

The gall bladder and the bile ducts

Surgical anatomy and physiology

The gall bladder is pear-shaped, 7.5—12cm long, with a normal capacity of about 50 ml, but capable of considerable distension in certain pathological conditions. The anatomical divisions are a fundus, a body and a neck that terminates in a narrow infundibulum. The cystic duct is about 3 cm in length but variable. Its lumen is usually 1—3 mm in diameter. While the cystic duct joins the common hepatic duct in its supraduodenal segment in 80 per cent of cases, it may extend down into the retroduodenal or even retropancreatic part of the bile duct before joining.

The common hepatic duct is usually less than 2.5 cm long and is formed by the union of the right and left hepatic ducts.

The common bile duct is about 7.5cm long and formed by the junction of the cystic and common hepatic ducts. It is divided into four parts:

- The supraduodenal portion, about 2.5 cm long, running in the free edge of the lesser omentum;
- The retroduodenal portion;
- The infraduodenal portion lies in a groove, but at times in a tunnel, on the posterior surface of the pancreas;
- The intraduodenal portion passes obliquely through the wall of the second part of the duodenum where it is surrounded by the sphincter of Oddi. It terminates by opening on the summit of the ampulla of Vater.

The arterial supply of the gall bladder is the cystic artery, a branch of the right hepatic artery, is usually given off behind the common hepatic duct. Occasionally, an accessory cystic artery arises from the gastroduodenal artery

Lymphatics

The lymphatic vessels of the gall bladder (subserosal and submucosal) drain into the cystic lymph node of Lund (the sentinel lymph node), which lies in the fork created by the junction of the cystic and common hepatic ducts. Efferent vessels from this lymph node go to the hilum of the liver, and to the coeliac lymph nodes. The subserosal lymphatic vessels of the gall bladder also connect with the subcapsular lymph channels of the liver, and this accounts for the frequent spread of carcinoma of the gall bladder to the liver.

Surgical physiology

Bile, as it leaves the liver, is composed of 97 per cent water, 1—2 per cent bile salts, and 1 per cent pigments, cholesterol and fatty acids. The liver excretes bile at a rate estimated to be approximately 40 ml/hour. The rate of bile secretion is controlled by cholecystokinin which is released from the duodenal mucosa. With feeding there is increased production of bile.

Functions of the gall bladder

- 1) The gall bladder is a reservoir for bile. During fasting the bile excreted by the liver is diverted to the gall bladder. After feeding the gall bladder contracts and the bile enters the duodenum. These motor responses of the biliary tract are in part affected by the hormone cholecystokinin.
- 2) The second main function of the gall bladder is concentration of bile by active absorption of water, sodium chloride and bicarbonate by the mucous membrane

of the gall bladder. The hepatic bile which enters the gall bladder becomes concentrated 5—10 times, with a corresponding increase in the proportion of bile salts, bile pigments, cholesterol and calcium.

- 3) The third function of the gall bladder is the secretion of mucus — approximately 20 ml is produced per day. With total obstruction of the cystic duct in a healthy gall bladder, a mucocele develops on account of this.

Investigation of the biliary tract

Plain radiograph

1. It will show radio-opaque gallstones in 10 per cent of patients.
2. It will also show the rare cases of calcification of the gall bladder, a so-called 'porcelain' gall bladder. The importance of this appearance is that it is premalignant and an indication for cholecystectomy.
3. Limey bile is frequently related to multiple small stones. This lesion is not a premalignant lesion.

Oral cholecystography (Graham—Cole test)

Iopanoic acid BP is taken as tablets on the night before the examination. A control radiograph is taken before the tablets are given and a series of X-rays is taken on the following day, with further films after a fatty meal. The fatty meal stimulates gall-bladder contraction and reveals the adequacy of gall-bladder function.

This investigation has been discarded by most hospitals because of its inaccuracy except to show diverticulae and polyps, and to assess function.

Intravenous cholangiography

Intravenous cholangiography permits radiological visualisation of the bile ducts. The drug is given intravenously and is rapidly secreted by the liver into the biliary tree. Careful radiography with or without tomography can clearly define the ducts and the gall bladder delineating the presence of stone disease. The contrast agent can cause allergic reactions such that this test has been discarded in most units.

Ultrasonography

Ultrasonography is non-invasive and is now the standard initial imaging technique for the investigation of the patient suspected of having a gallstone, and is also the prime investigation for the patient presenting with jaundice. It will demonstrate biliary calculi, the size of the gall bladder, the thickness of the gall-bladder wall, the presence of inflammation around the gall bladder, the size of the common bile duct and, occasionally, the presence of stones within the biliary tree. It may even show a carcinoma of the pancreas occluding the common bile duct.

Radioisotope scanning

Technetium-99m (^{99m}Tc)-labelled derivatives of imino-diacetic acid (HIDA scan) are excreted in the bile and used to visualise the biliary tree. In acute cholecystitis the gall bladder is not seen. The technique is used when biliary enteric anastomoses are functioning inadequately as it will show the extent of obstruction at the anastomosis and indicate the delay in excretion.

Computerised tomography (CT)

CT is not a useful technique in investigating the biliary tree. Its only value is in the investigation of patients who may have a cancer of the gall bladder or bile ducts, and in

these patients will define its extent, the presence of lymphadenopathy and the presence of metastases.

Magnetic resonance cholangiopancreatography (MRCP)

MRCP is now becoming the standard technique for investigation of the biliary tree. Contrast is not necessary and, with appropriate computing, a clear outline of the biliary tree can be achieved with a sensitive and specific diagnosis of bile-duct stones.

ERCP (endoscopic retrograde cholangiopancreatography)

This indicated for patient with obstructed pattern of liver function test & for patient with an abnormality of the biliary tract.

Advantages are

- 1) Stone retrieval from the common bile duct.
- 2) Balloon dilatation of CBD stricture
- 3) Endoprosthesis insertion.
- 4) For taking brush cytology of CBD tumour.
- 5) Endoluminal ultrasound is useful for the biliary tract tumour showing the extent of hilar tumour.
- 6) For sphincterotomy.

Acute cholangitis may follow ERCP when contrast fills a dilated and obstructed duct; antibiotics are given as prophylaxis, and if obstruction is encountered relief of that obstruction by the placement of a stent must be undertaken.

Percutaneous transhepatic cholangiography (PTC)

It is used when: **1)** When endoscopic cholangiography is failed or impossible **2)** In patients with hilar bile duct tumour in whom endoscopic cholangiography fails to visualize the intrahepatic bile ducts.

This investigation is only undertaken once a bleeding tendency has been excluded and the patient's prothrombin time is normal. Antibiotics should be given prior to the procedure.

PTC provides external biliary drainage or the insertion of indwelling stents. The scope of this procedure can be further extended by leaving the drainage catheter in situ for a number of days and then dilating the track sufficiently for a fine flexible choledochoscope to be passed into the intrahepatic biliary tree in order to diagnose strictures, take biopsies and remove stones.

Peroperative cholangiography

During cholecystectomy a catheter can be placed in the cystic duct and contrast injected into the biliary tree. The technique defines the anatomy and excludes the presence of stones.

Operative biliary endoscopy (choledochoscopy)

At operation a flexible fibre-optic endoscope can be passed down the cystic duct into the common bile duct enabling stone identification and removal under direct vision.

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