an associated inflammation of the pancreas. No stercobilin will be found as a rule, although in some cases traces may be present, as a small quantity of bile may find its way through a soft growth.

Cancer of the liver is distinguished by the irregular enlargement and nodular feeling of the organ, the rapid deterioration of health, the less intense jaundice, and the absence of fever and paroxysmal pain. The urinary pancreatic reaction is negative, unless the pancreas is invaded by growth.

A diagnosis of gall-stones may be made by the sequence of a long antecedent history of spasms without jaundice, then a severe attack of pain followed by jaundice, and, after a time, recurrent pains with increase of icterus, associated with

ague-like seizures. The absence of tumour is more common in gall-stones than in chronic pancreatitis, though in the latter the gall-bladder may be found contracted at times. The paroxysmal attacks in chronic pancreatitis may be quite as severe as those met with in gall-stone seizures, but there is usually less pain. The tenderness, however, will be over the gall-bladder with gall-stones and in the middle line with pancreatitis; moreover, the radiating pain in gall-stones is toward the right infra-scapular region, and in pancreatitis towards the left or to the mid-scapular region. When the gall-stones are situated in the first or second part of the common bile duct, the pancreatic reaction is negative and the fæces are alkaline in reaction. Although the stools often contain a considerable excess of fat, they do not show the high proportion of unsaponified fat usually met with in pancreatic cases, but are as a rule rich in combined fatty acids. A fairly well-marked reaction for stercobilin is usually obtained even when the fæces are typically clay-coloured. When a stone is impacted in the third part of the duct, there is,

according to our experience, an associated inflammation of the pancreas in from 60 to 70 per cent. of cases, and when the calculus lies in the fourth part the pancreas is almost certain to be affected.

Chronic catarrh of the bile ducts is characterised by jaundice and loss of flesh, coming on for the most part painlessly. It is usually associated with inflammatory changes in the pancreas, to which many of the more serious results of the disease are really due.

Chronic pancreatitis due to other causes than cholelithiasis varies somewhat in its symptoms according to its origin. There may be merely an aching in the epigastrium, or slight pain not at all pronounced, or the symptoms may come on painlessly, associated with dyspepsia and with slight jaundice, which soon becomes more marked. In such cases the gall-bladder may dilate and give rise to a suspicion of cancer of the pancreas, which the rapid loss of flesh will tend to confirm. Jaundice, however, is by no means a constant symptom, only being present in about 16 per cent. of our cases that were not associated with cholelithiasis. There is often a

marked loss of flesh and strength, and an examination of the blood will show a more or less severe anæmia, which in advanced cases often closely resembles the pernicious type. The urine will give the pancreatic reaction, and the fæces show an excess of fat, chiefly due to unsaponified neutral fats and free fatty acids, when the disease interferes with the digestive functions of the pancreas. In very advanced cases, too, the urine may contain more or less sugar.

CHAPTER X

MEDICAL TREATMENT

SINCE modern research has shown that the formation of gall-stones is dependent upon infection of the biliary tract, the treatment of cholelithiasis must be directed to the prevention of such infection, or its speedy cure should it be established. The medical treatment is therefore essentially preventive, for although much may be done by diet, hygiene, and drugs to allay or modify the symptoms and effects produced by gall-stones, once they have formed nothing short of surgical interference can be relied upon to bring about their safe removal, and avert with certainty the complications and catastrophes which their presence is liable to bring about.

The general measures to be recommended for the prevention of cholelithiasis, particularly in those who have a special tendency to the disease, or in the past have suffered from infection of the biliary tract, are

such as will ensure an avoidance of gastro-intestinal catarrhs and infections, a healthy condition of the liver, with regular flow of bile, and, as far as possible, a normal metabolism in the body generally. The meals should be regular and at frequent intervals. A mixed diet is better than one based upon the supposed influence that any particular form of food stuff may have upon the formation of gall-stones, but over indulgence in sweet or starchy foods, as well as in rich or made dishes, should be avoided, as these tend to induce gastro-intestinal catarrh. Alcohol should only be used in moderation, well diluted, and with food. As many patients the subject of cholelithiasis habitually drink very little fluid, it is important that the consumption of a sufficient amount of water daily should be enjoined. This not only helps to dilute the body fluids and flush out the biliary passages, but also assists intestinal peristalsis. Regular movement of the bowels should be secured, and, if necessary, some simple laxative should be used for the purpose. A tumblerful of natural Carlsbad water daily before breakfast, and a tumblerful of plain hot water before each of the

remaining meals of the day, may be recommended, but as the continued and regular use of Carlsbad salts induces a gastro-duodenal catarrh in some people, the effervescing phosphate of soda may be substituted with advantage. As women suffer from gall-stones much more frequently than men, it has been thought that their mode of dress, and especially the wearing of stays, may be one of the causes, but probably the want of sufficient exercise, with constipation and an excess of sugary and starchy foods, is more to blame. The use of properly fitted "straight-fronted" corsets is, however, advisable. Fresh air, warm baths, and regular exercise, with systematic deep abdominal breathing, are other hygienic measures that may be recommended.

Should there be any condition of the heart, lungs, or liver likely to give rise to congestion of the portal circulation, it should be remedied as far as possible. Inflammatory catarrhal conditions of the stomach or duodenum should be combated by attention to the diet, daily saline laxatives, particularly phosphate of soda, and the administration of bismuth

and sodium bicarbonate an hour before meals, as their continuance is liable to lead to infection of the biliary passages and give rise to a condition favourable to gall-stone formation. Recently the administration of milk "soured" with lactic acid bacilli has been recommended in such cases, and, as it appears to have a disinfectant and stimulant effect in the intestinal tract, it is probably a useful adjunct for their treatment. Hyperchlorhydria is frequently associated with gall-stones, but the spasm of the pylorus to which this condition is liable to give rise is also at times incorrectly diagnosed as gall-stone colic. In either case its treatment is necessary, for continued hyperchlorhydria may pave the way for subsequent cholelithiasis, or, if gall-stones are already present, mask the true cause of the symptoms.

Much could probably be done to prevent the formation of gall-stones if more attention were paid to the condition of the biliary tract in disease where it is now known that they are liable to be infected. This is particularly true of typhoid fever. As we have already pointed out, there is a steadily growing conviction that many more cases of cholelithiasis are

due to past attacks of this disease than is generally supposed, and it is therefore advisable that in every case of typhoid fever precautions should be taken to prevent infection of the gall-bladder and bile ducts. This may be accomplished by the regular and routine use of hexamethylene tetramine (Urotropine), for the experiments of S. J. Crowe[1] have shown that when this drug was administered by the mouth to dogs it was excreted in quantity both in the bile and pancreatic juice, so that the ducts which had been artificially infected were rapidly sterilised. At the same time the spread of the disease through the urine would be prevented and the occurrence of "carrier" cases probably done away with, since the urine is also disinfected, and the typhoid bacilli found in the fæces of "carrier" cases are believed to be derived from a focus of infection remaining in the biliary channels after convalescence has been established. Salicylates are probably of definite value as disinfectants and cholagogues, and may be of use in suspected infections of the bile-ducts, but their effects must always be watched, and their

[1] *Johns Hopk. Hosp. Bull.*, April 1908, p. 109.

administration suspended on the appearance of undesirable symptoms. In sub-acute inflammations of the bile passages, ammonium chloride is often a remedy of some value. It may be administered in mucilage diluted with plenty of water, or in plain soda water.

The medical treatment of established cholelithiasis may be divided into that required in gall-stone colic and that of the intervals between the attacks.

The indications for treatment during the attack are to relieve the pain and spasm of the bile ducts, and to diminish the attendant inflammation as much as possible. In the milder cases, relief may often be afforded by the administration of 5 minims of ether in half an ounce of chloroform water, repeated every quarter of an hour if necessary, or by 10 to 15 grains of aspirin. For the more acute attacks of pain and spasm, opium will probably be indispensable. It is best given as a hypodermic injection of morphine sulphate, $\frac{1}{4}$ grain, combined with atropine sulphate, $\frac{1}{150}$ grain. The atropine is added because it assists the morphine in soothing the peripheral nerves, and also by its specific action on the

involuntary muscle fibres it tends to relax the spasm of the ducts, and aid in the passage of the stone. If the pain again increases, a further injection of $\frac{1}{8}$ grain of morphia may be given in one and a half to two hours, and a third dose of $\frac{1}{8}$ grain two or three hours later if necessary; but the dose of atropine should not be repeated, as it tends to contract the blood vessels, dry up the secretions, and inhibit the action of the morphine. Morphia should always be given with caution, and while enough is administered to dull the worst of the pain, care should be taken not to entirely obscure the symptoms. If the pain at any time is so intense that it cannot be controlled with moderate doses of morphia, it is better to obtain anæsthesia and abdominal relaxation with inhalations of chloroform than to stupefy the patient with opium. It is sometimes stated that chloroform inhalations are advisable in all cases, since chloroform anæsthesia will paralyse the muscle fibres of the ducts, and so lead to passage of the stone, but there does not appear to be any practical foundation for this belief. The administration of hyoscine has been advocated by some observers, as a sedative and to relieve the spasm.

A hot-water bag or hot fomentation applied to the upper abdomen, and frequently changed, is often useful in relieving the pain, or the patient may be placed in a hot bath. Dry heat or the addition of irritants, such as mustard, to the water are of little or no use, as the object of the application is to produce relaxation of the abdominal muscles. A method which has been advocated by Dock, and others, is copious lavage of the stomach with hot water, or hot Carlsbad water. It is maintained that this is the most soothing way of applying heat, and that it acts as a general sedative to the affected tissues, lessening the congestion and swelling. The lavage is repeated every two or three hours during the most severe pain, and once a day afterwards. In any case, copious draughts of hot water are useful, and warm olive oil may be administered if the patient is not vomiting, on the supposition that it may lubricate the duodenal outlet of the common duct, or even regurgitate into the duct, and so assist in the passage of the stone. When the pain ceases, because the stone has fallen back into the gall-bladder or, maybe, has passed into the duodenum,

a patient who has received large doses of opium will probably relapse into a deep sleep, but it is advisable to awaken him at intervals to avoid the danger of morphia coma. Should this develop, appropriate treatment should be at once applied.

If the stone does not pass, or become disengaged, the pain may still gradually subside, or occur only at intervals, the cessation of symptoms being due to a diminution of the inflammatory reaction and relaxation of the walls of the duct gripping it, or, if the stone has been long impacted, to injury or dulling of the sensitiveness of the nerves involved. Blocking of the common duct by a stone will soon be shown by the onset of jaundice, but it must be remembered that jaundice may also be produced by the obstruction due to swelling of the mucous membrane consequent on a stone that has passed into the duodenum, or has fallen back into the gall-bladder, or to gripping of the duct by an inflamed pancreas.

After the attack has subsided, the bowels should be opened with a dose of calomel or castor oil, subsequently their movement may be encouraged by the regular administration of hot Carlsbad water. Rest

should be enjoined, and the temperature, state of the blood, urine, and fæces, as well as the physical condition of the region of the biliary tract, be carefully inquired into and noted. By taking these into account, the cause of the symptoms and the probable location of calculi may be determined. It is then only a question of opinion as to when is the most suitable time to invoke surgical aid.

If the patient refuses operation, or for any reason it is thought inadvisable to operate, the treatment in the intervals between the attacks should be carried out along the lines suggested for the prevention of gall-stones—large quantities of water to drink, careful dieting, and regular movement of the bowels by means of hot Carlsbad water, with perhaps the use of urotropine or salicylates, being the chief indications. In some cases a systematic course of treatment at Carlsbad, Vichy, Aix les Bains, Cheltenham, Harrogate, Marienbad, or Châtel-Guyon may be of benefit.

The possibility of removing gall-stones by means of drugs administered through the mouth has long been a problem that has excited much interest, and

although many such remedies have been from time to time introduced it cannot be said that any one of them has fulfilled the claims that have been made on its behalf. It is apparently forgotten that no drug can reach the biliary passages save by a very circuitous route and in an extremely dilute form, so that, while many substances have the power of dissolving gall-stones in the test tube, they entirely fail to accomplish that end in the body. Thus benzoic acid, benzoate of soda, salicylic acid, turpentine, ether, chloroform, and numerous other agents reported to have a beneficial effect, really produce no material change in the caliculi themselves; but, since some of them relieve the associated catarrh of the bile ducts and gall-bladder, the change observed in the patient's condition after their administration is to be attributed to this. The more healthy condition of the mucous membrane will probably also restrict the increase in size of gall-stones already formed, or prevent the appearance of new ones, thus proving really curative if the patient has had the good fortune to part with those which already existed. It is also possible that if the mucous membrane of

the gall-bladder is not much damaged, and any infection which is present can be cured, that calculi consisting chiefly of cholesterin may be slowly dissolved, for the experiments of Vaughan Harley and Barrett, and later of Bain, have shown that gall-stones introduced into the normal gall-bladders of dogs are dissolved within a comparatively short time, and that even when a mild degree of cholecystitis is set up some solution takes place, so that the stones are reduced in weight (Bain). Ichthoform, cholelysin, olive oil, and calomel were found by Bain to have no effect in resolving calculi introduced into a gall-bladder the mucous membrane of which was inflamed; but he states that, during a course of Harrogate old sulphur water, gall-stones become disintegrated in cases of cholecystitis experimentally induced, and that treatment of artificially produced cholelithiasis with a mixture of urotropin and iridin had a pronounced effect in causing dissolution of the calculi.

The beneficial results following the administration of olive oil in gall-stone cases was at one time strongly urged, and that it is often of distinct value there can be no doubt, but not in the way originally

imagined. There are now very few who believe that the olive oil given by the mouth can dissolve gall-stones in the biliary tract, and that such an idea ever gained credence is probably due to the discovery in the stools of concretions having a superficial resemblance to biliary calculi after its administration. These usually consist of large white lumps, varying in diamater from 0·5 to 2 centimetres, and of the consistency of hard tallow. They are now known to consist of thick emulsions, or masses of combined fatty acids (soap), formed by the action of the intestinal secretions and bacteria on the oil given by the mouth. The effect of oil in these cases is probably to be attributed partly to the influence it exerts in the stomach on the excessive secretion of hydrochloric acid and hypermotility present in some instances, and partly to the lubricant action on the duodenal papilla and lower part of the common duct.

Recently, succinate of soda in 5-grain doses has been suggested as a solvent of gall-stones, but we have had no personal experience of it, and the reports already to hand by those who have employed it do not suggest that it is of more value

than the many other drugs introduced for the purpose.

Attempts to obtain the passage of gall-stones into the intestine by abdominal massage have been made, but it is scarcely necessary to do more than draw attention to the many changes frequently present in the gall-bladder and bile ducts in such cases in order to prove how futile, and even dangerous, such attempts are, however skilfully performed; for not only is it unlikely, but in the large majority of cases it is utterly impossible, that the concretions can be forced through passages so narrow as we know the cystic and common ducts to be.

CHAPTER XI

SURGICAL TREATMENT

After medical treatment has been fairly tried and failed, surgical measures should be resorted to, if possible, before complications have supervened.

While cholecystotomy is generally recognised as the operation to be aimed at in the treatment of cholelithiasis, it is often impossible to say what operation will have to be done until the abdomen is opened.

The indications for operating are as follows:—

1. Frequently recurring biliary colic without jaundice, with or without enlargement of the gall-bladder.
2. Enlargement of the gall-bladder without jaundice, even if unaccompanied by great pain.
3. Persistent jaundice ushered in by pain, and

where recurring pains, with or without ague-like paroxysms, render it probable that the cause is gall-stones in the common duct.

4. Empyema of the gall-bladder.
5. Peritonitis, starting in the right hypochondrium.
6. Abscess around the gall-bladder or bile ducts, whether in the liver, or under, or over it.
7. Some cases where, although gall-stones may have passed, adhesions remain and prove a source of pain and illness.
8. Fistula discharging mucus or muco-pus.
9. Certain cases of chronic jaundice with distended gall-bladder dependent on some obstruction in the common duct, even though the suspicion of malignancy be entertained.
10. Phlegmonous cholecystitis and gangrene of the gall-bladder.
11. Suspected rupture of the gall-bladder, with or without external wound.
12. Infective and suppurative cholangitis.
13. Certain cases of biliary fistula, if it be thought that the cause of obstruction may possibly be removed or short-circuited.

14. Acute, subacute, or chronic pancreatitis due to gall-stone obstruction and secondary infection.
15. Certain intervisceral fistulæ due to gall-stones.
16. Tumour below the right costal margin failing to yield to general treatment, and the nature of which cannot be determined without exploration.

Diagnostic Operations

The operative measures undertaken for diagnosis are sounding and aspiration of the gall-bladder. The so-called "sounding for gall-stones," either by means of a probe passed through a cannula, or by the fine needle of an aspirator, is both uncertain and dangerous, and may more safely be replaced by a small exploratory incision, which can be extended for treatment if required. If the patient be thought too feeble to bear a general anæsthetic, this operation may be done under cocaine.

Aspiration of a distended gall-bladder through the unopened abdomen, though apparently a simple procedure, is not unattended with danger, death having followed in more than one instance. Murphy

says it is fatal in 25 per cent. It is only in very exceptional cases that it can do any good.

It is infinitely preferable to make a small exploratory incision, then to empty the gall-bladder by the aspirator, and afterwards to explore the bile passages with the fingers. If, however, aspiration without exploration be decided on, a small needle should be used, and the cyst emptied as far as possible, in order that intracystic tension may not lead to extravasation through the needle puncture.

General considerations bearing on operations on the gall-bladder and bile ducts.—While cholecystotomy is generally recognised as the operation to be aimed at in the treatment of affections of the gall-bladder and bile ducts, it is often impossible to say what operation will have to be done until the abdomen is opened and the exact state of affairs made out, for a contracted or dilated gall-bladder, a suppurating or merely a viscus distended with mucus, concretions in the gall-bladder or cystic or common ducts, the condition of the surrounding organs, the presence or absence of adhesions, and a host of other conditions, will all influence the subsequent action of the surgeon,

who always begins the operation as an exploratory one, the subsequent steps depending on the nature of the disease.

No surgeon should attempt the removal of gall-stones unless he is prepared for any of the various operations on the biliary passages, such as choledochotomy or cholecystectomy, as it is almost impossible to say beforehand what may be required until the ducts have been explored by the fingers, and the condition of the affected viscera ascertained; no operation should, as a rule, be concluded until it is clearly made out that the ducts, including the hepatic and common, are quite free from concretions, otherwise disappointment and dissatisfaction are certain to follow. Since in the majority of cases, then, an operation for gall-stones is in the first place simply exploratory, the actual operation on the gall-bladder or bile ducts being only determined by the condition found when the abdomen is opened, it may be well first to consider a simple abdominal section in the gall-bladder region (Fig. 34).

Preparation for operation.—It may be convenient here, before considering the operation itself, to give

some of the details applicable to the operations about to be described.

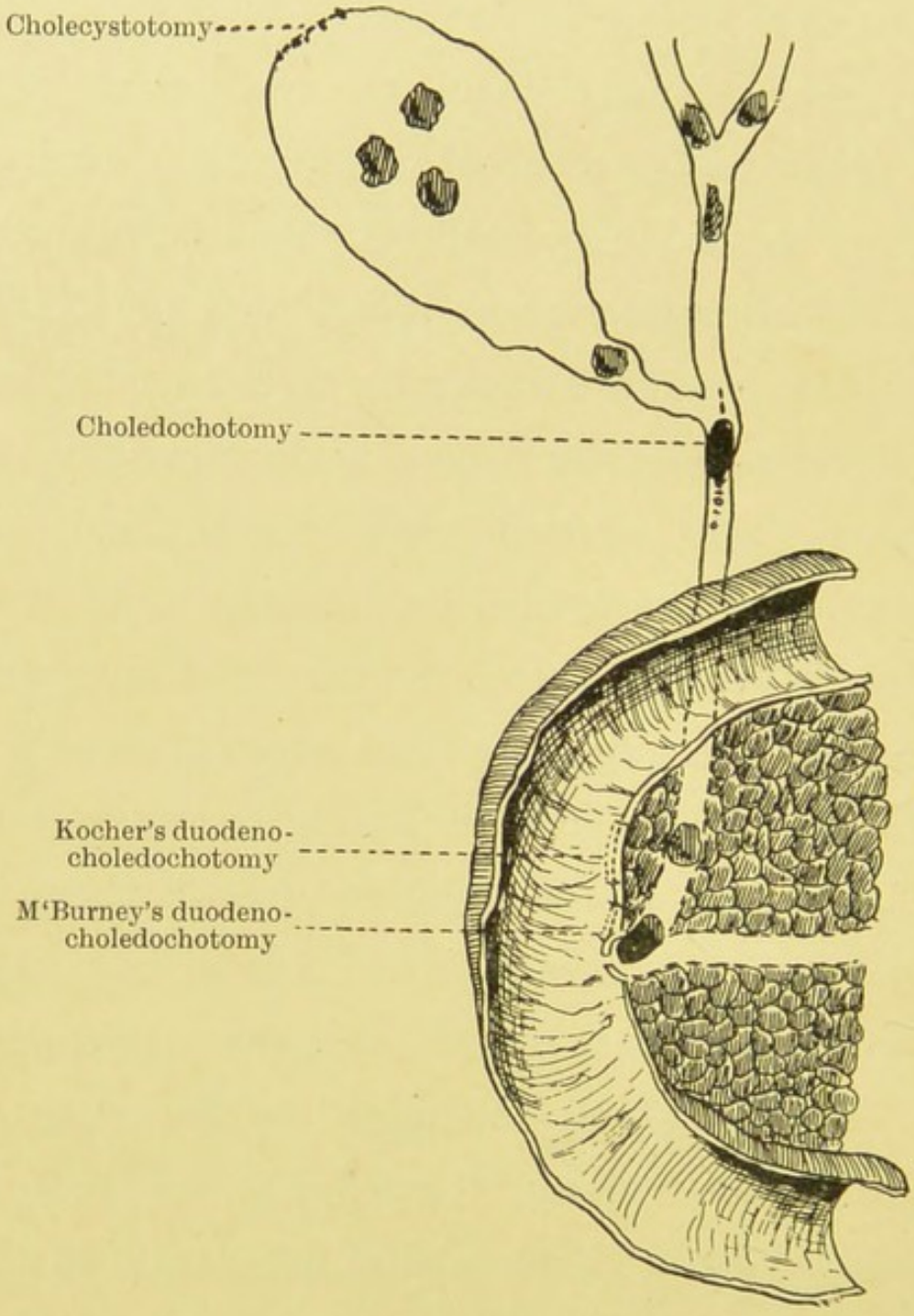


FIG. 34.—Sites of incisions into the biliary tract for the removal of gall-stones.

First, as to the room in which the operation has

to be performed. Any ordinary, well-cleaned room, having high windows so as to give good top light, answers almost as well as an operating theatre. There is an advantage in having an electric light suspended from the ceiling so as to cast a vertical light into the abdomen, but the operation now performed on the bile passages is done close to the surface with few exceptions, not, as formerly, at a great depth.

The advantage of operating in a hospital or surgical home is that the surgeon, or his house surgeon or assistant, is responsible not only for the operation, but also for the after-attendance, a matter almost as important as the operation itself. Moreover, the surgeon can do his work better, and with greater confidence, where he is accustomed to operate, and where he is confident that all his directions, before, at the time, and subsequently, will be carried out to the letter.

The surgeon ought also, if possible, to be helped by his ordinary assistant; for a stranger, no matter how skilful, can never accommodate himself immediately to the needs of the operator; moreover, it must be

remembered that surgery is a fine art that can only be carried out with the greatest perfection under circumstances that are favourable to the operator.

The selection of the anæsthetist is important, so that the surgeon can devote the whole of his mind to the work without having his attention diverted to make suggestions concerning the anæsthetic.

With regard to instruments, a gall-stone scoop is the only special appliance we employ. All the instruments are boiled for half-an-hour before being used.

The sutures and ligatures are of iodised catgut, No. 1 size is used for ligatures, and Nos. 2 and 3 for sutures; they are strong, and reliably aseptic. For the outer or serous suture in stitching the incision in the duct in choledochotomy, the "OO" green chromic catgut prepared by the iodine process answers well, as it does not become absorbed before the second or third week.

Sterilised gauze swabs are employed as sponges. The area of operation is surrounded by dry sterilised towels. The operator and his assistant wear boiled rubber gloves, but take especial care to scrub and

wash several times before operating; and near the operating table is a bowl of 1 in 2000 mercury biniodide solution to lave the hands from time to time during the course of the operation. The instruments are used out of a sterile normal saline solution, and the sponges are either used dry, or wrung out of a hot normal saline solution. The iodised ligatures are immersed in a bowl of simple sterilised water.

The patient is prepared by having an aperient so as to secure the bowels being moved the day before operation, and an enema is given the evening before, if the operation is to take place early the next morning. If there is any feebleness of pulse, 5 minims of liq. strychnia are injected subcutaneously on the afternoon and evening of the day before operation, and 10 minims as soon as the operation has begun. Should there be chronic jaundice, or a tendency to hæmorrhage, calcium chloride or lactate is given before operation in 10-grain doses by the mouth thrice daily for two days, and afterwards in 20 grain doses by the rectum once daily for two or three days, or longer if needful, for although there is a greater tendency to bleeding in

chronic jaundice from pancreatic disease than when jaundice is due to gall-stone obstruction, we think there can be no doubt that in all cholæmic conditions the blood becomes so altered that the coagulability becomes seriously diminished, and these factors demand serious attention before any operation is undertaken in cases of common duct cholelithiasis.

The skin of the patient over the operation area is prepared the day before by thoroughly washing with soft soap, or some soap, not necessarily antiseptic, that will give a good lather; if needful, shaving is then done, and the whole area is gently rubbed with benzine. A dressing of lint, wet with 1 in 40 carbolic solution in water, is then applied, and over this oilskin or gutta-percha tissue. The dressing is changed early the next morning, and the skin is thoroughly washed, so as to clear away all loose and sodden epithelium, after which another 1 in 40 dressing is applied, to be removed on the operating table; or æther soap may be used to cleanse the skin, and a solution of 1 in 1000 biniodide of mercury in methylated spirit employed for the preliminary dressing.

If the patient is feeble, a pint of normal saline

solution, with an ounce of brandy, is given a short time before the operation. As shock is intensified by exposure to cold, the patient is always enveloped in cotton

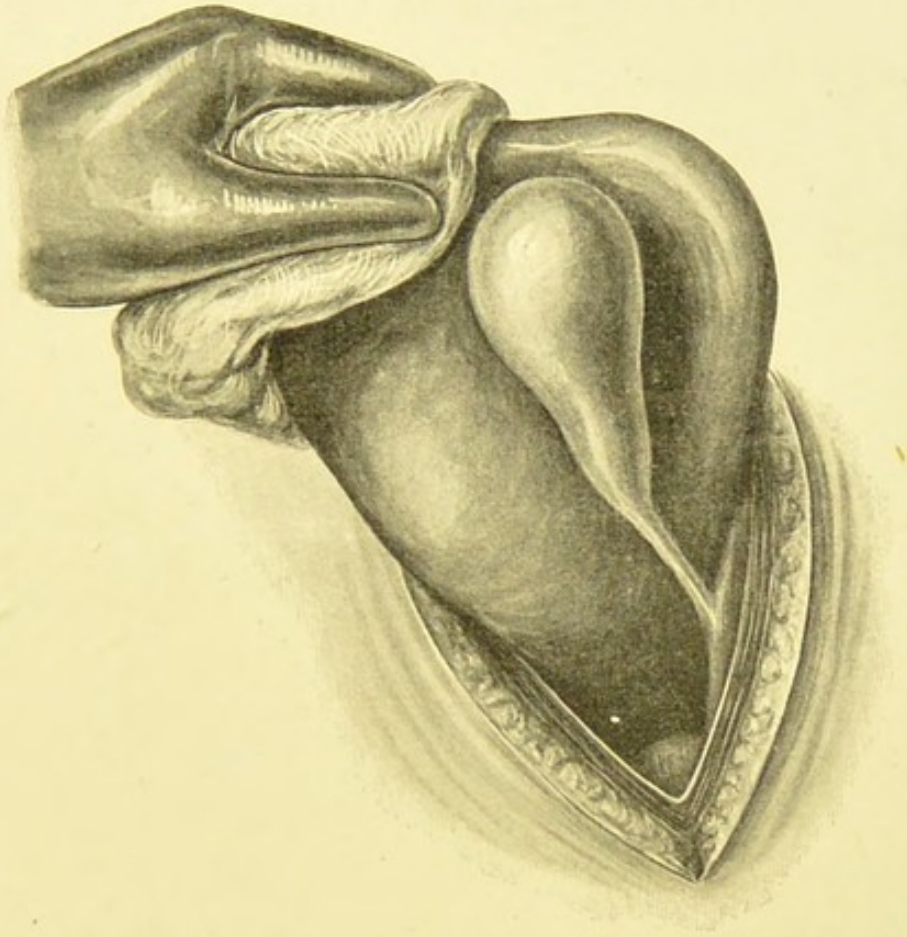


FIG. 35.—Complete exposure of the biliary passages: showing how the common bile duct is displayed when a sand-bag is placed under the spine.

wool, which is conveniently done by making a suit of gamgee tissue, that can be readily run together by the nurses in an hour or two the day before operation. It will be found that a firm sand-bag, about 18 inches

long by 6 inches wide and 3½ inches deep, covered with flannel, and placed on the operating table at the liver level, will push the spine forward, and with it the liver and bile ducts, so that the common and hepatic ducts are brought several inches nearer the

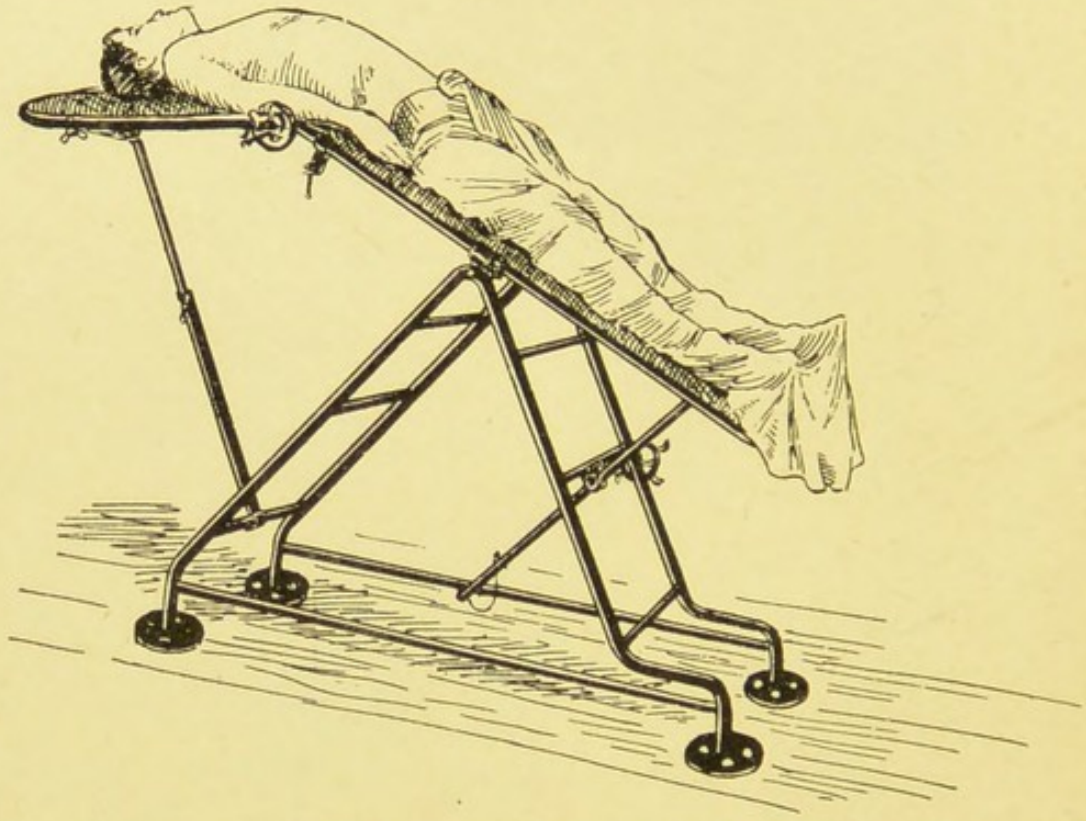


Fig. 36.—Guyot-Greville table.

surface. By opening out the costal angle, and tending to make the intestines slip down from the liver, it acts like the Trendelenburg position in pelvic surgery (Fig. 35). Instead of the sand-bag we now employ a table which, by means of a screw, will bend up in the centre, thus elevating the hepatic region (Fig. 36).

Exploratory operation.—The incision is made vertically over the middle of the upper part of the right rectus in a line parallel with its fibres (Fig. 37), which are then separated by the finger, the posterior sheath of the rectus and peritoneum being divided together. Where the gall-bladder is distended and there is no jaundice, a small incision of 2 or 3 inches only may be sufficient; but when it is necessary to explore either the hepatic, common, or deeper part of the cystic duct, instead of prolonging the incision downwards, as was formerly done, it is carried upwards in the interval between the ensiform cartilage and the right costal margin as high as possible, thus exposing the upper surface of the liver very freely. It will be found that by lifting the lower border of the liver in bulk and rotating it (if needful, first drawing the organ downwards from under cover of the ribs), the whole of the gall-bladder and cystic and common

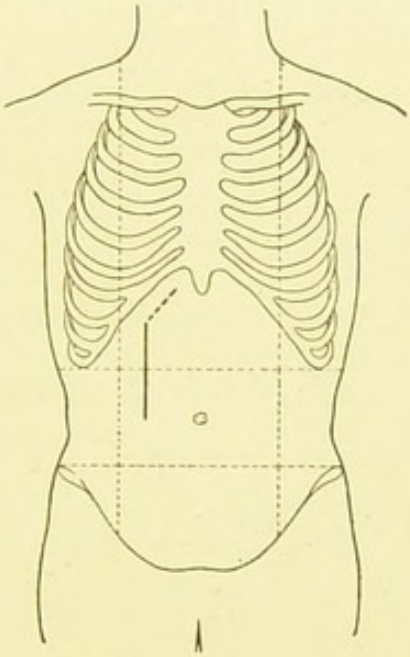


FIG. 37.—Line of incision and extension for complete exposure of the biliary passages.

ducts are brought quite close to the surface; and as the gall-bladder is usually strong enough, an assistant can take hold of it with his fingers or forceps, and by gentle traction can keep the parts well exposed, at the same time that, by means of his left hand with a flat sponge under it, he retracts the left side of the wound and the viscera, which would otherwise fall over the common duct and impede the view. The exposure of the area of operation is improved by the employment of the special table mentioned previously, or by the use of sand-bag or air cushion placed on the table at the liver level.

It will now be observed that, instead of the gall-bladder and cystic duct making a considerable angle with the common duct, an almost straight passage is found from the fundus of the gall-bladder to the entrance of the gall-bladder into the duodenum, and, if adhesions have been thoroughly separated, the surgeon has immediately under his eye the whole length of the ducts, with the head of the pancreas and the duodenum. So complete is the exposure, that, if needful, the peritoneum can be incised over the free

border of the lesser omentum, and the common duct separated from the hepatic artery and portal vein, but this is not necessary except where a growth or glands have to be excised. The surgeon, whose hands are both free, can now deal with the gall-bladder, cystic, common, or hepatic ducts quite easily, performing any operation that may be necessary.

After completing whatever operation may be required, the abdominal wound should be sutured layer by layer, employing No. 3 catgut for the deep aponeurosis and peritoneum, and bringing the sutures back through the superficial fascia; a few interrupted sutures being employed to bring together the subcutaneous tissues.

Three silkworm gut sutures are passed through all the layers of the abdominal wall, and tied loosely on the surface of the skin. They take off tension, and act as stays in case the catgut absorbs too early. The skin margins are approximated by Michel's clips.

Forcipressure is employed for the immediate arrest of hæmorrhage, but it is more satisfactory also to ligature all the bleeding points, as in jaundiced cases

the compressed and unligatured vessels are apt to bleed subsequently, and to lead to complications that are avoidable by careful hæmostasis. For the same reason we prefer to divide and ligature firm visceral, especially hepatic, adhesions, where that is practicable, rather than to separate them with the finger or tear them through.

If the liver be slightly torn in separating adhesions, the bleeding must be carefully arrested before the abdomen is closed. Sponge pressure is usually sufficient if the laceration be small, but if the laceration be extensive, deep catgut sutures, applied by means of a round intestinal needle, will usually accomplish the desired effect; or, this failing, gauze pressure, the plug being left in until it becomes loose, will be certain to answer.

In an ordinary cholecystotomy, drainage of the abdomen, apart from drainage of the gall-bladder, is unnecessary; but where the ducts have had to be incised, as in choledochotomy, and any infected bile has escaped and soiled the tissues, drainage is safer, for, owing to the separation of adhesions, there is generally some pouring out of fluid immediately after

operation, and should this become infected a fear of septic complications is far from problematical.

A stab wound in the loin, through which a tube is passed into the right kidney pouch (Fig. 40), effectually prevents any accumulation. In twenty-four hours this tube may be replaced by a smaller one, prepared beforehand, and in another twenty-four hours that may be removed and not replaced.

The after treatment is almost as important as the operation itself. Expedition in operating is an important factor in lessening shock, especially in abdominal surgery, for it stands to reason that prolonged manipulation and exposure of the viscera in patients so ill, as the class of cases we are now considering must generally be, will sometimes be badly borne. It is not only the work of the surgeon but the deep anæsthesia that adds to the shock, since for these operations to be expeditiously performed the muscles must be well relaxed.

After operation, a pint of saline fluid with an ounce of brandy is given by enema, and 5 minims of liquid strychnia are given subcutaneously, this being repeated if called for. Subcutaneous injections of

saline fluid or intravenous infusion are only rarely required.

Beyond sips of hot water or hot tea from time to time, all feeding is by the rectum for the first twenty-four hours, though if there is no vomiting the teaspoonful of water is increased to a tablespoonful, or even two, every hour. After forty-eight hours, if there is no vomiting, milk and soda and barley water can be freely given. A little plasmon dissolved in the tea, or beef tea, or barley water, considerably adds to the nutritive value of the fluid. Light custard pudding is usually given on the fourth day, fish on the fifth, and chicken on the sixth, after which the diet becomes almost normal.

The bowels are not disturbed before the third or fourth day, and then only by enema, unless there is vomiting or distension; and in case of either of these complications 1 grain of calomel is administered and followed by 2 ounces of Apenta water every two hours until it acts or until flatus passes freely, this being helped by the rectal tube or by turpentine enema.

Morphine is better avoided after abdominal opera-

tions, as it tends to paralyse the intestines, and leads to an accumulation of flatus. We believe that abstention from the use of morphine is a great feature in the success of abdominal surgery, just as we believe that in the past it has killed many patients who would otherwise have done well.

If a sedative is needed, 10 grains of acetyl-salicylic acid (aspirin) will be found useful, and this can be repeated in two hours if required. In case of vomiting being troublesome, or epigastric distension persisting, gastric lavage will be found useful, and when the stomach is emptied, a dose of Apenta water may be left in it to incite peristalsis. Under the circumstances no food or fluid is allowed by the mouth, but plenty of fluid in the shape of normal saline is given by the rectum.

As a rule, recovery is uneventful, and for the most part, after-treatment is almost negative. The stitches are removed on the eighth day, and the tube usually comes away about the same time; the wound generally will have healed by first intention, and the spot where the tube was heals by granulation. The dressings are of the simplest, sterilised gauze and sterilised

wool being employed as a rule, double cyanide gauze being sometimes used next to the wound.

Over the dressings, 2-inch wide strips of non-irritating adhesive plaster are applied, leaving intervals of about 2 inches between each strip, and the whole is secured by a many-tailed bandage.

Cholecystotomy

Cholecystotomy, or cholecystostomy, the term applied to the operation of draining the gall-bladder after removing any gall-stones from the gall-bladder or bile-ducts, usually follows on exploration, as it is the operation *par excellence* in the treatment of gall-stones.

The indications for the operation are:—

1. Where the gall-bladder is sufficiently large to permit of drainage, after gall-stones have been removed, and when it is not seriously damaged by disease.
2. Where, although there are gall-stones in the ducts, the patient is too ill to bear a prolonged operation, cholecystotomy may be performed as a temporary measure, the gall-stones being

deliberately left for subsequent treatment when the patient is in better condition.

3. Empyema of the gall-bladder, where that viscus is not too much disorganised to be permitted to remain.
4. Certain cases of chronic catarrh of the gall-bladder or bile ducts, producing attacks of pain simulating gall-stone seizures.
5. Infective or suppurative cholangitis.
6. Obstruction of the ducts due to hydatid disease.
7. Dropsy of the gall-bladder, after removal of obstruction.
8. Idiopathic rupture, or laceration, or gunshot injury of the gall-bladder or ducts when cholecystectomy is felt to be undesirable.
9. In choledochotomy, in order to avoid tension in the sutured duct, when drainage of the common duct has not been thought desirable.
10. In certain cases of obstructive jaundice dependent on malignant tumour, which is occluding the ducts. In these cases, in which relief can only be temporary, not only the increased danger of operation must be borne

in mind, but also the distress of a biliary fistula.

11. In some cases of phlegmonous cholecystitis where the patient is too ill to bear cholecystectomy, simple drainage by a cholecystotomy may be adopted as a temporary measure.
12. In chronic pancreatitis associated with jaundice due to pressure on the common bile duct; but as a rule cholecystenterostomy is the better operation in this class of cases.

The contra-indications are:—

1. Where the gall-bladder is seriously damaged or contracted, so that it is unlikely to resume its functions.
2. When the gall-bladder is very much thickened, so that there may be a suspicion of commencing growth.
3. When the gall-bladder contains recesses or pockets.
4. In calcification of the gall-bladder.
5. In ulceration or stricture of the cystic duct.
6. In obstruction of the common duct incapable

of removal, and where cholecystotomy would leave a permanent biliary fistula.

The description of the preliminary treatment and the first stages of the operation need not be repeated, as they will be found on p. 244.

Nothing can be simpler than an ordinary cholecystotomy with a distended gall-bladder, or even with a gall-bladder of ordinary size, where a small incision suffices to expose the sac, which is emptied by the aspirator. The collapsed sac is brought through the wound, and surrounded by sterilised gauze; it is then incised through the point where the aspirator needle was inserted, and through the wound in the fundus the gall-stone scoop is inserted, and all gall-stones are removed, a probe or the finger being employed to prove the ducts clear. A firm rubber tube, much firmer than the drainage tubes ordinarily sold, is then inserted from $\frac{1}{2}$ inch to 1 inch into the gall-bladder, the edges of the incision being drawn firmly around it by a catgut purse-string suture, which is tied and cut short, the drain being fixed in position by a catgut suture which transfixes the tube and the peritoneal edges of the incision in the gall-

bladder. The edges of the incision in the gall-bladder are then fixed to the aponeurosis by three or four catgut stitches, but never to the skin, unless a permanent biliary fistula is intended. This tube, which is sufficiently long to pass into a bottle by the side of the patient, drains all the bile away from the wound, and by the time the catgut has dissolved the wound will have healed by first intention, except where the tube was, and that part heals by granulation within the next week or two if the ducts are clear.

If the gall-bladder is deeply placed and surrounded by adhesions, the operation will not be so simple, and the extended incision previously described (p. 253) will have to be adopted for the more complete exposure of the gall-bladder and bile ducts.

In detaching adhesions, it may be found that there is a fistula between the gall-bladder and stomach, pylorus, or bowel, and a careful search must always be made for this, lest an opening into one of the hollow viscera be left, which would probably mean extravasation and death. After the adherent viscera have been separated, the gall-bladder must be

packed around with sterile gauze, and the fundus incised.

When all the gall-stones have been removed, and the ducts have been proved to be free from concretions, the next question will be, how is the gall-bladder to be dealt with? If it is large enough to reach the abdominal wall it will be treated as described above, but if it is too small to be brought to the parietes, but sufficiently large to admit a drainage tube (Fig. 38), the method of fixing the tube by purse-string suture just described will be quite safe, even if the opening in the gall-bladder has to be left 2 or 3 inches from the surface, for the omentum can be made to lie against the tube, and by the time the catgut is dissolved, a track of adhesions will have formed that will quite effectually prevent extravasation.

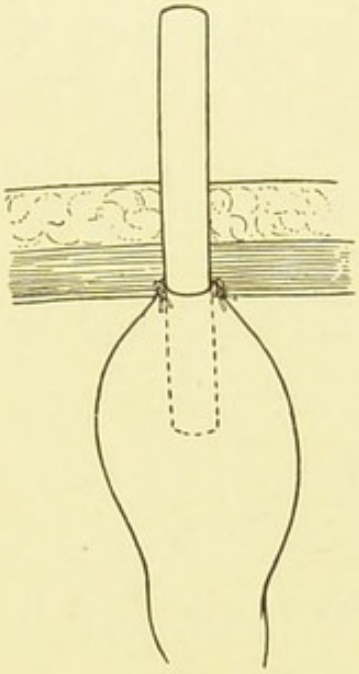


FIG. 38. — Diagram showing the method of securing a drainage tube in the gall-bladder in the operation of cholecystotomy.

If the gall-bladder be so contracted as to be incapable of admitting a tube, the contracted and

useless viscus should be removed by cholecystectomy.

Gall-stone in the cystic duct.—If, as frequently happens, gall-stones are so firmly fixed in the cystic duct that they cannot be pressed backward into the gall-bladder, it is better not to use force, but to incise the duct over the stone, and after clearing the duct to close it by a double row of sutures to mucous membrane and serous coat respectively. If the duct is ulcerated or contracted so that a stricture would be likely to form, the gall-bladder should be excised, though if the cystic duct be capacious and not ulcerated, and the gall-bladder healthy, it may be drained by a cholecystotomy.

The operation of cholecystotomy has been modified in several ways; for instance, the opening has been closed and then fixed to the abdominal incision, which has been closed over it; this operation is known as cholecystendysis (Courvoisier).

It can only be of use where the ducts are known to be thoroughly cleared, where there is no fear of subsequent stricture, and where there is no catarrh or inflammation of the bile passages or gall-bladder.

The so-called "ideal" operation was suggested by Langenbach.[1] The opening in the gall-bladder is sutured and the viscus returned without fixing it to the surface, but the serious objection to it is, that the benefits of drainage are not obtained as in the ordinary operation of cholecystotomy, hence it is now seldom performed.

Another modification suggested by Bloch, is that in two stages. The operation consists in incising the parietes until the peritoneum is reached, the cavity of which, however, is not opened; the wound is then packed with gauze and left for several days, when adhesions will have formed between the gall-bladder and the parietal peritoneum. The gall-bladder can then be safely opened. Or, if the peritoneum be incised, the gall-bladder is fixed, but not opened until adhesions have formed.

As the method is only available for the simplest cases—viz., where the gall-bladder is distended—as it does away with all chance of exploring the ducts by the hand within the abdomen, and as it is frequently followed by a fistula, it needs only to be mentioned to

[1] *Centralbl. für Chirurgie*, 1887.

be condemned as clumsy and uncertain, and not so safe as the ordinary operation of cholecystotomy.

The statistics of cholecystotomy vary very considerably according to the conditions for which the operation is performed.

In our experience, where the operation had been undertaken for simple disease, such as gall-stones, in the absence of malignant disease, or jaundice with suppurative and infective cholangitis, there was a mortality of 1·06 per cent.

If the complicated cases, such as phlegmonous cholecystitis, gangrene of the gall-bladder, suppurative or infective cholangitis (all of which are classified by Kehr as complicated cases) be included, the mortality has been 2·7 per cent.

If the malignant cases, where cholecystotomy has been performed in the presence of cancer of the pancreas or bile ducts be included, the mortality of the whole series was 5·8 per cent.

Dr. W. J. Mayo of Rochester, Minnesota, in a paper published in June 1902, in the *Annals of Surgery*, gives 227 cases of cholecystotomy for various simple conditions, for the most part gall-stones, with 6

deaths, or 2·6 per cent. mortality, whereas in malignant disease, of 4 cholecystotomies, 2 died. In a paper published in the *Boston Medical and Surgical Journal*, 21st May 1903, he gives 352 cholecystotomies for simple conditions, with 8 deaths, or a mortality of 2·27 per cent.; whereas of 5 cases in which cholecystotomy had been done for malignant disease, 3 died, equal to 60 per cent. mortality.

In Kehr's statistics, published in 1902,[1] he gives 720 laparotomies for gall-stones, with 15·5 per cent. mortality; the simple cholecystotomies had 2·1 per cent. mortality; but the complicated cases, including malignant disease, had a mortality of 97 per cent.

With regard to recurrence, if the ducts be cleared and the gall-bladder drained, relapse is extremely rare.

Operative treatment of calculi in the common duct.—The treatment of calculous obstruction in the common duct is of the utmost interest, both on account of the difficulties to be overcome and the great importance to the patient.

When once gall-stones have reached the common

[1] *Münchener med. Woch.*, 1902.

duct, their attempted dislodgement by purely medical means is, with few exceptions, disappointing in the extreme, and the unfortunate patients are condemned to a lingering and painful illness, usually ending in death, unless the obstruction can be removed by surgical intervention.

The following methods are available for the removal of calculi from the common duct under various conditions :—

(*a*) In a few cases, when the cystic duct is dilated, concretions may be manipulated backwards into the gall-bladder, and thence extracted by scoop or forceps, the operation being completed just as a simple cholecystotomy, but this is seldom practicable on account of the contraction of the gall-bladder and cystic duct.

(*b*) Occasionally a small stone may be pressed into the duodenum, but this is exceptional and not generally to be recommended, as not infrequently it may be pushed into a dilated diverticulum of Vater and so be missed and the whole operation rendered futile.

(*c*) Cholecystotomy, with subsequent treatment of the obstruction by solvent injections of olive oil or soap solution, has been adopted in exceptional cases where the patients were extremely ill and the common bile duct could not be easily exposed. Our experience of solvent injections has, however, not been so favourable as to make us very hopeful of accomplishing the solution, or the diminution to the passing point, of the concretion deliberately left behind, and a subsequent operation has usually been necessary. This method may be exceptionally excusable in patients too ill to bear choledochotomy.

(*d*) Cholelithotrity, or crushing the stones *in situ*, where the concretions are sufficiently soft to yield to the pressure of the finger and thumb, is a method of treatment that cannot be recommended, as, though in the early history of operations on the common duct some cases of cholelithotrity were successful, it was frequently followed by relapse or by continued infection of the bile ducts.

(*e*) Needling concretions through the duct walls is not unattended by danger as the damage to the walls of the ducts may lead to subsequent trouble. It is not necessary for soft stones, and uncertain in the case of hard concretions. It only needs mentioning to be condemned as uncertain and dangerous.

(*f*) Cholecystenterostomy, or short-circuiting the obstruction, may be adopted where the patient is too ill to bear a prolonged operation, but it is by no means an ideal operation in cholelithiasis as it leaves the obstruction untouched. As in gall-stone obstruction the gall-bladder is usually contracted, cholecystenterostomy is impracticable in the greater number of cases; moreover, if immediately successful, the small opening is liable to contract. The operation may, however, be advisable in certain cases after the gall-stones have been removed, where the head of the pancreas is enlarged and causing pressure on the common duct, as in interstitial pancreatitis.

(*g*) Choledochenterostomy, or uniting the dilated cystic or common duct to the duodenum, in cases of largely dilated ducts with contraction of the gall-bladder has been adopted on rare occasions, but the same objections apply to it as to cholecystenterostomy.

(*h*) Choledochostomy, or attaching the dilated duct to the surface and draining it, is so frequently associated with infection of the ducts in the liver that in a number of the cases reported a fatal result has followed. The operation is therefore not to be recommended.

(*i*) Choledochotomy, or incising the duct and removing the calculi is the operation *par excellence* for the treatment of gall-stones in the common ducts.

(*j*) Duodeno-choledochotomy, or reaching the duct through the opened duodenum for stones impacted in the duodenal end of the duct, is a useful modification of the operation.

It will thus be seen that in common duct cholelithiasis the surgeon has a great variety of operations to choose from, but we have no hesitation in stating

that the modern operation of choledochotomy is the only satisfactory method of treatment, as it is the only method available for all cases of common duct cholelithiasis.

Choledochotomy

Choledochotomy is the name given to the operation of incising the common bile duct for the extraction of gall-stones.

Operation.—It is the ideal operation for the removal of stones from the common duct and is therefore worthy of special study. What was formerly a most difficult procedure, involving prolonged manipulation, special appliances, and at least two assistants, and only to be undertaken after all other means had failed, is now a comparatively simple operation in the greater number of cases, only requiring the help of one assistant, and not requiring the use of any special apparatus. The modifications which we had the honour of suggesting some years ago have been set forth on p. 252, and an extensive experience by ourselves and other operators has confirmed their utility. The essential points consist in

a free exposure of the area of operation by the upward incision; a thorough separation of adhesions; rotation of the liver and a projection forward of the hepatic region by the use of a sandbag, air cushion, or special table.

By this method, the time involved in the operation is reduced considerably, and where adhesions do not give unusual trouble, it is easy to complete the work in from thirty to forty minutes, which not only means a saving of time and fatigue to the operator, but a considerable saving of shock to the patient.

The common duct having been freely exposed, and the assistant having retracted the viscera by means of his left hand with a flat sponge under it, and having raised the edge of the liver by holding it, or the gall-bladder, up by means of a swab, which gives a better grip, the surgeon, whose hands are both free, can so manipulate the common duct as to render prominent any gall-stone, which can be readily cut down on by a vertical incision so planned as to avoid wounding the small vessel that crosses the duct just above the upper border of the first part of the duodenum. After the concretions have been extruded,

the cut margins of the duct are caught up by long pressure forceps, and by means of a scoop passed up and down the duct all other concretions are removed.

When the duct is incised, there is usually a free flow of bile, which it must be remembered is probably infective; but by inserting a sponge in the kidney pouch, and rapidly mopping up the bile as it flows by means of sterilised gauze pads, any soiling of surrounding parts is avoided, and if thought necessary the bulk of the infected bile can be drawn off by an aspirator, either from the gall-bladder or from the common duct above the obstruction before the incision into the bile passages is made.

It is of the utmost importance to clear the ducts, or the operation will be futile. Fenger suggested a flexible metallic probe, which, he says, will give a click when it touches a stone, or which will produce a grating sensation when it passes one. This we know by experience to be a fallacious guide, as in one case, after carefully probing and even passing a scoop into both hepatic ducts, and up and down the common duct, without feeling a calculus, a finger inserted through the incision felt a stone, which was then

removed; but, had we trusted to a probe, the calculus would have been left. The duct is usually dilated sufficiently to permit digital exploration; which, under such circumstances we should always advise, reserving a bent probe, or, better still, a slender, bent scoop, for use where the duct is not capacious enough for the finger. The hepatic duct and its primary branches can be readily explored, and calculi removed from them through an incision in the common duct. If gall-stones be found in the hepatic duct, they may be reached by opening the common duct and passing a scoop or forceps through this opening, but, if needful, the hepatic duct may be incised and the concretions removed. Before closing or draining the duct, we always pass a large probe down into the duodenum, through the papilla, to be sure that the passage is quite free. In one case, not being able to pass the probe beyond the papilla, we opened the duodenum, and found a stricture of the common duct close to its termination, which was divided, after freely laying open the papilla over a director.

Having cleared the ducts of all concretions, drainage of the biliary passages must be provided for, seeing

that the bile is practically always infected in common duct cholelithiasis; moreover, in a considerable proportion of cases, about 60 per cent., the common bile duct passes through the head of the pancreas, which frequently participates in the inflammatory process and exercises pressure on the duct; thus, if drainage

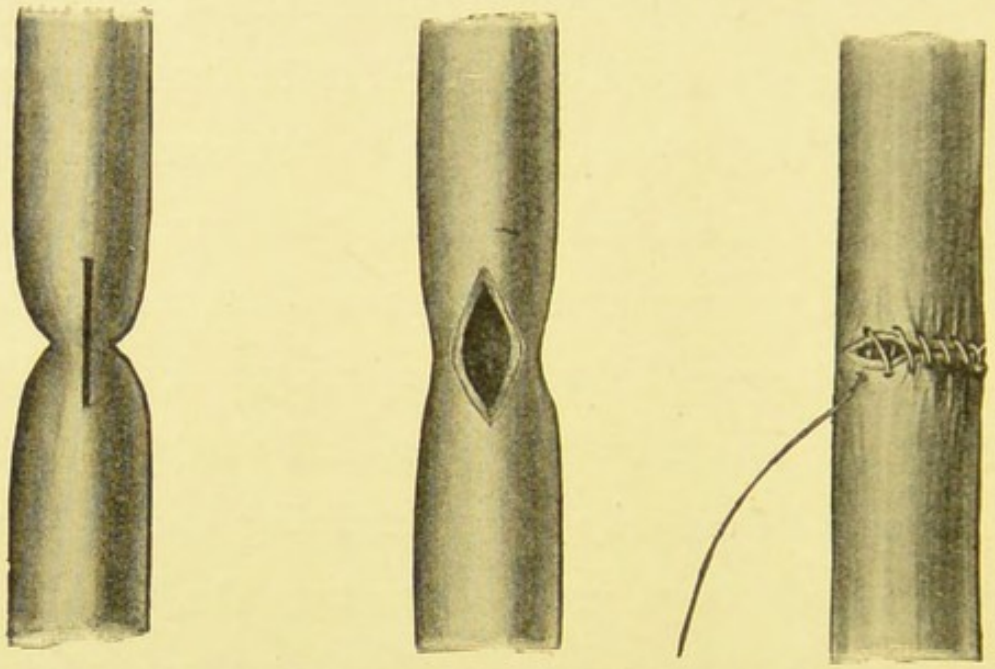


FIG. 39.—Method of repairing a stricture of the bile ducts.

be not allowed for, not only will the infected bile continue to be absorbed, but a certain amount of tension will remain and the jaundice will persist or possibly increase, whereas if efficient drainage be secured, at the same time the infected bile will be allowed to escape and the relief of tension will cause

a subsidence of the swelling in the pancreas, shortly permitting the whole of the bile to pass into the duodenum.

A convenient drainage tube is an ordinary No. 12 Jacques' catheter, which is passed through the incision in the common duct in the hepatic duct. The tube is fixed in position by a No. 1 iodised catgut stitch, which passes through the cut edges of the duct and transfixes the tube. This will dissolve in about a week and allow the tube to be removed. The remainder of the incision in the duct is brought together by a continuous catgut stitch which transfixes both sides of the opening in the duct, commencing at one end and passing through and through the edges until it reaches the tube, where it is knotted and cut short. This stitch causes the tube to be embraced closely so as to prevent any escape of bile until it is ready to come away in from seven to ten days. The end of the drainage tube is brought out through a stab wound in the right loin. If there has been any soiling of the operation area by the infected bile, it will be wise to place a medium-sized drainage tube in the right kidney pouch and to bring it out through

the same stab opening (Fig. 40). This tube will drain the peritoneal pouch on the right of the abdomen, and in case of escape of bile, or pouring out of effusion, will prevent any soiling of the general cavity of the peritoneum. The peritoneal tube can be removed ordinarily in from twenty-four to forty-eight hours.

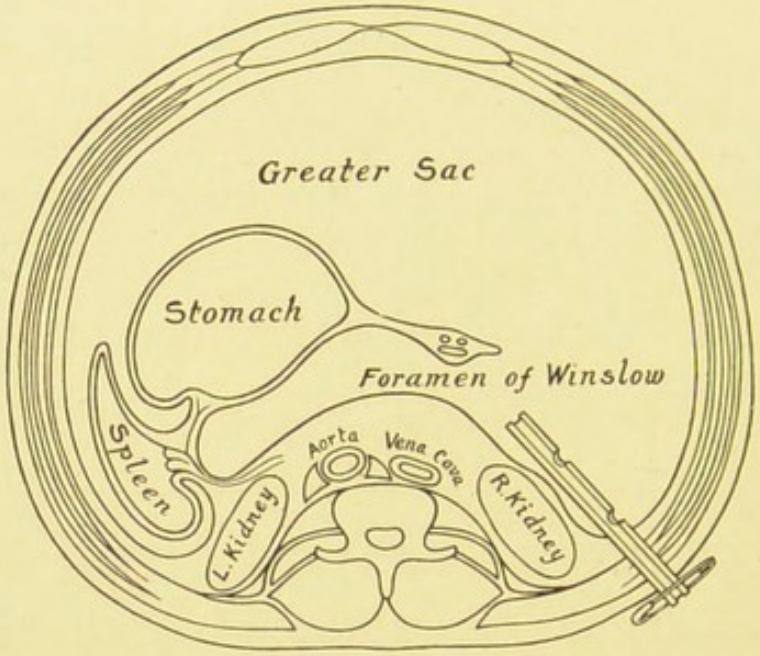


FIG. 40.—Transverse section through the kidney pouch, showing drainage tube *in situ*.

When the tubes are brought through a stab wound, the anterior wound can be completely closed as described on p. 255.

If the gall-bladder is of normal size, or sufficiently enlarged to allow of the insertion of a drainage tube, and if it is sufficiently healthy and the cystic duct

is also patent and free from ulceration and stricture, the incision in the common duct can be closed and the operation completed by draining the gall-bladder as in an ordinary cholecystotomy.

When the head of the pancreas is inflamed and pressing on the common duct, we have occasionally connected the gall-bladder to the duodenum so as to institute permanent drainage internally, thus avoiding a surface drain.

If the gall-bladder is contracted or seriously diseased, it may be removed by cholecystectomy and a small tube passed through the remains of the cystic into the common duct, the original incision into the common duct being then closed.

The total mortality in our cases of choledochotomy since 1899 has been 5·1 per cent., although we have recently had a series of 53 successive cases without a death. The division of choledochotomies into simple and complicated, followed by some writers, is open to serious objection, as practically all cases of common duct cholelithiasis present some complications, hence our statistics are based upon every case in which operation has been performed.

Duodeno-Choledochotomy

Duodeno-choledochotomy is a term applied to the modification of the operation of choledochotomy, in which the gall-stones are removed from the common duct through an incision in the duodenum.

Operation.—The operation is really less difficult than it would appear, and is much facilitated by placing a sandbag under the lower dorsal spines. Where the liver is small and the common duct cannot be made to reach the surface, its exposure through the duodenum may even be simpler than the ordinary operation of choledochotomy, especially if the second part of the duodenum is mobilised by dividing the peritoneum passing from it to the kidney. The termination of the common duct, including the duodenum, should be grasped between the finger and thumb of the left hand, and the anterior wall of the gut cut through vertically for about an inch, thus exposing the interior of the posterior wall of the intestine with the termination of the common duct running in it. Either the duct can be laid open from the papilla, or the stone may be cut down on through the posterior wall

of the duodenum: the former method was suggested by M'Burney, the latter by Kocher (Fig. 34). Bile escapes freely as soon as the obstruction is removed, and it must be mopped away as it flows, since it is always infective. As a rule there will be no trouble with bleeding, and no sutures need be placed in the posterior wall of the duodenum if the papilla has simply been laid open, but if Kocher's method is employed it is wise to catch up the incised margins of the duct and duodenum and to fix them together by two or more stitches. The incision through which the duodenum has been opened should be sutured by a continuous catgut suture, for the mucous membrane, and a continuous silk or celluloid thread, for the peritoneum.

For calculi impacted in the diverticulum of Vater, the operation is preferable to the ordinary choledochotomy, as it is occasionally difficult to extract a stone impacted in the ampulla through an incision in the supraduodenal portion of the common duct; moreover, an incision of the narrow orifice of the bile duct in the duodenum leaves a patent opening, which will allow any other concretion that may have escaped observation to pass without difficulty.

Retroduodenal Choledochotomy

Berg [1] suggests that the method of removing an impacted culculus from the retroduodenal portion of the ductus communis through an incision made into the lumen of the duodenum is difficult, and not free from danger. He argues that it is not always possible to find the duodenal papilla, and, beyond the slight risk of primary peritoneal infection, there is the serious and more likely one of the formation of an external duodenal fistula. The author describes the different steps of an operation which he has practised to his full satisfaction on the cadaver. This consists in making a vertical incision through the posterior parietal peritoneum on the right of the descending portion of the duodenum, so as to mobilise this portion of the intestine and to render it capable of being moved over towards the left side of the abdomen, and also of being rotated in the same direction. By this rotation the posterior surface of the intestine, together with the retroduodenal and papillary portions of the ductus communis, may be brought forward and freely

[1] *Centralbl. f. Chir.*, No. 27, p. 1903.

exposed to view. The duct can be readily recognised when thus exposed, and, whilst retained between the surgeon's fingers, be incised for the release of any impacted body.

Cholecystectomy

It has been suggested that on physiological, anatomical, and pathological grounds the gall-bladder is not only a useless but a dangerous organ, and that when any of its diseases require surgical intervention it should be treated in the summary fashion in which we now deal with the vermiform appendix. Our experience does not support these views, and we would urge that it must not be forgotten that gall-stones, though usually forming in the gall-bladder, may arise in any part of the biliary apparatus, both within and outside the liver. As a matter of fact, we have known gall-stones to develop in a dilated common duct on several occasions after cholecystectomy had been performed by various operators; whereas in the very large experience of Mayo, Kehr, and ourselves, whose aggregate of operations on the gall-bladder amounts to considerably over 3000,

it has been stated by each separately that the recurrence of gall-stones after cholecystotomy is an extremely rare event.

Bile is constantly being formed in the liver at the rate of about 1 oz. an hour, as one of us proved by a long series of observations some years ago,[1] but it is normally only poured into the intestine after food has been taken and is passing through the pylorus, the sphincter at the orifice of the common duct opening in response to the reflex effect of the stimulus of food passing the pyloric sphincter. In the intervals, the gall-bladder acts as a reservoir in storing the bile until it is required to neutralise the acid chyme and to help in emulsifying fat. While the bile is in the gall-bladder, mucus is added to it, and from our observations made in 1889 it is known that the amount of mucus is considerable, 72 c.cm. in twenty-four hours. This serves the purpose of rendering the bile less irritating. A series of experiments performed by Dr. Flexner demonstrated the fact that if pure bile is injected into the pancreatic ducts it sets up acute pancreatitis, but when bile

[1] *Proceedings of the Royal Society*, vol. xlvii.

is mixed with mucus the action is very considerably modified, and when a certain amount of mucus has been added it no longer acts as a serious irritant. This would seem to prove that the admixture of mucus with bile in the gall-bladder may be important; and at the best it is merely an expression of ignorance to say that the gall-bladder has no regular purpose to serve.

It is a question whether the loss of the gall-bladder does not always lead to a dilatation of the common duct, so as to replace to a certain extent the reservoir function of the gall-bladder. That this has occurred in some cases, we know from personal experience. If this is universal, it seems not unlikely that after cholecystectomy the dilated common and hepatic ducts may ultimately form a reservoir, and in cases of infection, concretions may, and in fact do, develop in the dilated common duct. Moreover, if the bile ducts within and outside the liver have to act as reservoirs, there must necessarily be back pressure on the secreting part of the liver, conditions which do not apply when the gall-bladder is acting as a bile store (Fig. 41).

Sufficient time has not elapsed to show whether

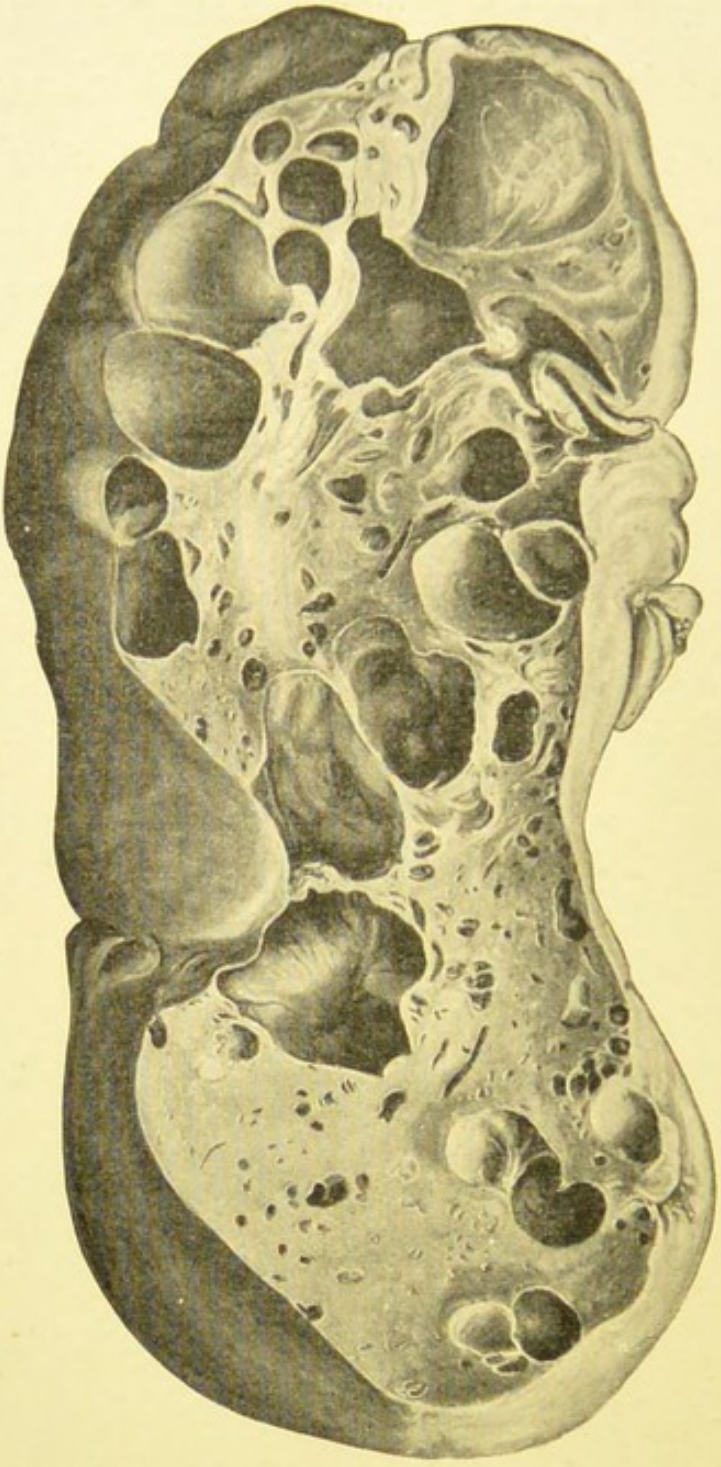


FIG. 41.—Cysts of the liver formed by dilated hepatic ducts. (R.C.S.)

the liver is injuriously affected by this pressure and

absorption, as it is only recently that cholecystectomy for almost normal gall-bladders has been adopted by some enthusiasts as a routine procedure.[1]

We suspect that cirrhosis of the liver and of the pancreas will result in a certain proportion of cases. That interstitial pancreatitis does at times develop we know by actual experience, as we have had to operate on several such cases, and all that could be done under the circumstances was to drain the common duct for a length of time; whereas, had the gall-bladder been present, a cholecystenterostomy would have been easy, and recovery more perfect.

The experiments of Oddi, De Voogt, and more recently of Quaife, show that in dogs the loss of the gall-bladder is generally followed by dilatation of the ducts, and, in some instances, by the formation of a new reservoir in the stump of the cystic duct. The dilatation, according to these experimenters, is due to the pressure of the bile brought about by the secretory

[1] Friedemann (*Beiträge z. klin. Chir.*, Ap. 1909, lxv) investigating the after-histories of 155 patients operated on for cholelithiasis or cholecystitis between 1901 and 1907, found that good results followed where intervention had been restricted to conservative measures, but that nervous or other disturbances still persisted in 10 out of 15 patients in whom the gall-bladder had been removed.

pressure from the liver, and the inspiratory force compressing the liver with each inspiration.

Moreover, if the bile ducts within and without the liver have to act as reservoirs, there must necessarily be back pressure on the secreting cells, with biliary absorption and alterations in the physiology and histology of the liver. De Voogt found at an early period in his experiments a dilatation of the biliary radicles, and Quaife states that in all the six dogs on which he experimented, and which were killed at a later period, the intralobular blood capillaries were dilated, the parenchyma liver cells were compressed, and the normal arrangement of the rows of liver cells was altered. Quaife concludes that after cholecystectomy "the retained bile acts as a poison to the hepatic cells, and nature in attempting to free the liver of this poison produces a hyperæmia. The dilated blood capillaries compress the parenchyma cells, disarranging them, and causing pressure atrophy of the cells. Nature furthermore attempts to correct the condition by partial regeneration of a reservoir for bile, but complete restitution of a gall-bladder does not take place. The vascularity persisting, it is reasonable to

assume that cirrhosis of the liver would result if the animals were permitted to live for a longer period; indeed, there was beginning cirrhosis in two instances."

In ordinary cases of cholelithiasis, cholecystotomy with drainage of the gall-bladder is a very safe and efficient operation, and if the ducts are cleared there need be no fear of fistula or of recurrence of gall-stones. Seeing that cholecystotomy has led to such good results, both immediate and remote, in the surgery of gall-stones, the operation should not be too hastily condemned and replaced by cholecystectomy as a routine procedure; although our experience is that cholecystectomy, in spite of being a more prolonged operation than simple drainage of the gall-bladder, can with due care, and in experienced hands, be performed with hardly more immediate risk, and that when the gall-bladder is contracted and infected, or inflamed and thickened, or gangrenous, or much dilated, it is better to remove it, yet we feel sure that if cholecystectomy were to become the routine procedure for inexperienced operators, the death-rate from gall-stone operations would be greatly increased.

The rate of mortality shown in some of the recent works on gall-stones does not reflect credit on the hospitals whose statistics are quoted; the mortality of simple cholecystotomy should not exceed at the most 1 per cent., and will not if due precautions are taken. If, however, these operations are done by inexperienced surgeons who have not taken the trouble to master the technique of the operation and of the after-attendance, the mortality will continue to be considerable. But if the mortality of cholecystotomy in inexperienced hands is considerable, what would happen if a concensus of opinion was allowed to go forth that cholecystectomy is the operation that ought always to be performed for gall-stones? For every surgeon must acknowledge that it is much more difficult to remove the gall-bladder than simply to drain it. We hold that no one ought to do any operation for gall-stones who is not fitted by experience and surgical ability to perform choledochotomy, cholecystenterostomy, cholecystectomy, or any of the more serious operations on the bile ducts, as it is frequently impossible to say beforehand what operation may be required.

Seeing that recurrence of gall-stones after cholecystotomy, with efficient drainage, is an extremely rare event, that the danger of cholecystotomy in uncomplicated cholelithiasis is almost nil—not 1 per cent. over a large number of cases—that drainage of the bile passages after any gall-stone operation is distinctly advantageous, and that if at some future time it should be necessary to drain the bile passages—say, for obstructive jaundice or interstitial pancreatitis—the difficulties would be increased by the absence of a gall-bladder, though not by a cholecystotomy, our feeling is very decided that cholecystectomy should not replace the simple operation of cholecystotomy as a routine procedure in operating for gall-stones.

Cholecystectomy is indicated in the following conditions:—

1. In cancer or other new growth of the gall-bladder where the disease is local and limited.
2. In contracted and useless gall-bladder, the result of repeated attacks of cholecystitis.
3. In dilated or hypertrophied gall-bladder, resulting from obstruction in the cystic duct.

   (*a*) Always, if resulting from stricture.

(*b*) Usually, if resulting from impacted gall-stones which may have induced ulceration that will subsequently lead to stricture.

(*c*) Usually, if resulting from kinking of the cystic duct, or from adhesions.

4. In phlegmonous or gangrenous cholecystitis.
5. In empyema of the gall-bladder.
6. In calcareous degeneration of the gall-bladder.
7. In mucous fistula of the gall-bladder, the result of stricture or other obstruction of the cystic duct.
8. In gunshot or other serious injuries of the gall-bladder or cystic duct.

It is unnecessary in ordinary cholelithiasis, where the bladder is not seriously damaged, and where the cystic duct is not ulcerated or narrowed by stricture; and it is contra-indicated in all cases where the surgeon cannot be certain that the deeper bile passages are free from obstruction, unless at the same time the cystic or common ducts be short-circuited into the intestine.

The conditions for which cholecystectomy may have

to be performed may be conveniently divided into simple and malignant; no other classification seems to be necessary or desirable. In the former class the variety of the conditions for which we have performed the operation is considerable—phlegmonous cholecystitis, gangrene, ulceration, hydrops, perforation, adenoma, cystic disease, hour-glass contraction, inflammatory contraction and calcification of the gall-bladder, simple tumour, ulceration and stricture of the cystic duct, mucous and suppurating fistulæ, rarely biliary fistula, unless at the same time the common duct has been freed from obstruction. In the latter class—cancer, endothelioma and sarcoma of the gall-bladder or cystic duct.

In the Bradshaw Lecture for 1904, delivered by one of us at the Royal College of Surgeons of England, the causative relationship between gall-stones and cancer of the gall-bladder and bile ducts was fully considered, and the reasons for believing that biliary concretions are the chief determining cause of malignant disease of the biliary passages were discussed; increased experience only confirms the views then expressed.

The practical conclusions which we feel confidence in urging—both from our own experience and that of others—are, that as there is an undoubted relationship between cholelithiasis and cancer of the gall-bladder and ducts, and as gall-stones produce characteristic symptoms, and are therefore as a rule easily diagnosed, and since they can be removed in the early stages before serious complications have supervened with less than 1 per cent. of risk, the preventive treatment for cancer of the gall-bladder is obviously removal of the source of irritation.

In our own experience malignant disease has been found in a little over 5 per cent. of cases of operations for gall-stones, but we only know of two cases in which cancer of the gall-bladder developed subsequently to cholecystotomy, one of these having been under our own immediate observation.

Operation of Cholecystectomy.—Having exposed the parts to be operated on as described in detail on page 253, and having decided to remove the gall-bladder, the cystic duct is seized a little beyond its entrance into the common duct by means of strong

pressure forceps, which at the same time grasp the cystic artery and thus control bleeding during the remain-

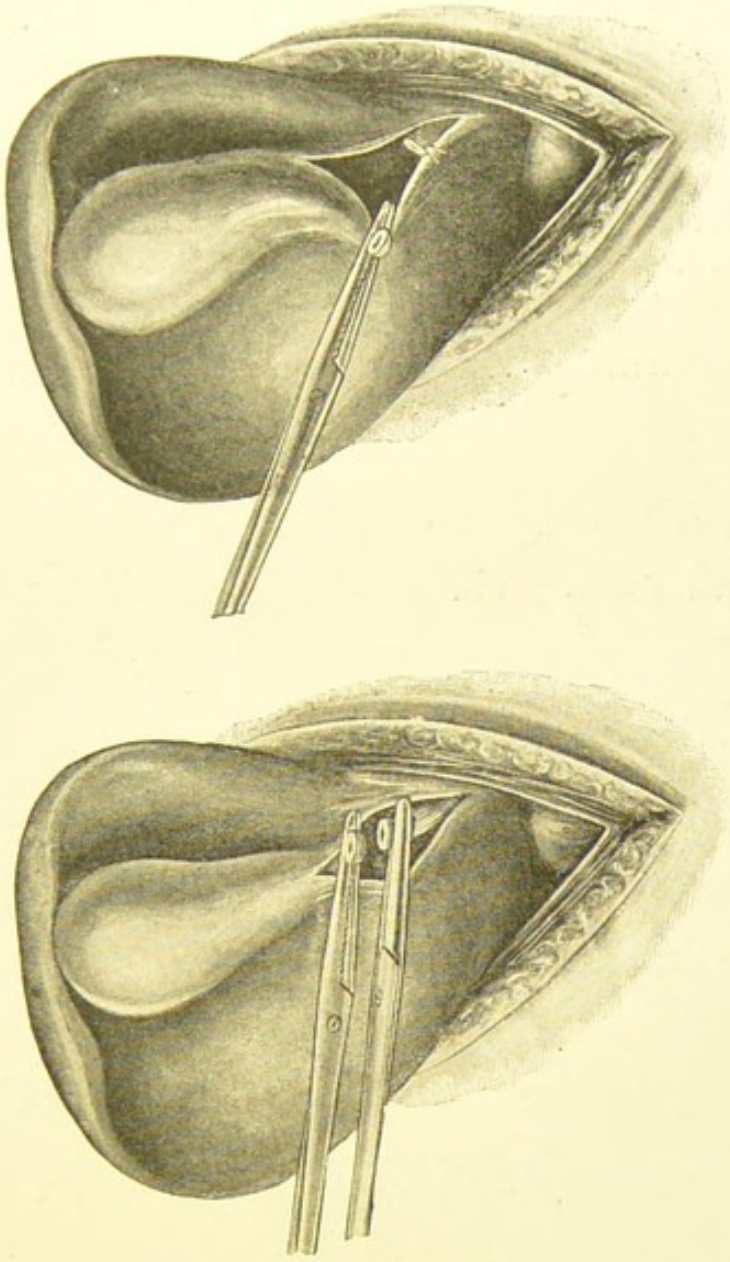


Fig. 42.—Two stages in the operation of cholecystectomy.

ing stages of the operation (Fig. 42). Another pair of pressure forceps is employed to seize the cystic duct half an inch nearer to the gall-bladder, and between

the two forceps the duct is divided. The finger, or a blunt dissector, can now be used to separate the gall-bladder from its bed, and as it is separated the peritoneum on each side is divided by scissors one-third of an inch from its reflection into the liver, care being taken to avoid wounding the liver. Sometimes it is easier to carry the separation from above downwards, but usually the dissection can be more easily effected from below upwards. Any bleeding points may now be ligatured, and the cystic artery, which was divided between the clamps, can be seen and readily secured by ligature. The open end of the cystic duct is now seized and ligatured, and the stump buried beneath the peritoneum, which is readily brought over it; the suture being continued upwards, brings together the cut peritoneal edges on each side of the gall-bladder fissure of the liver, so as to obliterate the fissure and leave no dead space. A gauze drain may be passed down to the duct, but this is not absolutely necessary if the operation has been cleanly conducted. Where there is any infection of the common bile duct, or of the liver ducts, it is advisable to insert a drainage tube into the divided

and open end of the duct, the tube being fixed in place by a catgut suture and surrounded by a purse-string suture of catgut; this will remain in position for a week without any fear of leakage, and by the time the catgut has dissolved a track will have been isolated from the general cavity of the peritoneum, so that the tube may be safely removed then or left in longer, should more prolonged drainage be necessary. The form of tube usually employed is a No. 12 Jacques' catheter. In order to avoid visceral adhesions, the right border of the omentum is brought up and placed between the tube and the viscera.

If the patency of the common duct is doubtful, yet the gall-bladder is too badly damaged to be safely retained, the cystic duct may be cut long and the open end anastomosed into the duodenum, so as to permanently short-circuit the obstruction. This may be advisable in cases where the pancreas is inflamed and compressing the bile duct.

In a considerable number of cases collected from various sources, the mortality of cholecystectomy is 5 per cent. In the Rochester clinic it has been

3 per cent., which corresponds exactly with our own experience in the last 80 removals of the gall-bladder, including both simple and malignant cases.

Cholecystenterostomy

Cholecystenterostomy consists in establishing an artificial opening between the gall-bladder and duodenum, jejunum, or colon, preferably the first.

The operation is indicated—

1. In jaundice due to interstitial pancreatitis.
2. In biliary fistulæ depending on stricture in, or other permanent occlusion of, the common duct.
3. In jaundice due to stricture or tumour of the common duct, or of the ampulla of Vater, or of the papilla.
4. Very occasionally in cancer of the head of the pancreas leading to chronic jaundice and distended gall-bladder, for in such cases the mortality will necessarily be so high that the justifiability of the operation is questionable.

5. Very rarely in impaction of gall-stones in the common bile duct, where the duct cannot be freely exposed, and the patient is not in a fit condition to bear the more prolonged operation of separating adhesions and crushing or removing the concretion by choledochotomy.

Contra-indications—

1. In any obstruction of the bile ducts which can be cleared away with reasonable probability of success.
2. In malignant disease of the head of the pancreas, or common bile duct, leading to distension of the gall-bladder the mortality is so great that it is hardly worth incurring the risk, unless the patient be in very good condition.
3. In contracted gall-bladder where it is impracticable to insert the necessary lines of suture.
4. In very large gall-bladder with obstruction of the cystic duct, where cholecystectomy should be done

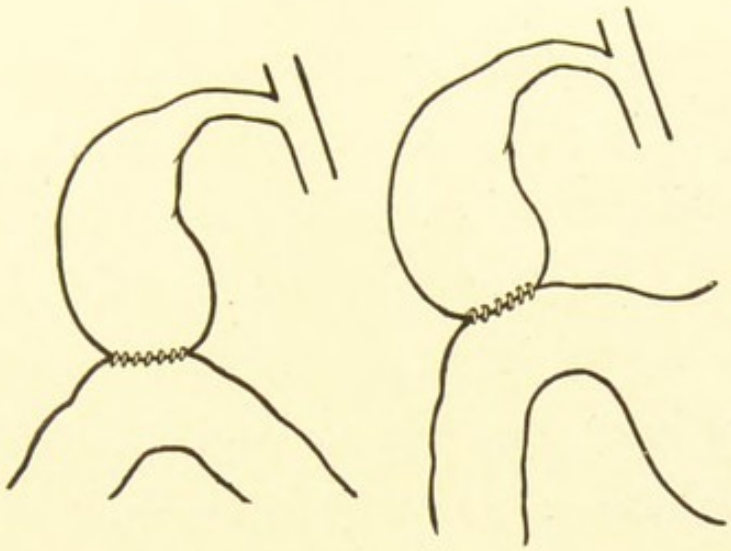
The operation of cholecystenterostomy is performed

through the same incision as is made for cholecystotomy. After the gall-bladder has been aspirated and clamped and the intestine also clamped, the junction is effected.

For convenience, the posterior semicircle of the serous (silk or thread) suture is first applied, and the needle is laid aside for a moment, but not unthreaded; the openings are then made and the posterior half of the mucous (chromic catgut) suture is inserted. The mucous suture is then continued around the anterior half of the opening until it meets the other end of the catgut, when the two ends are tied and cut off short; the serous suture is then carried around the anterior half until it reaches the point where it began, when the two ends are drawn on, tied, and cut short.

In considering the question of cholecystenterostomy, it has to be borne in mind that the operation can only be done when the gall-bladder is of moderate size, or dilated, and that it is inapplicable to the difficult class of cases where an obstruction is in the common duct and the gall-bladder is atrophied. When it can be done, the anastomosis should

be made to the duodenum (Fig. 43), but if preferred, a free loop of jejunum may be selected and brought over the hepatic flexure of the colon. In some of our earlier cases where we made the anastomosis between the gall-bladder and the colon, the result



a. *b.*

FIG. 43.—Cholecystenterostomy.
a. Anastomosis of gall-bladder with jejunum.
b. ,, ,, with duodenum.

appeared to be quite as satisfactory as if the gall-bladder and the duodenum had been joined; and as the operation of joining the gall-bladder and colon is so much simpler than that of joining the gall-bladder to the duodenum, and in cases of biliary fistula may often be done without actually opening

the peritoneum, we might have been inclined to favour the colic anastomosis had it not been for the fact that there are now several cases on record in which the gall-bladder-colic anastomosis has been followed by infection of the bile ducts and abscess of the liver.

Cholecystenterostomy has been advocated for obstruction in the commom bile duct by gall-stones. In our earlier practice we occasionally performed this operation, but since adopting the more effectual method of exposing the whole length of the bile ducts we have discarded cholecystenterostomy since it leaves the cause untouched, and should the artificial opening close, the symptoms inevitably return.

Although cholecystenterostomy is not in itself a dangerous operation, it is as a rule only undertaken in patients who are seriously ill, either from malignant disease or some affection producing complete obstruction of the biliary passages. In our experience, of over 60 cases, the mortality has been 4 per cent. in the absence of malignant disease; but where the operation has been undertaken for the temporary

relief of obstruction due to cancer the result has been much less satisfactory, the average mortality being about 50 per cent., an experience which agrees with that of other surgeons.

Choledochostomy

Choledochostomy is the term applied to the direct surface drainage of a dilated common bile duct, an operation which is frequently performed as part of the technique of choledochotomy, and which is then very successful: but there is a class of cases in which the common duct becomes cystic, forming a tumour so large as to be mistaken for a dilated gall-bladder or a pancreatic cyst. The simple drainage of such a cyst had been termed choledochostomy. The operation is most unsatisfactory and has with few exceptions ended fatally. The condition which is seldom dependent on gall-stones is best treated by choledochenterostomy or connecting the cyst to the duodenum.

Choledochenterostomy

Choledochenterostomy is the term applied to the

operation of connecting a dilated common duct to the duodenum. It may be called for in the cystic condition of the common duct just referred to under choledochostomy, or it may be needed to short-circuit an obstruction in the lower part of the common duct, when for some reason the gall-bladder is not available for the purpose. In the case of a large cyst of the duct the operation is as simple as a cholecystenterostomy, and is performed in a similar manner, but in an ordinary obstructed duct the difficulties are greater, as the duct has to be united to the first part of the duodenum by a double row of sutures.

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