

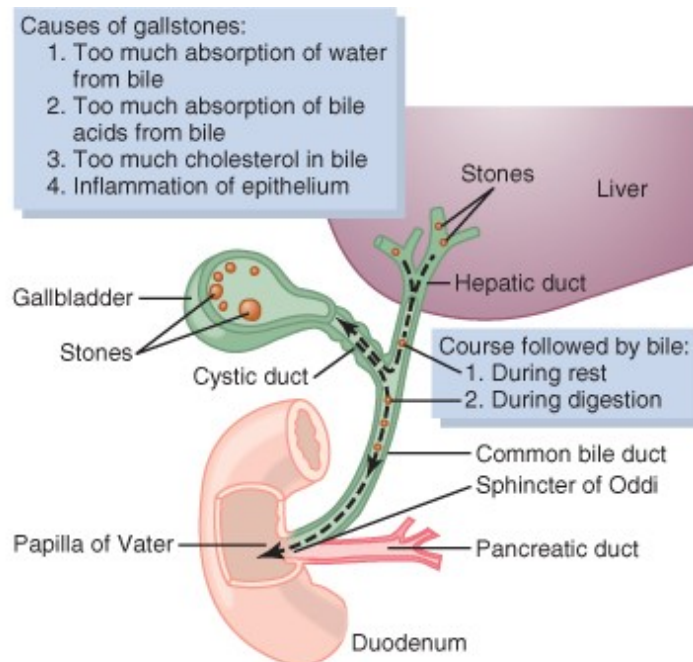
## Clinical aspect of Cholelithiasis

### **Cholelithiasis (Gallstones)**

Gallstones affect 10–20% of adult populations in the northern hemisphere Western countries. Adult prevalence rates are higher in Latin American countries (20-40%) and are low in Asian countries (3-4%).

There are two main types of gallstones. In the West about 80% are cholesterol stones, containing crystalline cholesterol monohydrate. The remainders are composed predominantly of bilirubin calcium salts and are designated pigment stones.

Among persons with gallstones, 70% to 80% remain asymptomatic throughout life, while the remainder becomes symptomatic at the rate of 1% to 3% per year. The risk for the appearance of symptoms diminishes with time. The symptoms are striking: pain tends to be excruciating, either constant or “colicky” (spasmodic) from an obstructed gallbladder or when small gallstones move down-stream and lodge in the biliary tree. Inflammation of the gallbladder, in association with stones, also generates pain. More severe complications include emphysema, perforation, fistulae, inflammation of the biliary tree, and obstructive cholestasis or pancreatitis. The larger the calculi, the less likely they are to enter the cystic or common ducts to produce obstruction; it is the very small stones that are more dangerous. Occasionally a large stone may erode directly into an adjacent loop of the small intestine, generating intestinal obstruction (“gallstone ileus”).



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Figure 1. Illustration of gallstones.

## Anatomy

A gallstone is a concretion in the gallbladder (*vesica biliaris; vesica fellea*), cystic duct (*ductus cysticus*), or bile duct (*ductus choledochus*) composed chiefly of crystalline cholesterol monohydrate (cholesterol stones) or predominantly of bilirubin calcium salts (pigmented stones). As mentioned earlier, about 70% to 80% of gallstones are asymptomatic. Over a 20-year period, two thirds of asymptomatic people with gallstones remain symptom free. For gallstones to cause clinical symptoms, they must obtain a size sufficient to produce mechanical injury to the gallbladder or obstruction of the biliary tree.

The distal end of the hepatopancreatic ampulla (*ampulla hepatopancreatica*), protruding as major duodenal papilla (*papilla duodeni major Vateri*), is the narrowest part of the biliary passages and is the most common site of impaction of gallstones. The infundibulum of the gallbladder is another common site of impaction. Gallstones may also lodge in the hepatic and cystic ducts. A stone lodged in the cystic duct causes biliary colic (intense, spasmodic pain). When the gallbladder relaxes, the stone may pass back into the gallbladder. If the stone blocks the cystic duct, cholecystitis (inflammation of the gallbladder) occurs because of bile accumulation, causing enlargement of the gallbladder. Pain develops in the epigastric region and later shifts to the right hypochondric region at the junction of the 9<sup>th</sup> costal cartilage and the lateral border of the rectus sheath (*vagina musucli recti abdominis*), indicated by the linea semilunaris (of Spigel). Inflammation of the gallbladder may cause pain in the posterior thoracic wall or right shoulder owing to irritation of the diaphragm. If bile cannot leave the gallbladder, it enters the blood and causes jaundice.

Ultrasound and CT scans are common non-invasive techniques for locating stones.

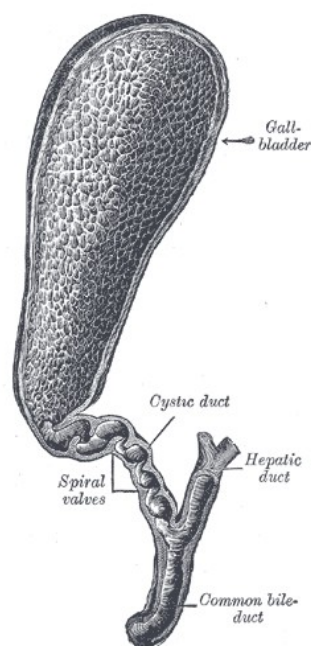


Figure 2. Showing the gallbladder, cystic duct, hepatic duct, and common bile duct.

## Cholecystectomy

Cholecystectomy is the surgical removal of the gallbladder. It is the most common method for treating symptomatic gallstones. Surgical options include the standard procedure, called laparoscopic cholecystectomy, and an older more invasive procedure, called open cholecystectomy. A cholecystectomy is performed when attempts to treat gallstones with ultrasound to shatter the stones (lithotripsy) or medications to dissolve them have not proved helpful.

People with severe biliary colic usually have their gallbladder removed. Laparoscopic cholecystectomy often replaces the open surgical method. The cystic artery most commonly arises from the right hepatic artery in the cystohepatic triangle (*trigonum cystohepaticum*; Calot's triangle) (fig. 3). Careful dissection of the cystohepatic triangle early during cholecystectomy safeguards these important structures should there be anatomical variations. Errors during gallbladder surgery commonly result from failure to appreciate the common variations in the anatomy of the biliary system, especially its blood supply (discussed below). Before dividing any structure and removing the gallbladder, surgeons identify all three biliary ducts, as well as the cystic and hepatic arteries (*arteria cystica, arteria hepatica propria, ramus dexter et sinister*). It is usually the right hepatic artery that is in danger during surgery and must be located before ligating the cystic artery. Bile duct injury is a serious complication of cholecystectomy, which is estimated to occur in 1 per 600 cases, and the risk appears to be modestly higher for laparoscopic cholecystectomy.

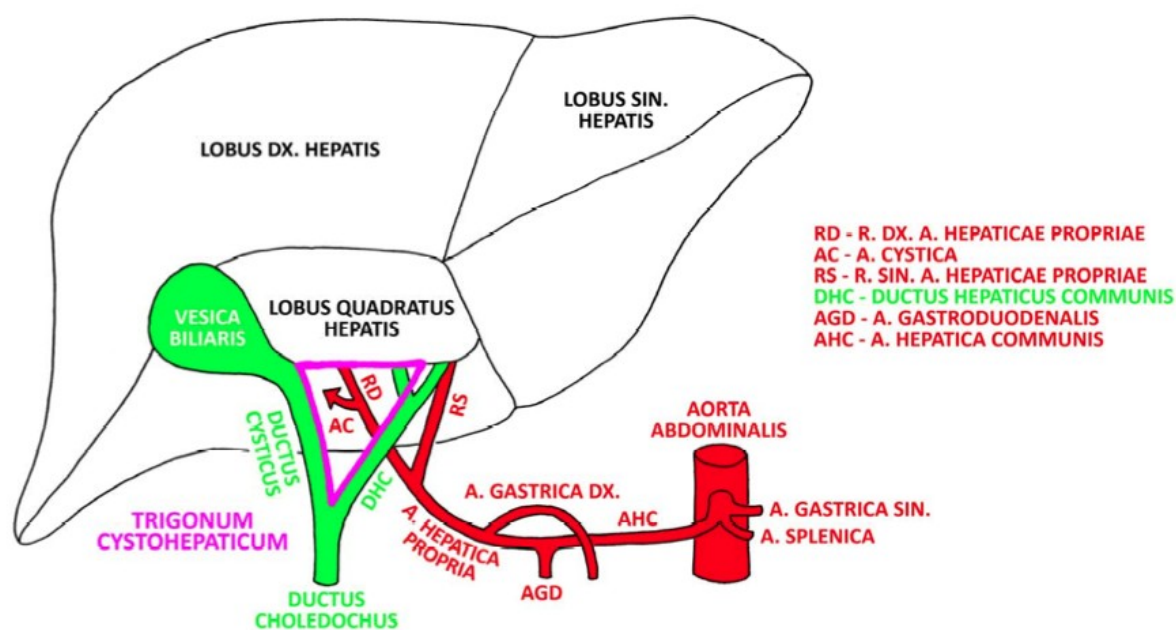


Figure 3. Calot's triangle (*trigonum cystohepaticum*)

### Variations of cystic artery:

- Double cystic artery (*arteria cystica accessoria*):
  - When superficial and deep branches of the cystic artery do not share a common origin it is defined as a double cystic artery occurring with a frequency of 15%. The deep branch consistently arises from the right hepatic artery (*ramus dexter arteriae hepaticae propriae*) which is generally also the source of the superficial branch, however in some cases it has been found to initiate from the anterior segmental artery (*arteria segmenti anterioris*), middle hepatic artery (*ramus intermedius arteriae hepaticae propriae*), left hepatic artery (*ramus sinister arteriae hepaticae propriae*), superior mesenteric artery (*arteria mesenterica superior*), gastroduodenal artery (*arteria gastroduodenalis*) or retroduodenal artery (*arteria retroduodenalis*).
- Aberrant origin of the right hepatic artery (*ramus dexter aberrans arteriae hepaticae propriae*):
  - Unusual anatomy of the right hepatic artery can itself affect the path and form of the cystic artery, with the most frequent variation resulting from an aberrant origin of the right hepatic artery (2-16% of cases). Generally this anomalous source is the superior mesenteric artery or more rarely the abdominal aorta, producing what has been described as a “replacing right hepatic artery”, passing through the cystohepatic triangle and running posterior and parallel to the cystic duct.
  - Because of the close proximity of the gallbladder to the (replacing) right hepatic artery, a “catapillar” or “Moynihan’s hump” may form (the most dangerous anomaly, the hepatic artery takes a tortuous course in front of the origin of the cystic duct or the right hepatic artery is tortuous, and the cystic artery is short) and this artery generally produces multiple short cystic branches rather than a single cystic artery.
- Left hepatic artery (*ramus sinister arteriae hepaticae propriae*):
  - The cystic artery can arise from the left hepatic artery, and in such a case it travels through a passage of liver parenchyma, approaching the neck of the gallbladder (*collum vesicae biliaris*), before bifurcating into ascending (or superior) and descending (or inferior) branches.
  - This form of the cystic artery does not pass through the cystohepatic triangle and has been found located both anteriorly and posteriorly to the common hepatic duct (*ductus hepaticus communis*).

- Recurrent cystic artery:
  - In less than 1% of patients a form known as a recurrent cystic artery is found. The cystic artery arises from the hepatic artery and passes through either the cholecystoduodenal or cholecystocolic ligaments, follows the right edge of the hepatoduodenal ligament (*ligamentum hepatoduodenale*), and connects to the fundus of the gallbladder (*fundus vesicae biliaris*) before descending to supply the body and neck.
- Low-lying cystic artery:
  - When a single cystic artery arises from gastroduodenal artery, it forms a configuration known as low-lying cystic artery, as it passes inferior to the cystic duct through the cholecystoduodenal ligament, and therefore remains outside the cystohepatic triangle.
  - This condition has alternatively been described as an inferior cystic artery and transposition of the cystic artery and duct with prevalence at approximately 5%.

## Surgery

Criteria for the operation of patients with uncomplicated gallstones:

- High indication that gallstone is the cause of the actual complaint.
- Absence of any contraindicated diseases that could increase the risk of the surgery.
- Repeated episodes of symptoms correlating with the presence of gallstones, and the patient electively wanting the surgery.

## Intervention

The operation is done by laparoscopic technique (fig.4) in full anaesthesia. The anaesthesia is based on substances with short half-life. Most used are intravenous infusion of propofol and short-acting opiates. About 95% of the patients undergoing scheduled day surgery go home as planned. The readmission rate is less than 5%. In more rare cases (1% or less) the operation has to be converted to an open procedure, more often by the operation of acute cholecystitis.

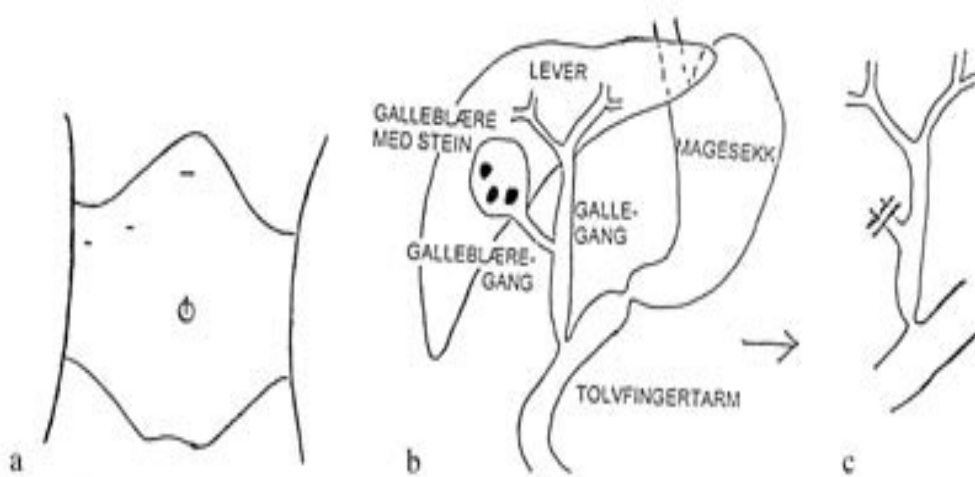


Figure 4 a) Drawing of the stomach, showing the laparoscopic incisions. B) relevant anatomy. C) Ducts after cholecystectomy.

The most important risk factor in operation is unintended ductal injury. This occurs with 0.6 – 0.8%. To avoid this, the dissection starts a short distance up on the gallbladder. The infundibulum is mobilized to give a better lateral drag on the cystic duct and thereby increased distance to the rest of the biliary tree. Thereafter the serosa is peeled down over the cystic duct and the cystic artery. No structures are cut before the whole anatomical picture is completely mapped. The risk for per- or postoperative bleeding is small, ca. 2%.

Serious postoperative complications occur in ca. 1% of the patients, and are often connected with remaining stone in the ducts.

## Reference

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