

# Mechanical Jaundice of Calculous Etiology: Pathogenesis, Complications and Therapeutic Tactics

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**Abstract** The current rise in the incidence of cholelithiasis is accompanied by an increased frequency of its complicated forms. Mechanical jaundice is a common unfavourable complication of cholelithiasis and choledocholithiasis, its consequence. Epidemiology, etiology, and clinical features of this disease are discussed. Classification of mechanical jaundice is proposed. Much attention is given to its pathogenetic mechanisms. Methods of laboratory and instrumental diagnostics as well as approaches to the surgical treatment of mechanical jaundice are described.

**Keywords** Mechanical jaundice, Calculous cholecystitis, Choledocholithiasis, Hepatogenic endointoxication, Diagnostics, Surgical treatment

## 1. Introduction

In the structure of diseases of the biliary system, cholelithiasis (GI) and calculous cholecystitis are the leading ones. A frequent and unfavorable complication of GI and its consequences — choledocholitis — is mechanical jaundice (in 61.3—72.2% of cases) [1].

The syndrome of mechanical (synonyms: obstructive, obstructive, subhepatic) jaundice unites an extensive group of diseases, the common and most striking clinical sign of which is yellowing of the skin and sclera as a result of increased bilirubin concentration in the blood due to impaired patency of the main bile ducts [2,3].

The results of clinical observations published in foreign and domestic literature indicate that in the last 45-50 years the incidence of GI has been doubling for every 10 years. The seriousness of the problem of GI as a nosological form is confirmed by the fact that gallstones are found in 20-25% of the deceased at autopsy [6]. 2.5 million people operate on this disease every year in the world. In 5-30% of patients, postcholecystectomy syndrome develops, in 2 - 65% of cases, stones occur repeatedly. In recent years, there has been an increase in the number of diseases in young people [7].

In addition to choledocholithiasis, there is a tendency to increase the number of patients suffering from mechanical jaundice of noncalculous origin, the cause of which is most often: stenosis of the large papilla of the duodenum (BSDC) — in 16-29%, pancreatitis — in 5.4—27.4%, cicatricial stricture of the extrahepatic biliary tract — in 5.3-15%, parasitic liver diseases — in 1.6—4%, as well as malignant neoplasms (cancer of the head of the pancreas, cancer of the

BSDC, bile ducts). Congenital malformations of the bile ducts are much less common [1].

Classification of mechanical jaundice [8]:

- by etiology: benign (choledocholithiasis, cicatricial strictures) and malignant (cancer of the pancreatic head, cancer of the biliary tract);
- according to the clinical course: acute and chronic;
- according to the degree of bile outflow: complete and incomplete, including intermittent (with the vent nature of jaundice). The classification of mechanical jaundice by severity is also found in the literature [9]:
- mild degree (total bilirubin level up to 100 mmol/l);
- medium degree (total bilirubin level up to 200 mmol/l);
- severe degree (the level of total bilirubin is more than 200 mmol /l).

## 2. Materials and Methods

The anatomical and physiological unity of the liver and extrahepatic biliary tract leads to their friendly damage in prolonged and recurrent forms of mechanical jaundice [10]. Morpho-functional disorders of the liver significantly aggravate and aggravate the course of pathological processes in the biliary tract, which ultimately increases the risk of surgical treatment and often determines its outcome [11].

Hypertension in the bile ducts leads to rupture of the latter, and bile diffuses into hepatocytes, causing their necrosis; oxygen consumption by hepatocytes decreases and the process of oxidative phosphorylation is disconnected. Biliary hypertension causes a widening of the diameter of the bile ducts, accompanied by thickening of their walls [12]. Stagnation of bile in the bile ducts is often combined with the development of cholangitis [13].

A sharp change in the walls of the bile ducts, especially with a significant expansion of their diameter, leads to a violation of peristalsis, which in turn increases bile stagnation [14]. Cholestasis caused by mechanical obstruction quickly leads to cholestatic intoxication, cholangitis, progressive liver failure, expressed by complex symptoms of disorders, the leading cause of which is the suppression of detoxification and synthetic liver functions [15].

Violation of bilirubin release into the biliary tract with the development of biliary hypertension has a toxic effect on hepatocytes with impaired function and leads to changes in the properties and structure of cellular membranes, due to changes in the composition of membrane lipids, cholesterol and fatty acids, impaired activity of membrane-bound enzymes involved in the processes of transport through the membrane [17].

In patients with mechanical jaundice, hepatic blood flow is reduced by more than 50%. At the same time, the decrease in the total hepatic blood flow is directly dependent on the duration of the blockade of the bile ducts [18]. Oxygen starvation has a detrimental effect even on an intact liver. Hypoxia enhances the phenomena of glycolysis and reduces glycogen stores in the liver. The degeneration of phospholipids observed in hypoxia can lead to dysfunction of cell membranes and the formation of hepatocytes. Ischemic liver tissue has toxic activity due to the appearance of necrosis of hepatocytes located centrally, since the hepatocytes located here are located in an area with low levels of oxygen supply [19]. In the pathogenesis of liver dysfunction, damage to subcellular structures that are extremely sensitive to hypoxia occupies a leading place [20].

Hemodynamic disorders characteristic of mechanical jaundice include bradycardia caused by a reflex arising from mechanical stretching of intrahepatic and extrahepatic bile ducts, increased cardiac output, vascular permeability and vasodilation — a decrease in total peripheral resistance. A decrease in blood pressure is associated with the action of bile acids on the receptors and the center of the vagus nerve, on the sino-atrial node of the heart and blood vessels. These factors require a large amount of fluid and a large stroke volume of the heart to support blood pressure and diuresis.

Mechanical jaundice and liver failure are integral parts of a single process that develops independently of the etiology of biliary tract obstruction.

### 3. Literature Review

Patients with jaundice belong to the category of the most difficult to diagnose, since a large group of diseases of various origins occur with the symptom of jaundice [16,17].

The diagnosis of mechanical jaundice (as well as the determination of its cause) is based on the following provisions [8]:

- the presence of appropriate clinical manifestations;
- the presence of characteristic changes in the results of laboratory research methods: general blood and

urine tests, biochemical blood tests, immunological, microbiological studies;

- the presence of characteristic changes during instrumental examinations: ultrasound (Ultrasound), fibrocholedochoscopy, endoscopic retrograde pancreatocholangiography, computed tomography, magnetic resonance and nuclear magnetic resonance imaging, radioisotope scanning of the liver.

Computed tomography, magnetic resonance imaging and nuclear magnetic resonance imaging provide a high degree of reliability in the diagnosis of surgical diseases of the liver, biliary tract and pancreas, make it possible to determine the extent, cause of obstruction, and assess the nature of the contents of the intrahepatic bile ducts (sluggish wall masses, flakes). The possibility of constructing a three-dimensional image of the bile ducts and determining their correlation with the portal system makes it possible to determine the safe access and type of decompression of the biliary tract.

Endoscopic retrograde pancreatocholangiography has become the most widespread in choledocholithiasis, which is primarily due to the possibility of completing the study with therapeutic manipulations - endoscopic papillosphincterotomy, nasobiliary drainage, biliary endoprosthesis.

It should be noted that a comprehensive clinical and instrumental examination makes it possible to establish the cause of mechanical jaundice, determine the level of damage to the biliary tract and develop tactics for the management of patients with mechanical jaundice.

Operational tactics in case of mechanical jaundice of calculous etiology; Surgical treatment of mechanical jaundice consists in radical or palliative removal of the biliary block. If the outflow of bile from the liver is not restored in a timely manner, the patient faces death from developing liver failure.

The traditional surgical treatment of patients with obstructive jaundice complicated by purulent cholangitis, liver failure, thrombohemorrhagic syndrome, etc., is very risky and is accompanied by high mortality. The postoperative mortality of patients with nontumor jaundice is 10.4-25.2%, and with tumor jaundice it can reach 40%.

The high mortality rate after traditional operations performed against the background of prolonged mechanical jaundice required dividing the treatment process in this severe category of patients into 2 main stages. At the first stage, decompression of the biliary tract is performed using minimally invasive techniques (percutaneous, endoscopic). After a slow elimination of biliary hypertension (rapid decompression is undesirable, as it can lead to exacerbation of liver failure, hemobilia), elimination of endogenous intoxication (by infusion therapy, hemodilution, according to indications - plasmapheresis), improvement of the functional state of the liver proceed to the final, second stage of treatment. Such a two-stage approach to the treatment of this severe category of patients has found an increasing number of supporters in recent years. Widespread introduction of new tactical and technological approaches

into clinical practice treatment regimens for patients with mechanical jaundice through the use of gentle methods of decompression of the biliary tract and methods of duct sanitation have significantly improved the results of treatment. There are various decompression methods and variants of their combinations: nasobiliary drainage, endoscopic papillosphincterotomy (EPST), laparoscopically assisted antegrade EPST, laparoscopic cholecystostomy, microcholecystostomy (under the control of laparoscopy, ultrasound, computed tomography), percutaneous transhepatic cholangiostomy (under the control of ultrasound, X-ray imaging), endoprosthesis, balloon dilation.

The question of choosing a method of drainage of the bile ducts in the preparation of patients with mechanical jaundice for radical surgery remains debatable. In this case, first of all, the level of the block of the biliary system, the presence of cholangitis, the size of stones, and anatomical features of the biliary tract are taken into account.

The most appropriate is the use of endoscopic methods of bile removal in cholangiolithiasis (especially in choledocholithiasis), lesions of the terminal part of the common bile duct (non-extended strictures, BSDC stenosis, papillitis, etc.).

An important role is played by the technical equipment of the medical institution and the experience of the staff performing the procedure. In this regard, preoperative decompression of the biliary system has emerged as an independent problem in mechanical jaundice.

At the moment, the surgery of choice for patients of any age is EPST and stone extraction using a Dormia basket or Fogarty probe. Often, being an effective method of preoperative preparation, this operation serves as an alternative to abdominal surgery and makes it possible to obtain optimal results in patients of such a severe group as elderly patients. One of the main tasks of the EPST They are the restoration of bile outflow and the elimination of biliary hypertension. Two-stage combined treatment consisting in EPST, removal of concretions from the common bile duct and subsequent laparoscopic cholecystectomy is optimal, fully meeting the principles of minimally invasive. The advantages of isolated choledocholithotomy over EPST include the preservation of the sphincter apparatus of the BSDC. In this regard, some surgeons prefer simultaneous laparoscopic treatment of such patients.

Percutaneous transhepatic decompression of the biliary tract in non-cancerous mechanical jaundice is used in those patients whose risk of surgery without prior therapy is extremely high. Percutaneous transhepatic drainage of the bile ducts makes it possible to stabilize the condition of patients in the preoperative period, stop the phenomena of cholestasis and cholangitis, and then perform surgery in the "cold" period.

Traditional open surgery of the biliary tract is by no means a thing of the past due to the appearance of minimally invasive surgical techniques, however, the scope of its application is becoming more and more narrowed every year. In the complex therapy of mechanical jaundice, external

cholecystostomy is most acceptable. Its implementation is possible only if the cystic duct is passable. Cholecystostomy can be performed in an open manner, laparoscopically or by puncture of the gallbladder under ultrasound control.

Laparoscopic choledochotomy as a method of decompression of the bile ducts can be used when diagnostic laparoscopy is required for the purpose of differential diagnosis of jaundice or diagnosis of acute inflammatory process of the abdominal cavity. In this case, with the gallbladder turned off (obstruction of the bile duct, confirmed by the data of surgical cholecystocholangiography), choledochotomy or puncture of the common bile duct with its external drainage (T-shaped drainage according to Kocher) is possible.

An important role in the outcomes of mechanical jaundice is played by the development of endogenous intoxication syndrome, which is the main factor shaping the clinical picture of the disease and determining the nature and outcome of the disease. The large role of endogenous intoxication in the pathogenesis of mechanical jaundice of non-tumor etiology determines the importance of timely intensive complex therapy that can prevent the development of irreversible disorders of the structure and function of many organs and systems and contribute to the processes of repair and adaptation.

The vast majority of surgeons recommend to begin treatment with conservative measures in almost all patients. The exception is patients with a clinical picture of peritonitis, in whom surgical treatment is carried out on an emergency basis.

## 4. Conclusions

It should be aimed at improving the properties and structure of cell membranes, eliminating cytopenia caused by this, correcting the hemostasis system, protein and electrolyte imbalance, rheological disorders, stopping the activation of the pathological process in the liver, reducing intoxication, hypoxia, restoring energy potential, eliminating liver failure and inflammatory infectious phenomena in the bile ducts.

Thus, at present, the problem of finding means and methods of rapid and effective to accurately determine the causes of mechanical jaundice, its surgical correction, as well as to combat severe multiple organ failure caused by prolonged cholestasis and accumulation of toxic metabolites in the blood.

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