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MINIMALLY INVASIVE TECHNOLOGIES IN THE TREATMENT OF COMPLICATED FORMS OF GALLSTONE DISEASE

Khakimov D. Sh.

Scientific supervisor**:** DSc, Associate Professor **Ruziboev S. A.**

Samarkand State Medical University

Abstract.

Objective. To evaluate the efficacy and safety of minimally invasive and hybrid surgical technologies in the treatment of complicated forms of gallstone disease.

Materials and Methods. A retrospective analysis of treatment outcomes was conducted in 92 patients with complicated forms of gallstone disease treated at the Surgical Department of the Samarkand branch of the Republican Center for Emergency Medical Care from 2020 to 2025. Depending on the clinical form of the disease and the applied surgical strategy, patients were divided into groups of minimally invasive and open surgical interventions. Treatment outcomes were assessed based on the incidence of postoperative complications, mortality, and length of postoperative hospital stay.

Results. Minimally invasive procedures were performed in 76 patients (82.6%), while open surgeries were carried out in 16 patients (17.4%). The most common complications were acute calculous cholecystitis (52.2%) and choledocholithiasis (29.3%). The postoperative complication rate was 8.0% in the minimally invasive group and 25.0% in the open surgery group. Postoperative mortality was 1.1% and occurred exclusively in the open surgery group. The mean postoperative hospital stay was significantly shorter in the minimally invasive group compared to the open surgery group (5.2 ± 1.6 vs. 9.8 ± 2.4 days, respectively).

Conclusion. Minimally invasive and hybrid surgical technologies are effective and safe methods for treating complicated forms of gallstone disease, allowing a reduction in postoperative complications and hospital stay. A staged approach in choledocholithiasis provides optimal clinical outcomes and should be considered the preferred treatment strategy.

Keywords

gallstone disease; complicated forms; laparoscopic cholecystectomy; endoscopic sphincterotomy; choledocholithiasis; minimally invasive technologies; hybrid interventions.

Introduction.

Gallstone disease (GSD) occupies a leading position among digestive system disorders and remains an important problem of modern abdominal surgery. According to epidemiological studies, gallbladder stones are detected in 10–20% of the adult population in economically developed countries, with a steady increase in prevalence, particularly among older age groups. Clinical data indicate that the prevalence of GSD increases with age and is closely associated with metabolic disorders, obesity, and concomitant cardiovascular diseases.

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Complicated forms of gallstone disease, including acute calculous cholecystitis, choledocholithiasis, obstructive jaundice, cholangitis, and biliary pancreatitis, are of particular clinical significance. These conditions represent the main cause of emergency hospital admissions and urgent surgical interventions. Numerous studies report that complications of GSD are associated with a higher risk of septic complications, increased postoperative mortality, and prolonged hospital stay, especially in elderly patients and those with significant comorbidities.

Until recently, open surgical procedures were the mainstay of treatment for complicated forms of GSD. However, high surgical trauma, a significant incidence of wound complications, and prolonged rehabilitation periods have limited their use, particularly in high-risk patients. Surgical guidelines emphasize that traditional laparotomic approacэhes in complicated GSD are associated with a higher rate of postoperative complications and poorer functional outcomes.

The introduction of laparoscopic technologies marked a major milestone in the development of biliary surgery. Laparoscopic cholecystectomy is currently considered the gold standard for the treatment of symptomatic gallstone disease. According to meta-analyses, minimally invasive interventions significantly reduce surgical trauma, postoperative complications, and length of hospital stay compared with open surgery.

Choledocholithiasis, which is detected in 10–20% of patients with complicated GSD, deserves special attention. In such cases, staged and hybrid approaches involving endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy followed by laparoscopic cholecystectomy have become increasingly widespread. This strategy allows effective elimination of biliary obstruction, reduces the risk of postoperative complications, and avoids extensive open procedures.

Current clinical guidelines emphasize that minimally invasive methods should be considered the treatment of choice for acute calculous cholecystitis and other complications of GSD in the absence of absolute contraindications. International and national professional societies support an individualized surgical approach based on the type of complication, disease duration, and the patient’s somatic status.

Despite significant progress in laparoscopic and endoscopic surgery, several controversial issues remain unresolved, including optimal timing of surgery for different forms of complicated GSD, the choice between single-stage and staged approaches in choledocholithiasis, criteria for conversion, and indications for open surgery. The lack of unified algorithms in certain clinical situations leads to variability in treatment strategies and outcomes.

In this context, studying the efficacy and safety of minimally invasive and hybrid technologies in the treatment of complicated gallstone disease remains a relevant task of modern surgery with significant practical importance.

Objective of the study: to evaluate the effectiveness of minimally invasive and hybrid surgical technologies in the treatment of complicated forms of gallstone disease.

Materials and Methods.

The study was based on an analysis of treatment outcomes in 92 patients with complicated forms of gallstone disease treated at the Surgical Department of the Samarkand

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branch of the Republican Center for Emergency Medical Care between 2020 and 2025. The study had a retrospective design.

The study included 92 patients, comprising 27 men and 65 women aged 34 to 82 years. In all patients, the diagnosis of gallstone disease was confirmed using clinical and instrumental examination methods.

Inclusion criteria were:

- presence of a complicated form of gallstone disease;

- age over 18 years;

- indication for surgical treatment.

Exclusion criteria were:

- decompensated comorbid conditions;

- malignant neoplasms of the hepatobiliary system;

- refusal of surgical treatment.

All patients underwent standard clinical and laboratory evaluation, including complete blood count and biochemical analysis with assessment of inflammatory markers and bilirubin metabolism. Instrumental diagnostics included abdominal ultrasonography and, when indicated, computed tomography and magnetic resonance cholangiopancreatography.

Endoscopic retrograde cholangiopancreatography was performed in patients with signs of choledocholithiasis and obstructive jaundice according to accepted indications.

Various surgical treatment strategies were applied depending on the clinical form of the disease, time of admission, and general condition of the patient. The main group consisted of patients who underwent minimally invasive procedures. Open surgery was performed in cases of severe inflammatory infiltrate, pronounced adhesions, or complications and was considered a reserve treatment option.

Treatment efficacy was assessed based on the incidence of postoperative complications, mortality, and length of postoperative hospital stay.

Results.

The study included 92 patients with complicated forms of gallstone disease. Minimally invasive procedures were performed in 76 patients (82.6%), while open surgical interventions were carried out in 16 patients (17.4%).

The structure of complications was as follows:

- acute calculous cholecystitis — 48 patients (52.2%);

- choledocholithiasis — 27 patients (29.3%);

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- obstructive jaundice without stones — 9 patients (9.8%);

- combined forms of complicated gallstone disease — 8 patients (8.7%).

Laparoscopic cholecystectomy was performed in 59 patients (64.1%). Staged treatment involving ERCP followed by laparoscopic cholecystectomy was applied in 23 patients (25.0%) with choledocholithiasis and obstructive jaundice. Hybrid laparo-endoscopic interventions were performed in 6 patients (6.5%).

Conversion to open surgery was required in 4 patients (4.3%). The main reasons for conversion were pronounced inflammatory infiltrate in the gallbladder neck (2 cases), dense adhesions (1 case), and atypical biliary anatomy (1 case).

Postoperative complications were observed in 11 patients (11.9%). In the minimally invasive group, the complication rate was 8.0%, compared with 25.0% in the open surgery group. The most common complications included postoperative infiltrates (4 cases), bile leakage (2 cases), wound complications (3 cases), and intra-abdominal abscesses (2 cases).

Overall postoperative mortality was 1.1% (1 patient). The fatal outcome occurred in the open surgery group in a patient with severe comorbidities and delayed hospital admission.

The mean postoperative hospital stay in the minimally invasive group was 5.2 ± 1.6 days, which was significantly shorter than in the open surgery group (9.8 ± 2.4 days).

Discussion.

The obtained results confirm the high efficacy of minimally invasive technologies in the treatment of complicated gallstone disease. A significant reduction in postoperative complications in the laparoscopic and endoscopic intervention group (8.0% vs. 25.0%) is consistent with data from domestic and international studies indicating lower surgical trauma and a more favorable postoperative course with minimally invasive techniques.

Laparoscopic cholecystectomy demonstrated high clinical efficacy in acute calculous cholecystitis and can be considered the treatment of choice for this form of complicated gallstone disease. The staged approach in patients with choledocholithiasis and obstructive jaundice was of particular importance. The use of endoscopic sphincterotomy followed by laparoscopic cholecystectomy allowed effective biliary decompression and reduced the risk of septic complications.

The low conversion rate (4.3%) indicates appropriate patient selection and adequate intraoperative assessment. However, delayed hospital admission and severe inflammatory changes remain key factors limiting the use of laparoscopic technologies.

Despite higher complication and mortality rates, open surgical procedures retain their role in the management of severe and advanced forms of complicated gallstone disease and should be considered a reserve method when minimally invasive surgery is not feasible.

The limitations of this study include its retrospective design and single-center setting, highlighting the need for further prospective studies with larger patient cohorts.

Conclusion.

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Minimally invasive technologies are effective and safe methods for treating complicated forms of gallstone disease. The use of laparoscopic and endoscopic interventions reduces the postoperative complication rate from 25.0% to 8.0% and shortens the length of postoperative hospital stay. Staged and hybrid approaches in choledocholithiasis provide optimal clinical outcomes and minimize the need for open surgery. Open surgical interventions remain indicated for severe forms of the disease and should be used according to strict indications.

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