

Diseases of biliary tract.

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Anatomy and physiology characteristics of liver and bile ducts.

The Liver

The liver is the largest gland in the body, weighing about three pounds (1200-1500 gr) in an adult. It is also one of the most important organs. In addition to being an accessory digestive organ, it plays a number of roles in metabolism and regulation. The liver is divided into two primary lobes: a large right lobe and a much smaller left lobe. In the right lobe, some anatomists also identify an inferior quadrate lobe and a posterior caudate lobe, which are defined by internal features. The liver is connected to the abdominal wall and diaphragm by five peritoneal folds referred to as ligaments. These are the falciform ligament, the coronary ligament, two lateral ligaments, and the ligamentum teres hepatis. The falciform ligament and ligamentum teres hepatis are actually remnants of the umbilical vein, and separate the right and left lobes anteriorly. The lesser omentum tethers the liver to the lesser curvature of the stomach.

The porta hepatis (“gate to the liver”) is where the hepatic artery and hepatic portal vein enter the liver. These two vessels, along with the common hepatic duct, run behind the lateral border of the lesser omentum on the way to their destinations

The **gallbladder** is 8–10 cm (~3–4 in) long and is nested in a shallow area on the posterior aspect of the right lobe of the liver. This muscular sac stores, concentrates, and, when stimulated, propels the bile into the duodenum via the common bile duct. It is divided into three regions. The fundus is the widest portion and tapers medially into the body, which in turn narrows to become the neck. The neck angles slightly superiorly as it approaches the hepatic duct. The cystic duct is 1–2 cm (less than 1 in) long and turns inferiorly as it bridges the neck and hepatic duct.

Chemical digestion in the small intestine relies heavily on the activities of accessory digestive organs: the liver and gallbladder. The digestive role of the liver is to produce bile and export it to the duodenum. The gallbladder primarily stores and concentrates the bile, while the bile ducts release it. Hepatocytes secrete about one liter of bile each day. A yellow-brown or yellow –green alkaline solution (pH 7.6 to 8.6), bile is a mixture of water, bile salts, bile pigments, phospholipids (such as lecithin), electrolytes, cholesterol, and triglycerides.

Because lipids are hydrophobic, meaning they do not dissolve in water, before they can be digested in the watery environment of the small intestine, large lipid globules must be broken down into smaller lipid globules. This process is known as emulsification. Bile is a mixture secreted by the liver to accomplish the emulsification of lipids in the small intestine.

Normal bile consists of 70% bile salts (mainly cholic and chenodeoxycholic acids), 22% phospholipids (lecithin), 4% cholesterol, 3% proteins, and 0.3% bilirubin. Cholesterol or cholesterol predominant (mixed) stones account for 80% of all gall stones and form when there is supersaturation of bile with cholesterol. Formation of stones is further aided by decreased gallbladder motility.

General and specific examination methods of biliary tract before and during surgery.

Ultrasonography, traditionally done transabdominally and requiring a period of fasting, provides structural, but not functional, information. It is the least expensive, safest, and most sensitive technique for imaging the biliary system, especially the gallbladder.

Ultrasonography is the procedure of choice for

- Screening for biliary tract abnormalities
- Evaluating the hepatobiliary tract in patients with right upper quadrant abdominal pain
- Differentiating intrahepatic from extrahepatic causes of jaundice
- Screening for liver masses

Abdominal Ultrasound (Gallstones)



The kidneys, pancreas, and blood vessels are also often visible on hepatobiliary ultrasounds. Ultrasonography can measure spleen size and thus help diagnose splenomegaly, which suggests portal hypertension. Use of endoscopic ultrasonography may further refine the approaches to hepatobiliary abnormalities. **Gallstones** cast intense echoes with distal acoustic shadowing that move with gravity. Transabdominal ultrasonography is extremely accurate (sensitivity > 95%) for gallstones > 2 mm in diameter. Endoscopic ultrasonography can detect stones as small as 0.5 mm (microlithiasis) in the gallbladder or biliary system. Transabdominal and endoscopic ultrasonography can also identify biliary sludge (a mixture of particulate material and bile) as low-level echoes that layer in the dependent portion of the gallbladder without acoustic shadowing.

Computed tomography (CT)

CT is commonly used to identify hepatic masses, particularly small metastases, with a specificity of > 80%. It is considered the most accurate imaging technique. CT with IV contrast is accurate for diagnosing cavernous hemangiomas of the liver as well as differentiating them from other abdominal masses. Neither obesity nor intestinal gas obscures CT images. CT can detect hepatic steatosis and the increased hepatic density that occurs with iron overload. CT is less helpful than ultrasonography in identifying biliary obstruction but often provides the best assessment of the pancreas.

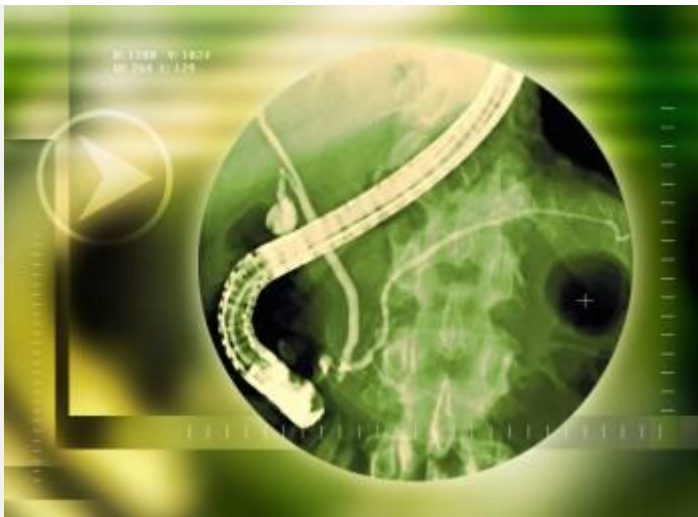
Magnetic resonance imaging (MRI)

MRI is used to image blood vessels (without using contrast), ducts, and hepatic tissues. Its clinical uses are still evolving. MRI is superior to CT and ultrasonography for diagnosing diffuse liver disorders (eg, fatty liver, hemochromatosis) and for clarifying some focal defects (eg, hemangiomas). MRI also shows blood flow and therefore complements Doppler ultrasonography and CT angiography in the diagnosis of vascular abnormalities and in vascular mapping before liver transplantation.

Magnetic resonance cholangiopancreatography (MRCP) is more sensitive than CT or ultrasonography in diagnosing common bile duct abnormalities, particularly stones. Its images of the biliary system and pancreatic ducts are comparable to those obtained with endoscopic retrograde cholangiopancreatography (ERCP) and percutaneous transhepatic cholangiography, which are more invasive. Thus, MRCP is a useful screening tool when biliary obstruction is suspected and before therapeutic ERCP (eg, for simultaneous imaging and stone removal) is done. MRCP is the screening test of choice for primary sclerosing cholangitis.

Endoscopic retrograde cholangiopancreatography (ERCP)

ERCP combines endoscopy through the second portion of the duodenum with contrast imaging of the biliary and pancreatic ducts. The papilla of Vater is cannulated through an endoscope placed in the descending duodenum, and the pancreatic and biliary ducts are then injected with a contrast agent.



ERCP provides detailed images of much of the upper gastrointestinal tract and the periampullary area, biliary tract, and pancreas. ERCP can also be used to obtain tissue for biopsy. ERCP is the best test for diagnosis of ampullary cancers. ERCP is as accurate as endoscopic ultrasonography for diagnosis of common duct stones. Because it is invasive, ERCP is used more for treatment (including simultaneous diagnosis and treatment) than for diagnosis alone. ERCP is the procedure of choice for treating biliary and pancreatic obstructing lesions, for removal of bile duct stones, stenting of strictures (inflammatory or malignant), sphincterotomy (for papillary stenosis, also called sphincter of Oddi dysfunction). Morbidity from a diagnostic ERCP with only

injection of contrast material is about 1%. Adding sphincterotomy raises morbidity to 4 to 9% (mainly related to pancreatitis and bleeding). ERCP with manometry to measure sphincter of Oddi pressure causes pancreatitis in up to 25% of patients.

Percutaneous transhepatic cholangiography (PTC)

With fluoroscopic or ultrasound guidance, the liver is punctured with a needle, the peripheral intrahepatic bile duct system is cannulated above the common hepatic duct, and a contrast agent is injected. PTC is highly accurate in diagnosing biliary disorders and can be therapeutic (eg, decompression of the biliary system, insertion of an endoprosthesis). However, ERCP is usually preferred because PTC causes more complications (eg, sepsis, bleeding, bile leaks).

Operative cholangiography

A radiopaque contrast agent is directly injected during laparotomy to image the bile duct system. Operative cholangiography is indicated when jaundice occurs and noninvasive procedures are equivocal, suggesting common duct stones. The procedure can be followed by common duct exploration for removal of biliary stones. Technical difficulties have limited its use, particularly during laparoscopic cholecystectomy.

Cholelithiasis. Incidence, etiology, pathogenesis. Clinical features, complications.

The commonest presentation of gallstone disease is biliary pain. The pain starts suddenly in the epigastrium or right upper quadrant and may radiate round to the back in the interscapular region. Contrary to its name, the pain often does not fluctuate but persists from 15 minutes up to 24 hours, subsiding spontaneously or with opioid analgesics. Nausea or vomiting often accompanies the pain, which is visceral in origin and occurs as a result of distension of the gallbladder due to an obstruction or to the passage of a stone through the cystic duct.

Most episodes can be managed with conservative by analgesics and spasmolytics. Pain continuing for over 24 hours or accompanied by fever suggests acute cholecystitis and usually necessitates hospital admission. Ultrasonography is the definitive investigation for gall stones.

- Age >40 years
- Female sex (twice risk in men)
- Genetic or ethnic variation
- High fat, low fibre diet
- Obesity
- Pregnancy (risk increases with number of pregnancies)
- Hyperlipidaemia
- Bile salt loss (ileal disease or resection)
- Diabetes mellitus
- Cystic fibrosis
- Antihyperlipidaemic drugs (clofibrate)

- Gallbladder dysmotility
- Prolonged fasting
- Total parenteral nutrition

Differential diagnosis of common causes of severe acute epigastric pain

- Biliary colic
- Peptic ulcer disease
- Oesophageal spasm
- Myocardial infarction
- Acute pancreatitis

COMPLICATIONS OF CHOLELITHIASIS

The effects and complications of gallstones can be summarized as follows:

1. In the gallbladder:

Silent stones

Chronic cholecystitis

Acute cholecystitis

Mucocele /hydrops of the gallbladder

2. In the bile ducts:

Obstructive jaundice

Acute cholangitis

3. In the pancreas and intestine Acute pancreatitis the intestine Acute intestinal obstruction

Acute cholecystitis. Classification, clinical features, diagnosing, treatment.

Classification of Acute Cholecystitis	
<u>Etiology</u> - calculous cholecystitis - incalculous cholecystitis	<u>Clinical course:</u> <u>uncomplicated</u> - catarrhal - phlegmonous - gangrenous <u>complicated</u> Intravesical: Perforation obstruction abscess extravesical: peritonitis cholangitis obstructive jaundice abscesses of liver pancreatitis sepsis

Grade	Criteria
1 Mild	Acute cholecystitis that does not meet the criteria for a more severe grade Mild gallbladder inflammation, no organ dysfunction
2 Moderate	The presence of one or more of the following: Elevated white blood cell count ($>18,000$ cells/mm ³) Palpable, tender mass in the right upper quadrant Duration >72 h Marked local inflammation including biliary peritonitis, pericholecystic abscess, hepatic abscess, gangrenous cholecystitis, emphysematous cholecystitis
3 Severe	The presence of one or more of the following: Cardiovascular dysfunction (hypotension requiring treatment with dopamine at ≥ 5 μ g/kg body weight per minute or any dose of dobutamine) Neurologic dysfunction (decreased level of consciousness)

In the base of acute cholecystitis there are following conditions

1/ Bile hypertension due to different causes. Bile congestion, most often, is looking in the gallbladder in cases of acute cholecystitis, seldom - in the gallbladder and the common bile duct as a result of its occlusion.

2/ The presence of virulent infection in the gallbladder.

3/ The blood supply lesions of gallbladder wall.

Most often, acute cholecystitis is developing in cases of stone obstruction of the cystic duct.

The next cause of acute cholecystitis development is bacterial contamination. Most often the microbes penetrate into the gallbladder by ascending way from the duodenum. The frequency of ascending microbe contamination of the gallbladder is increasing in condition of papilla Vaters insufficiency, chronic duodenal impassability, chronic antacid condition of the stomach.

The second bacterial contaminative way is hematogenic – by hepatic artery from distant suppurative focuses. From inflammatory focuses in abdomen cavity microbes

can come into the liver and the gallbladder by portal vein and lymphatic vessels. By this way microbes first of all come to the liver, and then by bile - into the gallbladder.

Among different microbes the most important role in pathogenesis of acute cholecystitis belongs to enteric bacillum, Proteus, staphylococcus.

Vascular factor acquires important significance in old age. Atherosclerosis, essential arterial hypertension, lesions of blood coagulability make the possibility for blood supply lesions of gallbladder wall. Vasculogenic cholecystitis usually is developing as primary gallbladder gangrene. If blood supply lesions are boarding by ends of arteries, the wall ischemia leads to increasing of mucose membrane permeability for microbe contamination.

It is divided 3 main morphological types of acute cholecystitis.

In the catarrhal cholecystitis mucous membrane and surrounding tissue are edemated and have leucocytes infiltration. Gallbladder bile transforms into turbid and watery fluid due to serous exudates coming into it.

In cases of phlegmonous lesions of gallbladder its wall became exfoliate with small intrawall abscesses. In phlegmonous-ulcerative form in addition for suppurative lesion of gallbladder wall the mucous membrane ulceration appears. Small vessel thrombosis are leading to mucous necrosis. So, gallbladder content becomes hemorrhagic. From external side the wall is very hyperemic with green focuses, is covered by fibrin. In cases of long time cystic duct obstruction due to stone in present of infection in its cavity empyema of gallbladder is developing. If there are no gallbladder content microbe contamination - hydrops of gallbladder is appearing. But, it is necessary to remember, that thought there is pus in the gallbladder in empyema cases the inflammatory changes of its wall isn't so sharp.

In cases of gallbladder gangrene wall necrosis is prevailing. These changes are more expressing in mucous. It is accompanied by all wall levels leucocytes infiltration. Gallbladder content is hemorrhage with unpleasant smell. At the beginning the wall necroses are aseptic, later microbe contamination is appearing.

The catarrhal cholecystitis is always reversible process and it is need conservative therapy only.

In cases of phlegmon cholecystitis intoxication symptoms are more severe.

The most valuable instrumental examinative method in suspicion cases of acute cholecystitis ultrasound examination is. The accurate diagnose of acute cholecystitis may be created by ultrasound only in 97%. For it is necessary to define changes of gallbladder wall, its content and surrounding tissues. It gives good possibility for creation accurate treating tactics. It has been proved, that the results of plan surgical treatment were more better, then urgent once. So, if there are some possibilities to postpone traditional surgical treatment without severe danger of complications appearance and to realize them in plan, it must be used. To add the traditional conservative therapy we widely used some methods of invasive sonography. They are: one moment transskinal transhepatic puncture lavage of the gallbladder or transskinal transhepatic microcholecystostomia. The base of acute cholecystitis the bile hypertension lies. So, treating influence have to be directed for its relieving. It can be reached by antispastic medicines using so as by methods of invasive sonography.

For today there is the only radical cure method - cholecystectomy in patients suffering from gallstones disease. But there are a lot of modes for it - traditional, laparoscopic and gallbladder removing from small access. They must be realized after fit patient examination and preparation only. And from this point of view the techniques of invasive sonography are very important. They give possibility to interrupt disease development immediately by adequate gallbladder decompression due to transhepatic puncture or microcholecystostomy. Besides, it is possible accurately to find the type of microbe, which is the initiator of gallbladder bacterial inflammation. It is so important for prescription correct antibiotic therapy in preoperative period.

Quick bile decompression leads to disappearance of pain syndrome; the local treating influence to the gallbladder due to drain tube allows to relieving the disease and creates the conditions for plan radical surgical correction.

Except clinical and ultrasound examination of the patient with suspected diagnosis of acute cholecystitis sometimes it is necessary to use some other methods, first of all laparoscopy and retrograde pancreatocholangiography, especially if acute cholecystitis is complicated by obstructive jaundice.

Main steps in treatment of acute cholecystitis are following:

1. Invasive sonography
2. Nasogastral aspiration and intravenous fluid therapy
3. Analgesics
4. Antibiotics
5. Subsequent management - most often cholecystectomy has been performed during 2-3 days after the acute attack has resolved.

Primary conservative therapy isn't indicated in cases of uncertain diagnosis . It isn't indicated in cases of peritonitis as a treating method too, but must be use as short time preoperative patient preparation.

Chronic cholecystitis. Clinical features, diagnosing, treatment.

Chronic cholecystitis is a chronic condition caused by ongoing inflammation of the gallbladder resulting in mechanical or physiological dysfunction its emptying. It presents as a smoldering course that can be accompanied by acute exacerbations of increased pain (acute biliary colic), or it can progress to a more severe form of cholecystitis requiring urgent intervention (acute cholecystitis). There are classic signs and symptoms associated with this disease as well as prevalence in certain patient populations. The two forms of chronic cholecystitis are calculous (occurring in the setting of cholelithiasis), and acalculous (without gallstones).

Symptomatic patients with chronic cholecystitis usually present with dull right upper abdominal pain that radiates around the waist to the mid back or right scapular tip. The pain may be exacerbated by fatty food intake but the classical post-prandial pain of acute cholecystitis is less common. Nausea and occasional vomiting also accompany complaints of increased bloating and flatulence. Often the symptoms occur in the evening or at night. Symptoms are usually present over weeks to months as opposed to the abrupt, severe presentation of acute cholecystitis. There might be a gradual

worsening of symptoms or an increase in the frequency of episodes. Fever and tachycardia are rare. Elderly patients with cholecystitis may present with vague symptoms and they are at risk of progression to complicated disease. Hence a high index of clinical suspicion is required in the diagnosis of this condition.

Laboratory testing is not specific or sensitive in making a diagnosis of chronic cholecystitis. Leukocytosis and abnormal liver function tests may not be present in these patients, unlike the acute disease. However basic laboratory testing in the form of a metabolic panel, liver functions, and complete blood count should be performed.

The diagnostic investigation of choice when chronic cholecystitis is suspected clinically is a right upper quadrant ultrasound. This non-invasive study that is readily available in most facilities can accurately evaluate the gallbladder for a thickened wall or inflammation. It also aids in the evaluation of gallstones or sludge. Computerized tomography (CT) with intravenous contrast usually reveals cholelithiasis, increased attenuation of bile, and gallbladder wall thickening. The gallbladder itself may appear distended or contracted, however, pericholecystic inflammation and fluid collection are usually absent.

The preferred treatment for chronic cholecystitis is elective laparoscopic cholecystectomy. It has a low morbidity rate and can be performed as an outpatient surgery. An open cholecystectomy is also an option however requires hospital admission and longer recovery time. This surgery is indicated in patients who are not laparoscopic candidates such as those with extensive prior surgeries and adhesions. Endoscopic retrograde cholangiopancreatography (ERCP) is usually done when choledocholithiasis is a concern. These patients usually undergo ERCP prior to elective surgery.

Patients who are not surgical candidates or who prefer not to undergo surgery can be closely observed and managed conservatively. A low-fat diet can help reduce the frequency of symptoms. In patients with symptomatic cholelithiasis, the use of ursodeoxycholic acid has been shown to decrease rates of biliary colic and acute cholecystitis.

Jaundice: causes, clinical features, diagnosing, treatment, peculiarities of preparation for surgery, types of operations.

The obstructive jaundice is one of the most often complication of bile stones disease. It is meeting in 13,9-43,6%.

Often obstructive jaundice develops due to common bile duct stones, scary stenosis of papilla Vatera, indurative pancreatitis.

Clinical picture of calculous cholecystitis in accompany with jaundice is various. It is possible to divide 5 main clinical forms.

1/ Icteric-pain form.

It is the most often clinical form. It is characterized by pain, vomiting, fever and jaundice. Pain appears suddenly in right hypochondriac region with irradiation in right shoulder. Usually it is very severe colic, especially if the stone localizes in papilla

Vatery. The fever in this clinical form isn't so long time and disappears when pain syndrome has resolved.

The jaundice is the most constant sign. Usually it appears in a 12-24 hour from the attack beginning. Its development is slow. In cases of floating bile stone the jaundice becomes intermittent.

2/ Icteric-pancreatic form.

This clinical form is being met in cases of impactive stones in papilla Vatery. The main signs - jaundice and acute pancreatitis are. In the base of in the theory of common channel lies. The bilio-pancreatic reflux and pancreatic juice congestion lead to acute pancreatitis.

3/ Icteric-cholecystical form.

This clinical form is characterized by acute cholecystitis and obstructive jaundice combination. The signs of acute cholecystitis are prevailing. Some times, this cholecystitis has enzyme genesis due to the presence of pancreato-gallbladder reflux in cases of papilla Vatery stone obstruction.

4/ Icteric-painless form.

This clinical form is characterized by pain syndrome absence, that is meeting in cases of malignant jaundice too. The jaundice appears slowly, on background of satisfactory general patient condition. Some times, it can be accompanied by not severe fever. The frequency of this form is about 4,1-5,9% only, but it is more difficult clinical form for different diagnose.

5/ Ictero-septic form.

Quick development of suppurative cholangitis is the base of this clinical form. It is the most severe illness with mortality about 37,8%. It can lead to sepsis. The severe development of the disease is the consequence of suppurative bile break into blood flow. Firstly Charcot described clinical picture of this form in 1877 as three main signs: pain in right hypochondrial region, fever till 38-39 C⁰ with shaking chills, jaundice. This clinical form can lead to bacterial shock, acute liver and kidney insufficiency. Not invasive sonography gives the possibility to corroborate the obstructive character of jaundice in 87,7-98,9%. Distension of bile tree is the only direct ultrasound sign of obstructive jaundice. The obstruction level may be found by ultrasound examination in 46,2-98,6%. The prevalence of bile tree dilatation and gallbladder condition permit to definite the level of obstruction. According combinations of this signs the bile obstruction may be subdivided into intrahepatic, upper extrahepatic, proximal common bile duct obstruction and distal block of the common bile duct. The last type of bile obstruction is more characterized for bile stones disease.

The real cause of bile obstruction can be found by ultrasound only in 56-83,8%. So, the task of real obstruction cause finding belongs to different methods of direct contrast examination of the bile tree. It can be reached by retrograde pancreatocholangiography and transskinal transhepatic cholangiography. Ultrasound control makes the last procedure more safe for patients and it can be finished by temporary external bile drainage. In this case the access into bile tree is realized wittingly upper the obstruction level, so the successful possibility for their creation is more, then in cases of RPCG. Antegrade cholangiostomy under ultrasound control allows to drain jaundice, to obtain more valuable information about its level and cause. The same information may be

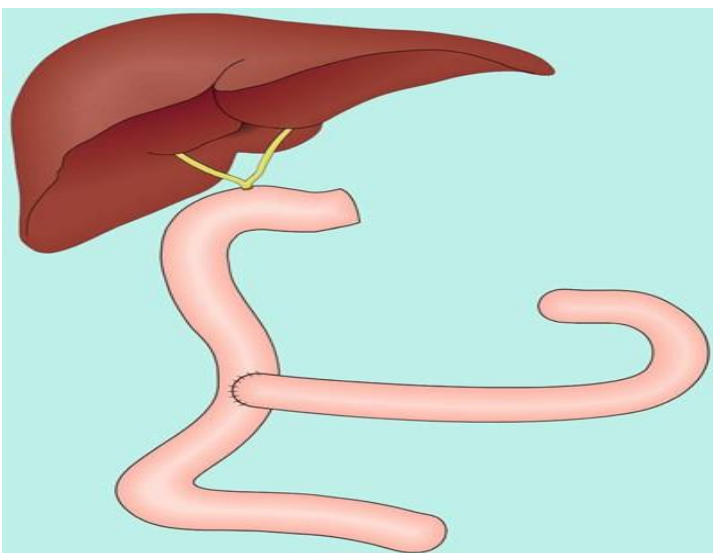
reached by RPCG, but this method first of all is diagnostic more, then care, besides transpapillary procedures can be complicated by suppurative cholangitis, acute necrotic pancreatitis. And so transpapillary endoscopic procedures have to be used as a treatment only in cases of established diagnosis in combination of preventive external transhepatic transhepatic drain. As a diagnostic method RPCG has the most value in cases of uncomplicated obstructive jaundice without large bile tree distension on background of distal common bile duct obstruction.

The upper extrahepatic obstruction of bile tree due to stones is very rare. But in these cases transhepatic access is the most valuable. Antegrade cholangiography has the same diagnostic value as intraoperative once.

In cases of complicated development of jaundice the first aim is to relieve this complication, such as suppurative cholangitis or acute pancreatitis. The result of their management depends on rational primary drain procedure. It can be reached due to transhepatic cholangiostomy or partial papillotomy.

The next aim - to resolve the jaundice cause. For today the most widespread treating mode the endoscopic techniques is. It may be transduodenal endoscopic lithoextraction or laparoscopic choledocholithotomy. Sometimes in young patients with big stones in bile tree traditional "open" surgical procedure is more effective and safe, first of all from long time results positions.

The traditional surgical way in cases of acute cholecystitis complicated by jaundice includes in itself cholecystectomy and examination of bile tree. It can be finished by choledocholithotomy with primary suture of the common bile duct or biliodigestive anastomoses. It is important to remind that the primary suture of the common bile duct or biliodigestive anastomoses are contraindicated in cases of suppurative lesions of bile ducts or peritonitis. Usually, surgical procedures on bile duct due to gallstones disease are being finished by external temporary bile drain /Kerr, Holsted/.



Acute cholangitis. Classification. Clinical features, diagnosing and treatment.

Classification

The severity of cholangitis can be classified into three grades, based on the onset of organ dysfunction and the patient's response to the initial medical treatment:

- Mild (grade I)
- Moderate (grade II)
- Severe (grade III)

The severity assessment criteria for acute cholangitis according to Tokyo guidelines is as follows:

Severity assessment of cholangitis			
Criterion	Severity		
	Mild (grade I)	Moderate (grade II)	Severe (grade III)
Onset of organ dysfunction	-	-	+
Response to medical treatment	+	-	-

Grade I acute cholangitis

Grade I, or mild acute cholangitis, don't meet the criteria of neither grade II (moderate) nor grade III (severe) acute cholangitis. The patient responds to initial medical treatment.

Grade II acute cholangitis

Grade II, or moderate acute cholangitis, is characterized by the presence of any two of the following:

- Abnormal white blood cell (WBC) count: $>12,000/\text{mm}^3$, $<4,000/\text{mm}^3$
- Fever $\geq 39^\circ\text{C}$
- Age ≥ 75 years
- Elevated total bilirubin ≥ 5 mg/dl
- Decreased albumin level $< 0.7 \times$ standard

Grade III acute cholangitis

Grade III, or severe acute cholangitis, is characterized by the onset of dysfunction in at least one of the following:

- Cardiovascular system: decreased blood pressure that necessitates the administration of dopamine ($>5 \mu\text{g}/\text{kg}/\text{min}$) or norepinephrine
- Neurological system: abnormal consciousness

- Respiratory system: PaO₂/FiO₂ ratio <300
- Renal system: serum creatinine >2.0 mg/dl, decreased urine output
- Hepatic system: PT-INR >1.5
- Hematological system: platelet count < 100,000/mm³

Acute cholangitis is a clinical syndrome characterized by fever, jaundice, and abdominal pain that develops as a result of stasis and infection in the biliary tract. It is also referred to as ascending cholangitis.

The most frequent causes of biliary obstruction in patients with acute cholangitis without bile duct stents are biliary calculi, benign biliary stricture, and malignancy. Acute cholangitis can also occur following endoscopic retrograde cholangiopancreatography, particularly therapeutic endoscopic retrograde cholangiopancreatography following stent placement, or postoperatively due to bile duct injury, or a strictured biliary-enteric anastomosis (pancreaticoduodenectomy, liver transplantation, liver resection, and Roux-en-Y hepaticojejunostomy). Rarely, the distal common bile duct may be obstructed by food, stones, or debris in patients with a biliary-enteric anastomosis (Sump syndrome).

Differential diagnoses of acute cholangitis:

Acute cholecystitis;

Cirrhosis of liver;

Acute hepatitis;

liver abscess;

Septic shock due to any cause;

Right sided diverticulitis;

Righted sided pyelonephritis.

Lab tests should include complete blood count, erythrocyte sedimentation rate or CRP, complete metabolic profile including renal and hepatic function, prothrombin time also recommends collection of bile sample during the drainage procedure. Bile culture can be positive in 59% to 93% of acute cholangitis cases.

Imaging studies may include ultrasound of the abdomen, regular or helical computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound (EUS). CT without contrast is more sensitive than abdominal ultrasound in detecting common bile duct stones. Among these, MRCP (82.2% accuracy in detecting choledocholithiasis) and EUS (96.9% accuracy in detecting choledocholithiasis) are the most sensitive imaging modalities, which can detect the level and cause of biliary obstruction. Transabdominal ultrasound is able to detect choledocholithiasis in 30% of cases, and CT in 42% of cases. Although MRCP is being increasingly used in the setting of acute cholangitis, its sensitivity in detecting less than 6 mm stone is low

Patients with cholangitis should be managed at the hospital, as this is considered as an emergent condition. Patients should be resuscitated first. As cholangitis is due to infection and obstruction of the biliary system, we have to treat both aspects.

Intravenous fluid and antibiotics should be started as soon as possible. Fresh frozen plasma or vitamin K may be required for correction of coagulopathy. The choice of antibiotics depends on multiple factors, including the patient's renal function, hepatic function, drug allergies, comorbidities, and also on the severity of cholangitis. The empiric antibiotics should cover both Gram-negative and anaerobic organisms. The initial choice should be piperacillin-tazobactam, ticarcillin-clavulanate, ceftriaxone plus metronidazole or ampicillin-sulbactam. If the patient is sensitive to penicillin, ciprofloxacin plus metronidazole, carbapenems or gentamicin plus metronidazole are good choices. The antibiotics should be further evaluated and adjusted according to the blood culture results. Blood culture is positive in 21% to 71% of cases of acute cholangitis. The dose of the antibiotics should be adjusted according to renal and hepatic functions. Ideally, the antibiotics should be continued for 7 to 10 days.

Because of high biliary intraductal pressure, biliary secretion of antibiotics is impaired. Biliary drainage is the next step. It can be best done by therapeutic ERCP. Depending on the etiology of biliary obstruction, intervention should be done. In case of biliary stricture, transpapillary biliary stent placement should give adequate drainage.

Other modalities of biliary drainage include endoscopic nasobiliary drainage (ENBD) by nasobiliary catheter, percutaneous transhepatic biliary drainage (PTBD), EUS-guided drainage and open surgical drainage (T-tube drainage after laparotomy).

Surgical drainage is reserved when other modalities of biliary drainage are contraindicated or fail. It is done rarely now-a-days because of high morbidity and mortality of 20% to 60%. To avoid prolonged surgery, choledochotomy with T-tube drainage without choledocholithotomy is recommended. Laparoscopic choledochotomy with stone extraction can be done in case of failed endoscopic extraction of common bile duct stone.

Management of recurrent pyogenic cholangitis requires a multidisciplinary team (endoscopist, interventional radiologist and surgeon). Initial treatment includes administration of intravenous fluid and antibiotics, endoscopic treatment with stricture dilation, stone extraction and stent placement for biliary drainage or percutaneous biliary drainage in case of failed ERCP. Segmental hepatic resection should be considered in case of localized disease. Orthotopic liver transplantation has also been reported in case of diffuse disease and end-stage liver disease due to recurrent acute cholangitis.