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THE ROLE OF RADIOLOGY SURGERY IN COMPLICATED FORMS OF GALLSTONE DISEASE

Abstract

Gallstone disease (GSD) remains one of the most prevalent disorders of the hepatobiliary system worldwide and is responsible for substantial morbidity, hospital admissions, and healthcare costs. Although many patients remain asymptomatic, approximately 20–30% develop severe complications, including acute calculous cholecystitis, choledocholithiasis, acute cholangitis, gallstone pancreatitis, biliary obstruction, hepatic abscesses, and sepsis. These complications require rapid diagnosis and timely intervention to reduce mortality and preserve biliary function.

Keywords: Gallstone disease, complicated cholelithiasis, interventional radiology, biliary drainage, percutaneous cholecystostomy, biliary stenting, cholangioscopy, ultrasound, computed tomography.

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O'T-TOSH KASALLIGINING ASORATLANGAN SHAKLLARIDA RENTGEN JARROHLIGINING ROLI

Annotatsiya

O't-tosh kasalligining asoratlangan shakllarida intervension radiologiyaning o'zni O't-tosh kasalligi gepatobiliar tizimning eng ko'p uchraydigan kasalliklaridan biri bo'lib, butun dunyoda kasallanish, shifoxonaga yotqizilish va o'lim ko'rsatkichlarining muhim sabablaridan biri hisoblanadi. Bemorlarning aksariyatida kasallik simptomtsiz kechishiga qaramay, taxminan 20–30% holatlarda o'tkir kalkulyoz xoletsistit, xoledoxolitiaz, o'tkir xolangit, biliar pankreatit, mexanik sariqlik, jigar absessi va sepsis kabi og'ir asoratlar rivojlanadi. So'nggi yillarda intervension radiologiya sohasidagi yutuqlar o't-tosh kasalligining asoratlangan shakllarini davolash usullarini tubdan o'zgartirdi. Ultratovush va rentgen nazorati ostida bajariladigan

minimal invaziv muolajalar, jumladan perkutan transhepatik biliar drenaj (PTBD), perkutan xoletsistostomiya, biliar stentlash, perkutan xolangioskopiya hamda tasvir nazorati ostida toshlarni olib tashlash usullari yuqori operatsion xavfga ega yoki endoskopik muolajalarni bajarish imkoni bo'lmagan bemorlarda samarali davolash usuli hisoblanadi.

Kalit so'zlar: o't-tosh kasalligi, asoratlangan xoletiaz, interventsion radiologiya, biliar drenaj, perkutan xoletsistostomiya, biliar stentlash, xolangioskopiya, ultratovush tekshiruvi, kompyuter tomografiyasi.

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РОЛЬ ИНТЕРВЕНЦИОННОЙ РАДИОЛОГИИ ПРИ ОСЛОЖНЁННЫХ ФОРМАХ ЖЕЛЧНОКАМЕННОЙ БОЛЕЗНИ

Аннотация

Желчнокаменная болезнь (ЖКБ) является одним из наиболее распространённых заболеваний гепатобилиарной системы и остаётся важной причиной госпитализации, инвалидизации и смертности во всём мире. Несмотря на бессимптомное течение у большинства пациентов, примерно у 20–30% развиваются тяжёлые осложнения, включая острый калькулёзный холецистит, холедохолитиаз, острый холангит, билиарный панкреатит, механическую желтуху, абсцессы печени и сепсис.

Современные достижения интервенционной радиологии значительно изменили подходы к лечению осложнённых форм желчнокаменной болезни. Минимально инвазивные вмешательства под визуальным контролем, такие как чрескожное чреспечёночное билиарное дренирование (ЧЧБД), чрескожная холецистостомия, билиарное стентирование, чрескожная холангиоскопия и удаление конкрементов под лучевым контролем, являются эффективной альтернативой хирургическому лечению у пациентов высокого операционного риска или при невозможности выполнения эндоскопических вмешательств.

Ключевые слова: желчнокаменная болезнь, осложнённая желчнокаменная болезнь, интервенционная радиология, билиарное дренирование, чрескожная холецистостомия, билиарное стентирование, холангиоскопия, ультразвуковое исследование, компьютерная томограф

Introduction

Gallstone disease is among the most common gastrointestinal disorders affecting adults worldwide. The global prevalence varies between 10% and 20% depending on geographic location, ethnicity, dietary habits, age, sex, and metabolic risk factors. Increasing rates of obesity, diabetes mellitus,

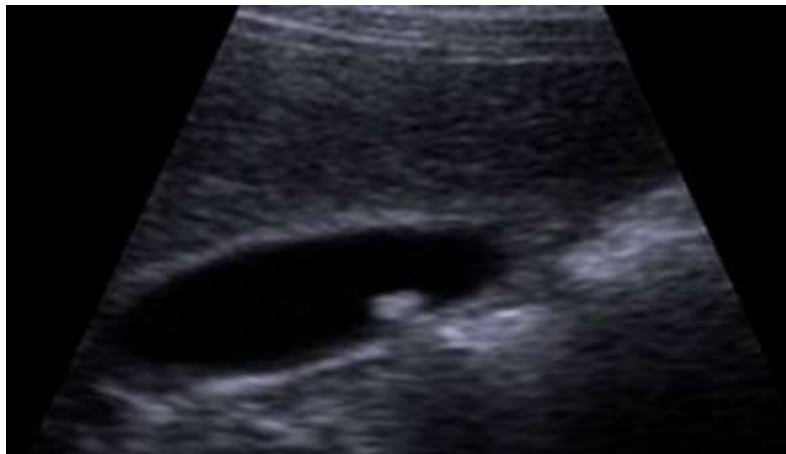
metabolic syndrome, and aging populations have contributed to the growing incidence of gallstone-related complications during the last decade. Gallstones develop due to disturbances in bile composition, impaired gallbladder motility, chronic inflammation, and biliary stasis. Cholesterol stones account for approximately 80–90% of all gallstones, whereas pigment stones are more frequently associated with chronic hemolytic disorders and biliary infections.

Although the majority of patients remain asymptomatic throughout life, nearly one-third eventually experience complications requiring urgent medical attention. Acute calculous cholecystitis is the most frequent complication and results from obstruction of the cystic duct by gallstones. Delayed treatment may lead to gallbladder empyema, gangrenous cholecystitis, gallbladder perforation, and generalized peritonitis. Migration of gallstones into the common bile duct can cause choledocholithiasis, obstructive jaundice, ascending cholangitis, secondary biliary cirrhosis, and acute biliary pancreatitis. These conditions are associated with increased morbidity and mortality if diagnosis and treatment are delayed.

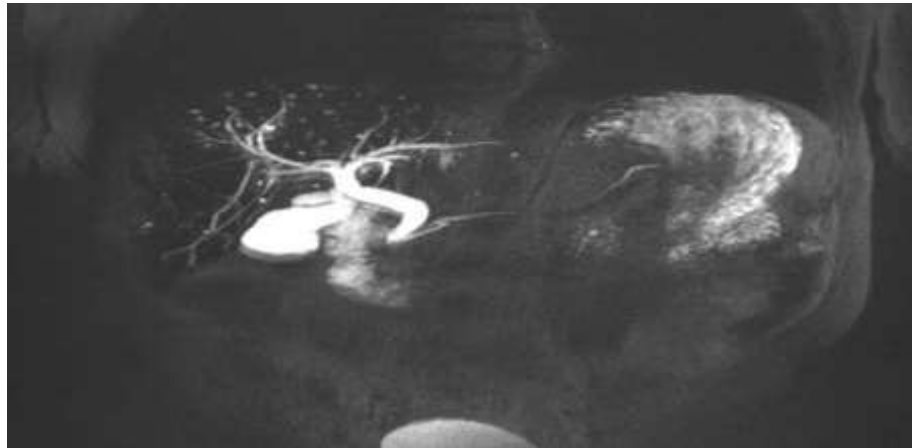
For many decades, surgery remained the standard treatment for complicated gallstone disease. However, a considerable proportion of patients are elderly or suffer from severe cardiovascular, pulmonary, hepatic, or renal diseases that significantly increase operative risk. In such patients, minimally invasive image-guided interventions have emerged as valuable alternatives capable of providing both emergency decompression and definitive treatment. Interventional radiology has experienced remarkable progress due to improvements in ultrasound guidance, fluoroscopy, computed tomography, digital subtraction angiography, and dedicated biliary intervention devices. These advances have expanded the role of radiologists from purely diagnostic imaging to therapeutic management of hepatobiliary disorders. Today, interventional radiology offers several effective techniques for the management of complicated gallstone disease, including percutaneous transhepatic biliary drainage (PTBD), percutaneous cholecystostomy, percutaneous biliary stenting, image-guided stone extraction, balloon dilatation of biliary strictures, and percutaneous cholangioscopy. These procedures are particularly beneficial for critically ill patients, individuals with failed ERCP, altered postoperative anatomy, malignant biliary obstruction, or severe sepsis requiring urgent biliary decompression. Recent international guidelines published between 2025 and 2026 emphasize the importance of multidisciplinary management involving radiologists, hepatobiliary surgeons, gastroenterologists, anesthesiologists, and intensive care specialists. Advances in image-guided interventions have substantially reduced procedure-related complications while improving technical success rates and long-term patient survival. The aim of this review is to evaluate the current role of interventional radiology in the diagnosis and treatment of complicated gallstone disease, summarize recent technological developments, compare available minimally invasive procedures, and discuss future directions for clinical practice based on the latest international evidence.

Materials and Methods

This study was conducted to evaluate the role of interventional radiology in the diagnosis and treatment of complicated gallstone disease. A retrospective observational study was performed involving patients diagnosed with complicated forms of gallstone disease who were treated at the Department of Radiology and the Department of General Surgery of Samarkand State Medical University. A total of 50 patients diagnosed with complicated gallstone disease were included in the study. Patients were selected based on clinical presentation, laboratory findings, and imaging examinations. The inclusion criteria comprised patients with acute calculous cholecystitis, choledocholithiasis, acute cholangitis, gallstone pancreatitis, obstructive jaundice, or other biliary complications requiring imaging evaluation and minimally invasive intervention. Patients with malignant biliary obstruction or incomplete medical records were excluded from the study. All patients underwent comprehensive ultrasonographic examination using the GE Versana Balance ultrasound system. Ultrasound was performed to evaluate the gallbladder, intrahepatic and extrahepatic bile ducts, liver parenchyma, and associated complications. Color Doppler imaging was applied when vascular assessment was required. When clinically indicated, additional imaging studies, including contrast-enhanced computed tomography (CT), magnetic resonance imaging (MRI), and magnetic resonance cholangiopancreatography (MRCP), were performed to assess biliary obstruction, inflammatory changes, stone localization, and procedure planning. Interventional radiology procedures were selected according to the patient's clinical condition, imaging findings, and current international recommendations. These procedures included percutaneous transhepatic biliary drainage (PTBD), percutaneous cholecystostomy, biliary stent placement, and other image-guided biliary interventions. All procedures were performed under ultrasound and fluoroscopic guidance using standard sterile techniques. Clinical effectiveness was assessed by evaluating symptom relief, reduction of serum bilirubin and inflammatory markers, restoration of biliary drainage, imaging findings during follow-up, duration of hospitalization, and procedure-related complications. The collected clinical and imaging data were analyzed using descriptive statistical methods. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages.



Magnetic Resonance Cholangiopancreatography (MRCP)



Results

A total of 50 patients with complicated gallstone disease were included in the study. The diagnosis was established using clinical findings, laboratory investigations, and multimodal imaging techniques.

Ultrasonography successfully identified gallstones, gallbladder wall thickening, biliary dilatation, and inflammatory changes in the majority of patients, confirming its value as the primary diagnostic modality. CT and MRI/MRCP provided additional information regarding the extent of biliary obstruction, associated complications, and anatomical variations, which were essential for treatment planning.

Image-guided interventional procedures were successfully performed in patients who required minimally invasive biliary decompression. Percutaneous transhepatic biliary drainage and percutaneous cholecystostomy effectively relieved biliary obstruction and improved the clinical condition of patients presenting with severe acute cholangitis, obstructive jaundice, or acute calculous cholecystitis.

Following treatment, patients demonstrated clinical improvement characterized by reduction of abdominal pain, normalization of body temperature, improvement of laboratory parameters, restoration of bile flow, and decreased inflammatory response. Follow-up imaging confirmed adequate catheter position and resolution of biliary obstruction in successfully treated patients. Procedure-related complications were infrequent and were managed conservatively or by additional image-guided intervention when necessary. Overall, minimally invasive interventional radiology techniques proved to be safe and effective for the management of complicated gallstone disease.

Discussion

The present study evaluated the role of interventional radiology in the diagnosis and management of patients with complicated gallstone disease. The findings demonstrate that modern imaging modalities combined with minimally invasive image-guided interventions play a crucial role in improving clinical outcomes and reducing the need for emergency surgical procedures.

Ultrasonography was the primary imaging modality used in this study because of its wide availability, rapid performance, and high diagnostic value in detecting gallstones, gallbladder wall

thickening, biliary dilatation, and inflammatory changes. However, in patients with complex biliary obstruction or inconclusive ultrasound findings, CT and MRI/MRCP provided additional anatomical information that was essential for treatment planning. These observations are consistent with recent international recommendations, which emphasize a multimodality imaging approach for complicated biliary diseases.

The use of interventional radiology procedures, including percutaneous transhepatic biliary drainage (PTBD), percutaneous cholecystostomy, and biliary stenting, provided effective biliary decompression in patients with severe complications such as acute cholangitis, obstructive jaundice, and acute calculous cholecystitis. These minimally invasive techniques contributed to rapid clinical stabilization and created favorable conditions for subsequent definitive management when required. The results of this study are in agreement with recently published international studies, which have reported high technical success rates and low complication rates for image-guided biliary interventions. Recent evidence suggests that PTBD remains an effective alternative in patients with failed or contraindicated ERCP, while percutaneous cholecystostomy has become an accepted treatment option for critically ill patients who are not suitable candidates for emergency surgery. An important strength of the present study is the integration of diagnostic imaging and therapeutic intervention within a single clinical pathway. The combination of ultrasonography, CT, MRI/MRCP, and fluoroscopic guidance allowed accurate diagnosis, careful procedural planning, and continuous post-procedural monitoring. This comprehensive radiological approach improved treatment efficiency and reduced the risk of procedure-related complications.

Despite these encouraging findings, several limitations should be acknowledged. This study was conducted at a single institution and included a relatively limited number of patients. In addition, the retrospective design may have introduced selection bias. Future multicenter prospective studies with larger patient populations are required to validate these findings and establish standardized treatment algorithms for complicated gallstone disease.

Overall, the present study confirms that interventional radiology has become an indispensable component of modern hepatobiliary medicine. The integration of advanced imaging technologies with minimally invasive therapeutic procedures significantly improves patient management, reduces surgical risk, shortens hospital stay, and enhances clinical outcomes. Continued technological innovation and multidisciplinary collaboration are expected to further expand the role of interventional radiology in the treatment of complicated gallstone disease.

Conclusion

Complicated gallstone disease remains a significant clinical challenge because of its high prevalence, potential for life-threatening complications, and increasing incidence among elderly patients and individuals with multiple comorbidities. Early diagnosis and timely therapeutic intervention are essential to reduce morbidity, mortality, and long-term hepatobiliary dysfunction.

This review demonstrates that modern imaging modalities, including ultrasonography, computed tomography, magnetic resonance imaging, and magnetic resonance cholangiopancreatography, play a fundamental role in the comprehensive management of complicated gallstone disease. These techniques not only facilitate accurate diagnosis but also provide essential guidance for minimally invasive therapeutic procedures.

Interventional radiology has become an indispensable component of contemporary hepatobiliary treatment. Image-guided procedures such as percutaneous transhepatic biliary drainage, percutaneous cholecystostomy, biliary stent placement, percutaneous cholangioscopy, and image-guided stone extraction provide safe and effective alternatives for patients in whom conventional surgery or endoscopic treatment is contraindicated or unsuccessful.

The analysis of recent international publications published during 2025–2026 indicates that technological innovations—including digital cholangioscopy, cone-beam CT navigation, fusion imaging, advanced biliary stents, robotic-assisted interventions, and artificial intelligence-assisted procedural planning—have significantly improved procedural precision, technical success, and long-term clinical outcomes. These developments have reduced procedure-related complications, shortened hospitalization, and enhanced patients' quality of life.

A multidisciplinary approach involving interventional radiologists, hepatobiliary surgeons, gastroenterologists, diagnostic radiologists, anesthesiologists, and intensive care specialists is essential for optimizing treatment strategies. Individualized patient assessment allows the selection of the most appropriate minimally invasive intervention based on disease severity, anatomical characteristics, and overall clinical condition.

Future research should focus on large multicenter prospective clinical trials evaluating the long-term efficacy, cost-effectiveness, and safety of emerging interventional radiology techniques. Further integration of artificial intelligence, robotic navigation systems, and next-generation biodegradable biliary devices is expected to transform the management of complicated gallstone disease and establish new standards of patient care.

In conclusion, interventional radiology has evolved from a supportive imaging discipline into a key therapeutic specialty in the management of complicated gallstone disease. Continuous technological progress and evidence-based clinical practice will further strengthen its role in improving patient survival, reducing treatment-related complications, and providing effective minimally invasive alternatives to conventional surgical management.

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