# Review of imaging in post-laparoscopy cholecystectomy complications

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## Abstract

Laparoscopic cholecystectomy is now considered the procedure of choice for uncomplicated symptomatic gallstone disease worldwide. Various biliary, vascular, gastrointestinal, neurological and local complications may be seen on imaging post surgery. Knowledge of these entities and imaging appearances is indispensable for the radiologist in today's era. We emphasize on the list of potential complications and imaging appearances of this surgical procedure.

**Key words:** Bile duct injury; cholecystectomy; complications; laparoscopy

## Introduction

Laparoscopic cholecystectomy is now considered the procedure of choice for uncomplicated symptomatic gallstone disease worldwide replacing open cholecystectomy as the first choice. At present, approximately 750,000 laparoscopic cholecystectomies are performed annually in the United States.[1] Laparoscopic cholecystectomy was introduced in the late 1980s and quickly gained popularity among patients with symptomatic gallstones. In the laparoscopic procedure, the gallbladder is removed through small incisions in the abdomen, rather than the larger incision used in open cholecystectomy. The procedure results in short hospital stay, less postoperative pain, wound infection, better cosmetic results, and higher patient satisfaction.[2] Although laparoscopic cholecystectomy is associated with lower mortality and morbidity rates, few complications are more frequent with this procedure compared to the open technique. Various complications associated with laparoscopic cholecystectomy are listed in Table 1.

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Radiologists should be aware of the correct imaging modality – ultrasound (US), computed tomography (CT), endoscopic retrograde cholangiopancreatography (ERCP), or magnetic resonance cholangiography (MRCP) – to establish the type and site of postoperative complications. The various imaging modalities are complementary and no single imaging modality is specific for a particular complication.[3,4] In general, patients with evidence of pain, fever, jaundice or biliary fistula should have an imaging study to look for fluid (abscess, biloma) in the abdomen, either by an ultrasound or an abdominal CT scan. In addition to US and CT, the first method of choice in the imaging of biliary tree and gallbladder pathology is the MRI/MRCP. PTC, PTBD, and ERCP should be performed as therapeutic procedures and should not be used for primary diagnosis.

## Gallbladder remnant and cystic duct related complications

### Residual or reformed gallbladder

Subtotal cholecystectomy accounts for nearly 13.3% of total laparoscopic cholecystectomies.[5] Subtotal or



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partial cholecystectomy is considered a safe procedure in complicated cases (e.g., acutely inflamed phlegmonous mass, frozen Calot's triangle with adhesions, and cirrhotic patients with portal hypertension). The mucosa of the remainder wall is fulgurated, leaving practically nonfunctioning residual gallbladder behind.[6] The remaining gallbladder is not closed to avoid reformation of the gallbladder and stones. Other reasons for leaving residual gallbladder are poor visualization of the gallbladder fossa during surgery, excessive bleeding, confounding gallbladder morphology such as congenital duplication, intrahepatic gallbladder, hourglass configuration due to adenomyomatosis, or inadequate technique.[7] On imaging, residual fluid-filled structure in the region of gallbladder fossa with wall formation by the omentum is seen with or without stones [Figures 1 and 2].[8]

**Table 1: List of post-laparoscopic cholecystectomy complications**

| Region involved | Complications |
|---|---|
| Gallbladder and cystic duct remnant | Residual or reformed gallbladder<br>Stump cholelithiasis<br>Mirizzi's syndrome<br>Leak<br>Mucocele<br>Inflammation<br>Amputation neuroma, suture granuloma |
| Biliary tract | Biliary injury<br>Cholangitis<br>Adhesions<br>Strictures<br>Obstruction<br>Choledocholithiasis<br>Clip migration/Inaccurate clip placement<br>Choledochoduodenal fistula<br>Dyskinesia<br>Nonspecific dilatation or hypertension<br>Dilatation without obstruction<br>Malignancy |
| Periampullary | Sphincter of Oddi dysfunction (*Functional biliary sphincter disorder*); spasm; hypertrophy<br>Stricture<br>Papilloma<br>Malignancy |
| Pancreas | Pancreatitis<br>Functional pancreatic sphincter disorder<br>Stone<br>Tumors |
| Vascular | Injury to hepatic artery, portal vein (pseudoaneurysm, portal vein thrombosis)<br>Mesenteric ischemia |
| Nerve and CNS related | Intercostal neuralgia<br>Neuroma<br>Spinal nerve lesions<br>Depression, tension, anxiety |
| Liver | Fatty liver; hepatitis; cirrhosis; idiopathic jaundice<br>Liver abscess |
| Esophagus | Esophagitis |
| Stomach | Bile gastritis<br>Peptic ulcer disease |
| Duodenum | Peptic ulcer disease<br>Irritable bowel disease<br>Perforation |
| Small bowel | Adhesions; incisional hernia; irritable bowel disease |
| Colon | Constipation<br>Diarrhoea<br>Adhesions; incisional hernia; irritable bowel disease |
| Subcutaneous tissue | Hematoma<br>Abscess |
| Miscellaneous | Dropped gallstones<br>Thermal injury<br>Trocar site hernia<br>Parasitic infestation (Ascariasis) |

## Stump cholelithiasis

Calculi in the cystic duct remnant accounts for less than 2.5% of the cases.[9] Patients usually present with symptoms of biliary colic. Typically, cystic duct stump remnant is defined as residual cystic duct stump length greater than 1 cm.[10] A cystic duct measuring >5 mm in diameter is considered abnormal and dilated.[11] Occasionally, the cystic duct remnant may dilate giving the impression of a remnant or reformed gallbladder on imaging studies [Figure 3].

## Mirizzi's syndrome

Post-cholecystectomy Mirizzi syndrome can be caused by multiple mechanisms – stones in the remnant cystic duct or long remnant cystic duct parallel to the common hepatic duct can compress the common hepatic duct. MRCP is the optimal method for evaluating biliary tree in these patients, as it is noninvasive. On MRCP, post-cholecystectomy Mirizzi syndrome is seen as cystic duct stone causing extrinsic compression of the common hepatic with proximal dilated ductal system and normal calibre common bile duct distal to the site of obstruction. A rare cause of post-cholecystectomy Mirizzi syndrome is laparoscopic clip migration, which can lead to secondary inflammation and stricture formation.[12]

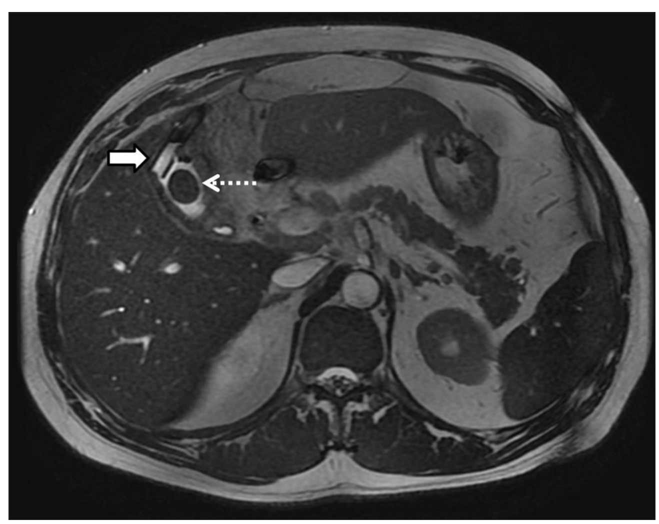

**Figure 1:** Axial FIESTA MR Image showing drainage tube (arrow) in residual gallbladder and hypointense filling defect suggestive of cholelithiasis (dashed arrow)

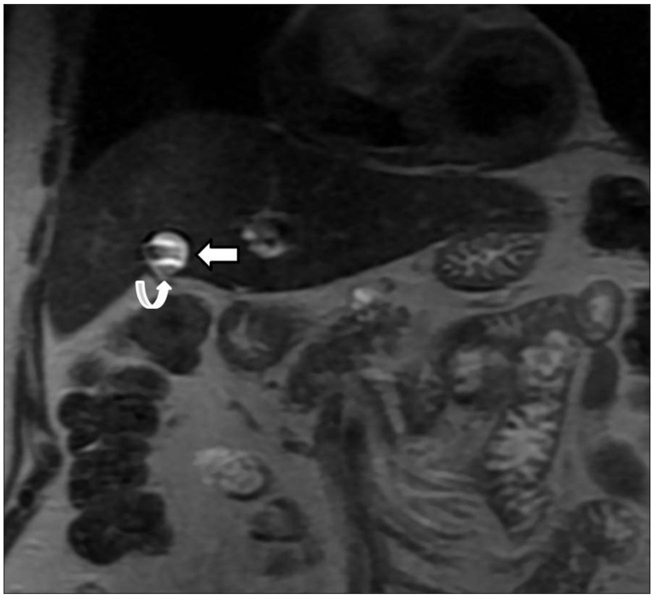

**Figure 2:** Coronal T2-weighted MR image confirming the residual intrahepatic gallbladder (arrow) with intracystic air foci and sludge ball (curved arrow)

### Cystic duct stump leak

Stump leak is defined as a persistent leakage of bile into the peritoneal cavity or through the drain, if present, and is the most common morbidity.[13] Cystic duct stump leak can result from clip dislodgement, imperfect clip application, necrosis of the cystic duct stump, electrosurgery-related, short-wide cystic duct, injury or stones in common bile duct, or cystic duct remnant.[14] On imaging, a high index of suspicion is to be made when there is persistent subhepatic collection in continuity with the stump [Figure 4].

### Mucocele

Cystic duct stump mucocele is a rare complication, where the remnant cystic duct is distended with mucus.[15] The cause of a cystic duct mucocele is unclear. Ischemia-reperfusion injury, lack of nervous regulation of the biliary tract, and inflammation are considered to contribute to mucocele formation.[16] Cystic duct mucocele can lead to biliary obstruction. MRCP is the investigation of choice and shows dilated-tensed cystic duct remnant usually more than 5 mm in diameter, having a "flashlight bulb" appearance along with compression of the common bile duct.[17]

### Stump inflammation

Cystic duct remnant harboring stones, gravel, or sludge can cause inflammation of the stump and biliary colic like pain resulting in stump cholecystitis.[18,19] On imaging, presence of stones, microliths, or sludge with wall thickening, enhancement, and adjacent fat stranding is a clue to the diagnosis.

### Neuroma and suture granuloma

Traumatic neuroma is an exuberant non-neoplastic proliferation of a nerve that occurs after injury or surgery.

**Figure 3:** Coronal 2-dimensional MRCP image showing cystic duct remnant calculi (arrow) and T2-hypointense calculus (dashed arrow) within the common bile duct

Usually, the patient presents with jaundice and features of extrahepatic biliary obstruction. These lesions can mimic a pseudotumor and present as small enhancing lesion that may or may not cause biliary obstruction near the clip or stump site[20] [Figure 5]. The appearance of a suture granuloma at imaging is highly nonspecific and can manifest as a solid or a mixed solid-cystic lesion at ultrasound, CT, or MR imaging. Preoperative diagnosis is extremely difficult and confirmation is only by biopsy which shows fibrocollagenous proliferation and absence of malignant cells.[21] Radiological awareness of this entity is required as it can masquerade a neoplasm.

## Biliary Tract Related Complications

### Biliary injury

Bile duct injury (BDI) is more common in laparoscopic cholecystectomy (0.3% open vs 0.6% laparoscopic).[22] The main causes of biliary duct injury are unintentional cutting of bile ducts, inadvertently placed clips or ligatures, and thermal injury owing to electrocautery. BDI can lead to either bile leak or obstruction because of stricture formation due to periductal fibrosis. Appropriate clinical scenario with constant bile juice in drain in a postsurgical setting warrants a thorough search for ductal injury evaluation. The classification by Strasberg *et al*.[23] is popular and is the most widely accepted [Table 2; Figures 6-11]. BDI can cause serious clinical conditions including bile leak, fistula, sepsis, biliary peritonitis, jaundice, cholangitis, and eventually biliary cirrhosis. The role of imaging is to establish the diagnosis, delineate the extent of injury, and plan appropriate

**Figure 4:** Coronal 2-dimensional MRCP image showing filling defect (arrow) in common bile duct suggestive of choledocholithiasis and thin rim of perihepatic fluid (dashed arrows) due to leakage from the cystic duct stump (Type A injury)

**Table 2: Strasberg-Bismuth classification of bile duct injuries**

| Types | Nomenclature |
|---|---|
| Type A | Bile leak from the cystic duct/accessory duct/small ducts in liver bed without loss of continuity |
| Type B | Occlusion of an aberrant duct with loss of continuity with the common bile duct |
| Type C | Complete transection of the aberrant right hepatic duct with loss of continuity with the common bile duct |
| Type D | Partial lateral wall injury to the CHD or CBD |
| Type E1 | CHD injury, beyond 2 cm from the primary confluence |
| Type E2 | CHD injury, less than 2 cm from the primary confluence |
| Type E3 | Injury at the confluence; confluence is intact |
| Type E4 | Injury at the confluence; confluence separated |
| Type E5 | Injury to the aberrant right posterior sectoral duct along with stricture of the CBD |

intervention. CT and US can depict fluid collections and biliary duct dilatation. CT has been reported to have higher sensitivity than US for detecting fluid collections.[24] MRCP is a noninvasive modality and provides excellent anatomical information of the biliary anatomy proximal and distal to the level of injury. MRCP combined with dynamic contrast-enhanced MR with a hepatocyte-selective contrast agent with biliary excretion allows functional assessment of the biliary tree for the detection and localization of bile leaks with an accuracy close to 100%.[25]

## Stricture

Strictures are the most common late complication, developing a few months to years after cholecystectomy, seen in up to 0.6% of cases.[26] The typical locations of strictures are in the common bile duct near the insertion of the cystic duct or at the hepatic confluence due to inadvertent ligation, chronic irritation from surgical clips, or thermal injury.[26] MRCP allows accurate diagnosis, whereas ERCP provides both diagnostic and therapeutic options. MRCP tends to overestimate the length of the stricture, especially when the duct immediately distal to the stricture is collapsed.[27] Imaging findings include intra and extrahepatic ductal dilatation with gentle tapering, focal ductal narrowing, and nondepiction of a part of a duct[28] [Figure 12]. Benign biliary strictures are smooth and show tapered regular margins with symmetric narrowing whereas malignant biliary strictures are longer, irregular, have shouldered margins, with greater proximal dilatation, show thickening (>1.5 mm) and hyperenhancement of the duct wall.[29] Abrupt narrowing of the distal common bile duct is not reliable for distinguishing between benign and malignant strictures.[30] Accuracy of MRCP is comparable with that of ERCP in the diagnosis of benign and malignant strictures.[30] The main advantage of ERCP over MRCP is ERCP allows for tissue sampling using biliary brushings or biopsies.[31]

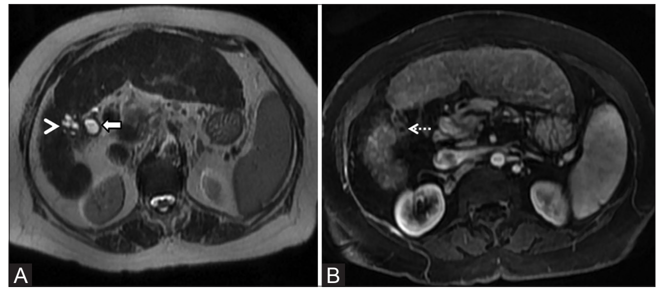


**Figure 5 (A and B):** 44-year-old female presenting with deranged liver function tests and weight loss 1 year post cholecystectomy. (A) Axial T2-weighted MR image showing crowding of right sided intrahepatic bile ducts (arrowhead) and residual gallbladder (arrow). (B) Axial post-contrast T1-weighted MR image showing subtle enhancing soft tissue (dashed arrow) near the cystic duct stump which proved to be traumatic neuroma. Also note is made of cirrhotic architecture of liver

## Choledocholithiasis

Calculi are classified as retained or recurrent if found before or after 2 years following surgery, respectively. The retained stones are likely to have been present at the time of the surgery and are usually secondary calculi due to migration of stones during surgery.[32] MRCP has a sensitivity of 95–100% and a specificity of 88–89% for detecting common bile duct calculi.[32] They appear as filling defects within the bile duct, usually in the dependent position, surrounded by a thin rim of hyperintense bile [Figure 13].

## Choledochoduodenal fistula

Biliary-enteric fistulas are a known complication of chronic gallbladder disease with an incidence of 0.06–0.14%.[33] There is no accurate data for the choledochoduodenal fistula

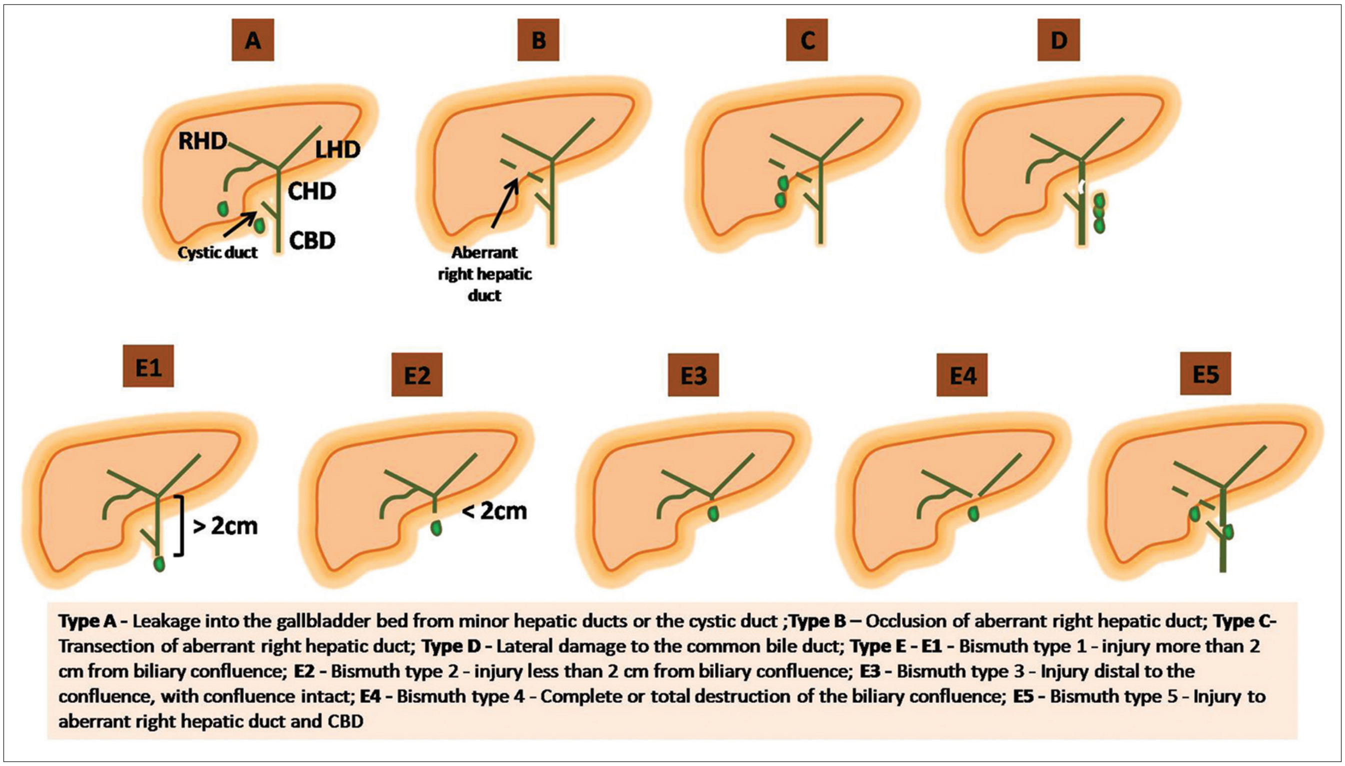


**Figure 6:** Line diagram showing Strasberg-Bismuth classification of bile duct injuries

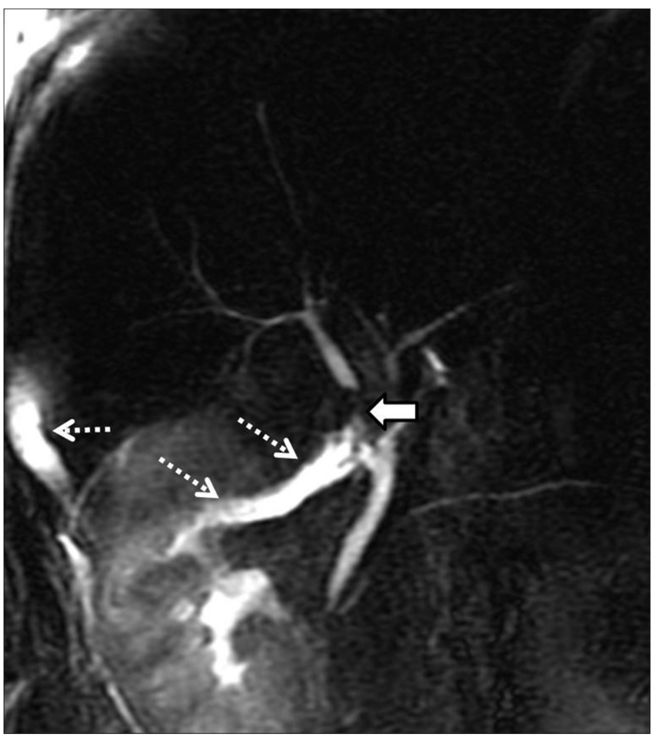

**Figure 7:** Coronal 3-dimensional MRCP image showing subhepatic and perihepatic fluid (dashed arrows) with complete transection of aberrant right hepatic duct (arrow) suggestive of ductal injury (Type C injury)

after cholecystectomy. Currently, CT is used for noninvasive diagnosis which shows presence of pneuomobilia and opacification of biliary tree by oral contrast [Figure 14].[34]

**Figure 8:** Coronal 3-dimensional MRCP image showing Type E1 ductal injury 2 cm beyond the confluence with collection/biloma (arrow)

### Inadverent clip placement and clip migration

Post-cholecystectomy clip migration (PCCM) is not uncommon, can occur at any time but typically occurs at a median of 2 years after cholecystectomy, and can lead to various complications. The number of clips used during the

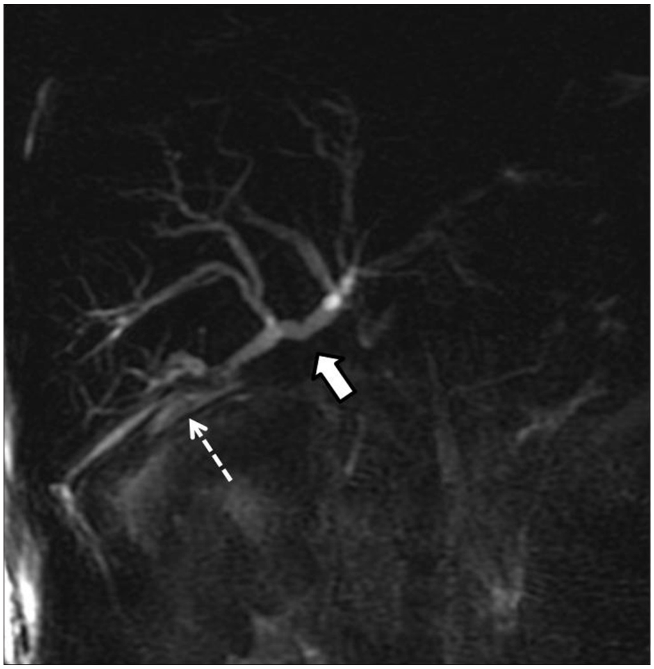

**Figure 9:** Coronal 3-dimensional MRCP image showing Type E3 injury at the confluence (arrow) with minimal subhepatic fluid (dashed arrow)

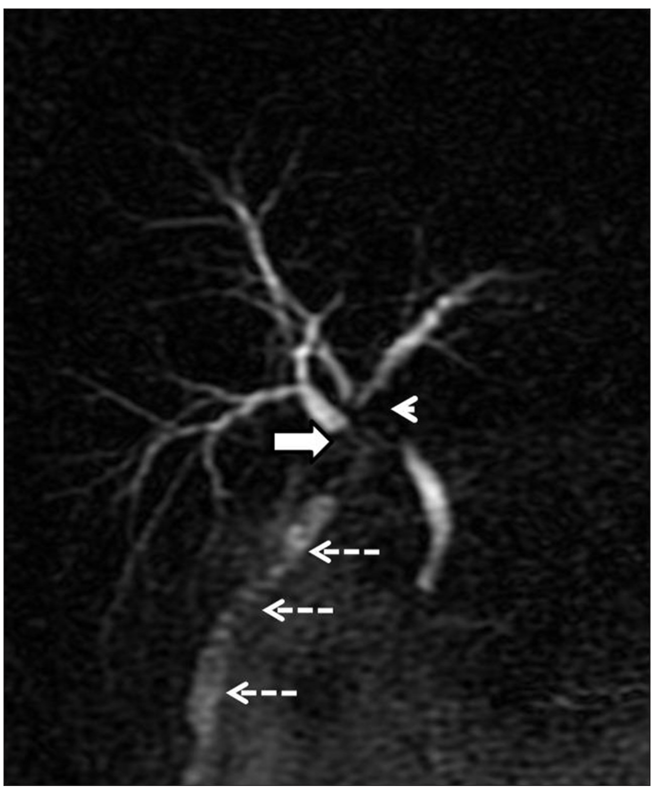

**Figure 11:** Coronal 2-dimensional MRCP image showing Type E5 ductal injury with injury to the aberrant right posterior sectoral duct (arrow) along with stricture of CBD (arrowhead) and perihepatic fluid (dashed arrows)

initial surgery is also an important factor. The use of more than four clips, localized inflammation, and infection are associated with clip migrations.[35,36] Most common site of migration

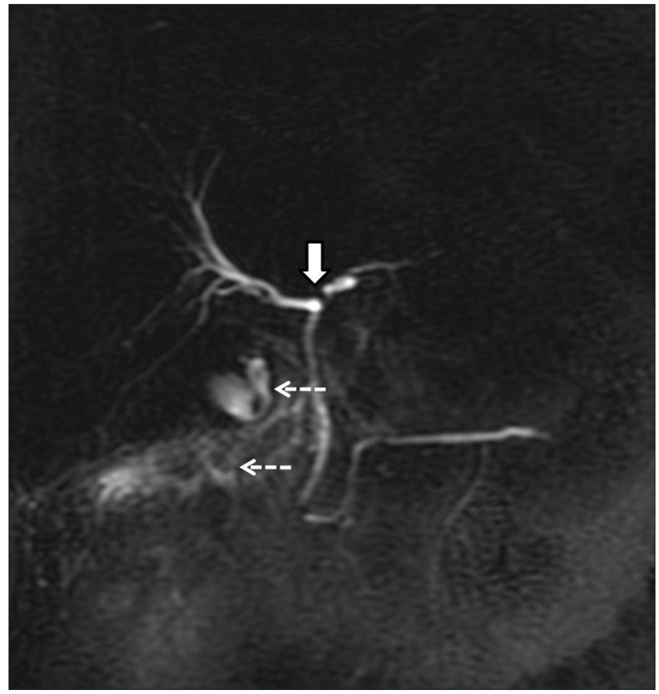

**Figure 10:** Coronal 3-dimensional MRCP image showing Type E4 ductal injury at the confluence with separation (arrow) and perihepatic fluid collection (dashed arrows)

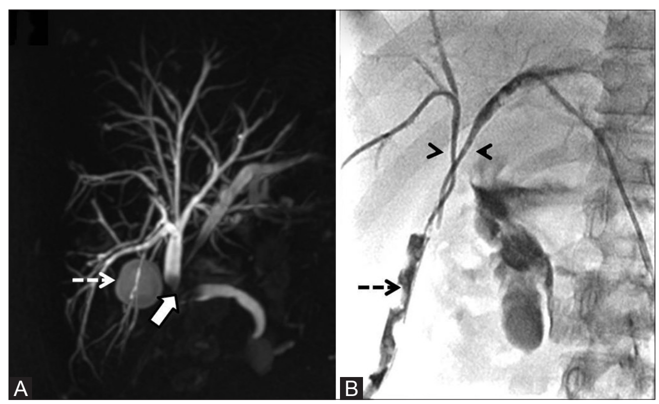


**Figure 12 (A and B):** (A) Coronal 3-dimensional MRCP image showing CHD stricture (arrow) with upstream bilobar intrahepatic biliary dilatation and a small collection (white dashed arrow). (B) Cholangiography images showing two PTBD catheters in right and left hepatic ducts (arrowheads) with controlled external fistula (dashed arrow)

is into the common bile duct. Inaccurate clip placement resulting into inadverent duct ligation is an important cause of post-cholecystectomy stricture and cholangitis [Figures 15-17]. Inaccurate clip placements can also result in clip migration. Various complications of clip migration are stone formation, obstructive jaundice, cholangitis, biliary colic, Mirizzi's, fistula, and acute pancreatitis.[12,37,38]

## Sphincter of Oddi Dysfunction

Sphincter of Oddi dysfunction (SOD) is known by various names such as papillary stenosis, sclerosing papillitis, biliary spasms, biliary dyskinesia, nonspecific dilatation

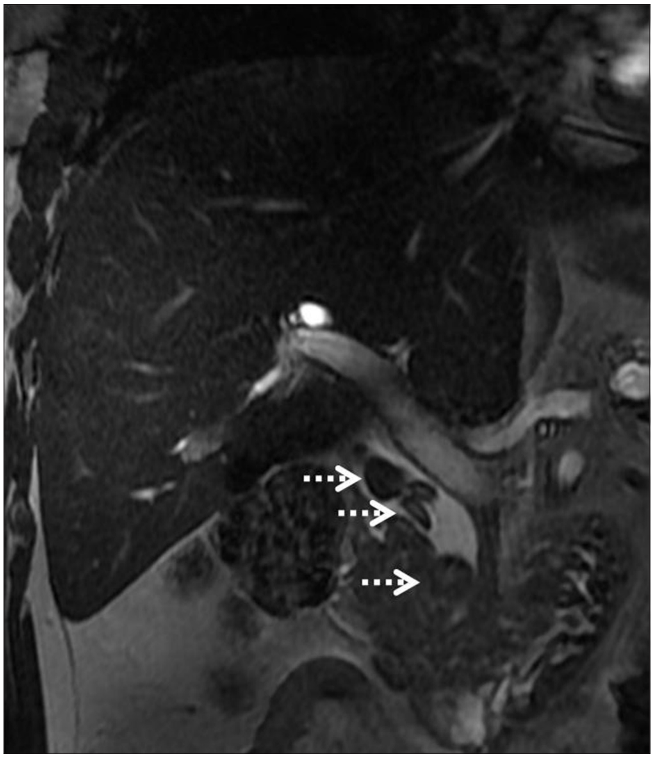


**Figure 13:** Coronal FIESTA MR Image showing multiple hypointense lithiases (dashed arrows) in common bile duct


**Figure 15 (A and B):** 39-year-old female presenting with deranged liver function tests 2 months post laparoscopic cholecystectomy. (A) Coronal 3-dimensional MRCP image showing stricture (arrow) at the confluence with mild upstream dilatation of intrahepatic bile ducts (arrowheads). (B) Coronal post-contrast hepatobiliary phase T1-weighted MR image using hepaotcyte-specific contrast agent showing excretion of contrast into the biliary tree and susceptibility clip artefact near the confluence (arrow) suggestive of inadverent clip ligation

or hypertension, and dilatation without obstruction.[39,40] It is a benign, acalculous obstructive disorder at the level of SOD. Several causes are implicated for this intriguing entity as stenosis at ampulla due to passage of gravel over time, congenital hypertrophic sphincter, or an over responsive sphincter to neuronal or hormonal stimulus. The longstanding popular classification of three types of SOD is no longer validated now.[39] Most patients with prior SOD type I have organic stenosis rather than functional pathology who benefit from biliary sphincterotomy. Type 1 SOD is diagnosed

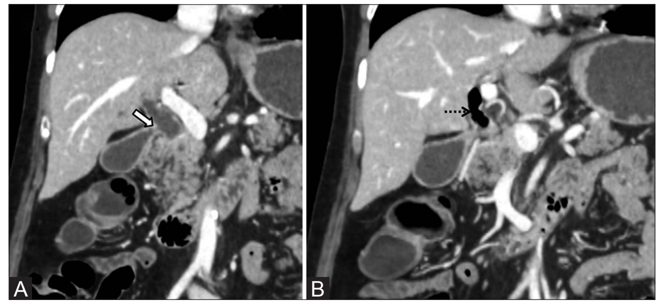


**Figure 14 (A and B):** (A and B) Coronal CECT images showing choledochoduodenal fistula (arrow) with air in the common bile duct (dashed arrow)

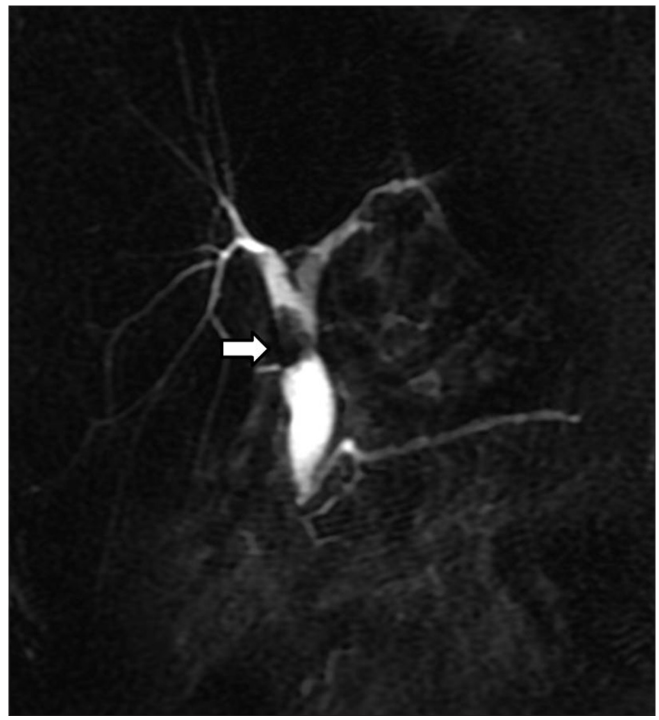

**Figure 16:** 41-year-old female presenting with cholangitis and deranged liver function tests post laparoscopic cholecystectomy. Coronal 2-dimensional MRCP image showing metallic clip susceptibility artefact (arrow) in upper CBD suggestive of inadverent placement of clip and mild dilatation of CBD

according to the modified Milwaukee classification system in patients with typical biliary pain, elevated liver enzymes 1.5–2 times the upper limit of normal on at least 2 or more occasions, and bile duct diameter ≥10 mm[41] [Figure 18]. Previously classified SOD Type II is now referred to as functional biliary sphincter disorder (FBSD). Diagnostic criteria for FBSD are typical biliary pain, elevated liver enzymes, or dilated bile duct, but not both and absence of stones or other structural abnormalities in the bile duct. Normal amylase/lipase and abnormal manometry results (basal pressure >40 mm Hg) are included in the supportive criteria.

## Functional Pancreatic Sphincter Disorder

Dysfunction of the pancreatic sphincter can cause pancreatitis such as pain. Diagnostic criteria for functional

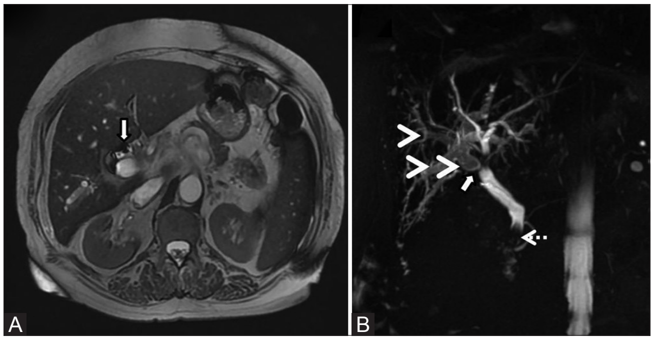


**Figure 17 (A and B):** 44-year-old female presenting with complaints of fever, abdominal pain post laparoscopic cholecystectomy. (A) Axial FIESTA MR Image showing metallic susceptibility artefact (arrow) suggestive of inadverent right hepatic duct ligation (B) Coronal 3-dimensional MRCP image showing non-visualization of confluence of right hepatic duct (arrow) suggestive of stricture and resultant upstream dilatation of right lobar intrahepatic bile ducts with T2 hypointense internal contents (arrowheads) due to cholangitis. Aerobilia noted in distal common bile duct (dashed arrow)

pancreatic sphincter disorder are documented recurrent episodes of pancreatitis (typical pain with amylase or lipase >3 times normal and/or imaging evidence of acute pancreatitis) after other causes of pancreatitis have been excluded, negative endoscopic ultrasound for any organic cause, and elevated pancreatic pressures on manometry. This disorder may be either caused by SOD or chronic pancreatitis induced cicatricial papillary stenosis.[42,43]

## Vascular Complications

Bleeding complications are subset of nonbiliary injuries in post-cholecystectomy patients. Vascular injuries are the most devastating, occurring almost exclusively during the creation of pneumoperitoneum or during dissection within the Calot's triangle. These are classified into major or minor vessel injuries. Major vascular injury is said to occur when there is injury to the aorta, vena cava, iliac vessels, right hepatic artery, cystic artery, or the portal vein seen in 0.04–0.18% of the patients; minor vascular injuries occur as a result of injury to the epigastric, mesenteric, and omental vessels.[44-47] Life-threatening bleeding can occur from the gallbladder bed without obvious major vessel injury due to various causes viz. surgical factors (improper instruments, defective training, rough technique, etc.) and patient- related (cirrhosis, portal hypertension, coagulopathy, adhesions, etc.). Hepatic artery pseudoaneurysm formation has also been described after laparoscopic cholecystectomy and may be due to bile leak and subsequent infection.[48] On CT, pseudoaneurysm is seen as a hematoma or as a hyperattenuating contrast-enhanced smooth-walled sac adjacent to an artery, usually with a communication.

Mesenteric/intestinal ischemia is a rare complication following laparoscopic cholecystectomy. Splanchnic hypoperfusion is a cause of intestinal ischemia following


**Figure 18:** 61-year-old female 7 months post open cholecystectomy with complaints of biliary colic evaluated for SOD. Coronal 3-dimensional MRCP image showing dilated common bile duct (arrow) due to elevated basal pressure within the CBD. Also note is made of normal cystic duct stump (dashed arrow)

laparoscopic surgeries. On CT, depending on the time course and etiology, various imaging findings such as vascular thrombosis, pneumatosis intestinalis, gas in the portal or mesenteric vein, pneumoperitoneum, submucosal haemorrhage, or free fluid is seen [Figure 19]. As laparoscopic procedure requires the creation of a pneumoperitoneum via insufflation of carbon dioxide, increased intraabdominal pressure leads to decreased blood flow through the splanchnic vessels with relative hypoperfusion of the celiac, superior mesenteric, and renal arteries despite normal blood pressure. Other risk factors are advanced age, atherosclerosis, low cardiac output states, cardiac arrhythmias, severe cardiac valvular disease, administration of medications known to reduce intestinal perfusion (such as diuretics, digoxin, alpha-adrenergic agonists), various forms of shock, septicemia, dehydration, hypotension, and others.[49,50]

## Dropped Gallstones

Spillage of gallstones is a relatively common complication after laparoscopic cholecystectomy that may occur in 25–30% of the cases.[51,52] The complication presents months to years after the procedure and is a difficult diagnosis unless a detailed history is elicited. Although dropped gallstones in the peritoneal and extraperitoneal cavity are usually asymptomatic, they may lead to abscess formation with an estimated incidence of approximately

0.3%.[53] Common locations of the abscess are abdominal wall, subhepatic, or retroperitoneum inferior to the subhepatic space.[53] On imaging, dropped gallstones are seen as hyperdense structures with or without surrounding abscess or inflammation [Figure 20]. Dropped gallstones can present with abscess, empyema,[54-56] broncholith,[57]

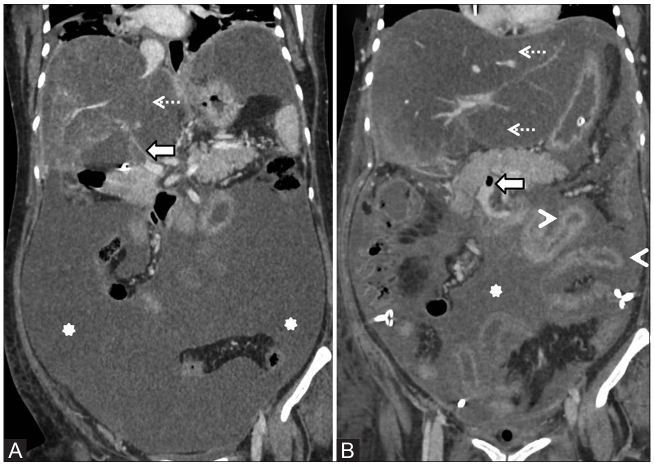


**Figure 19 (A and B):** 31-year-old male presenting with abdominal distension 3 days post cholecystectomy. (A) Coronal contrast-enhanced CT image showing cholecystectomy clips and portal vein thrombosis (arrow) with reduced enhancement of liver (dashed arrow) suggestive of hypoperfusion/ischemic injury to the liver. Note is made of gross ascites (asterix) due to liver decompensation. (B) Coronal contrast-enhanced CT image showing air (arrow) in superior mesenteric vein with thickening of jejunal loops suggestive of bowel ischemia (arrowheads)

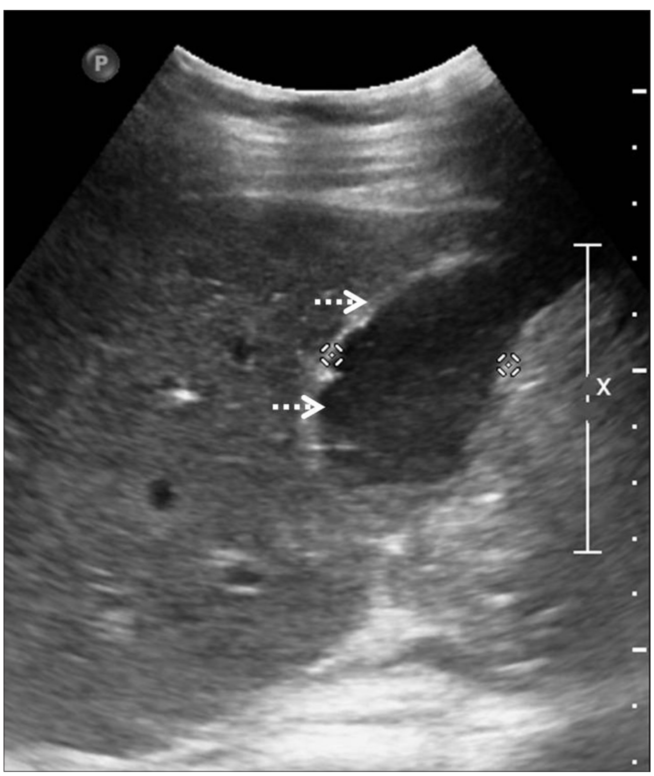


**Figure 21:** 41-year-old female presenting with fever post laparoscopic cholecystectomy. Ultrasound image showing collection (dashed arrows) with fine internal echoes in gallbladder fossa

expectoration of stones,[58,59] ileus, intestinal obstruction, and incarcerated hernia.

## Other Complications

Other complications that can be encountered in post-laparoscopic cholecystectomy are fluid collections in the postoperative period, abscess formation in the gallbladder fossa bed, liver abscess, hematoma, bilomas, seromas, ileus, duodenal perforation, etc., [Figures 21-24]. Post-cholecystectomy patients have increased incidence of duodenogastric reflux and higher concentration of bile acid in gastric juice, which may cause esophagitis and atrophic gastritis in these patients.[60] Previous studies have shown that the incidence of colonic tumors is higher in cholecystectomized patients compared to noncholecystectomized patients.[61,62] Intestinal adhesions

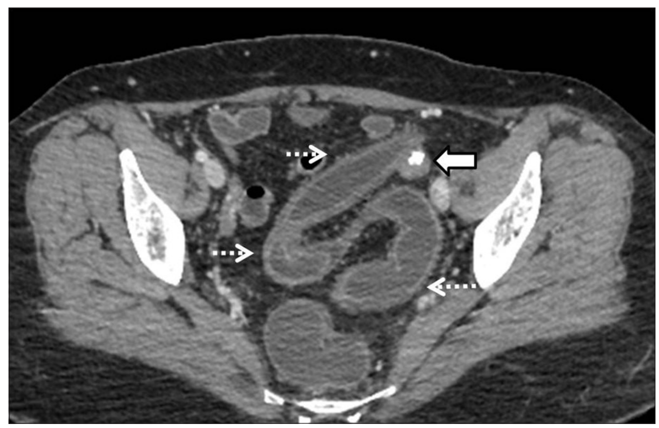

**Figure 20:** Axial contrast-enhanced CT showing calcified density (arrow) with soft-tissue surrounding it suggestive of dropped gallstone with granuloma formation. Also changes of inflammatory bowel disease are seen (dashed arrows)

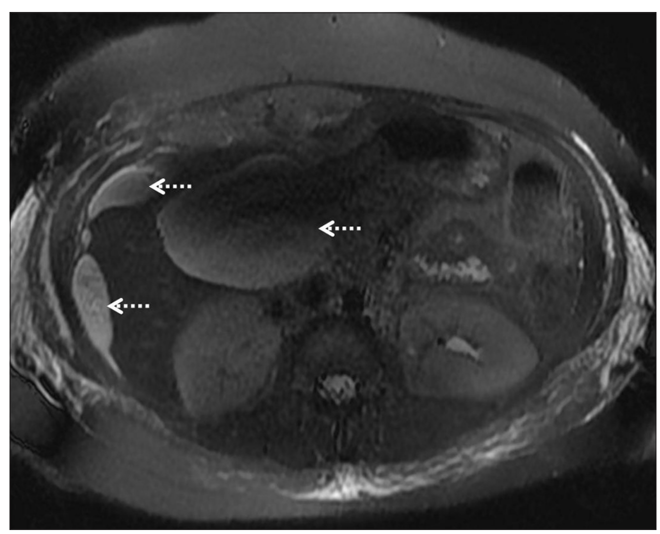

**Figure 22:** 37-year-old male presenting with complaints of fever and abdominal pain 3 weeks post cholecystectomy. Axial T2-weighted MR images showing intrahepatic and subhepatic T2-hyperintense fluid collections (dashed arrows) suggestive of bilomas

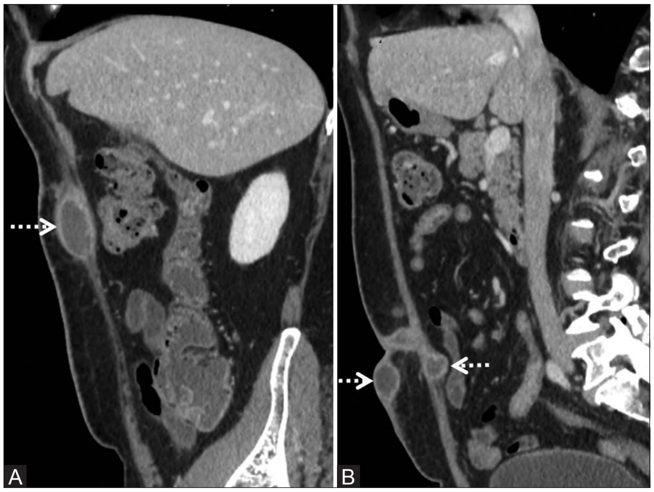


**Figure 23 (A and B):** Sagittal CECT images showing collections (dashed arrows) along the Trocar site

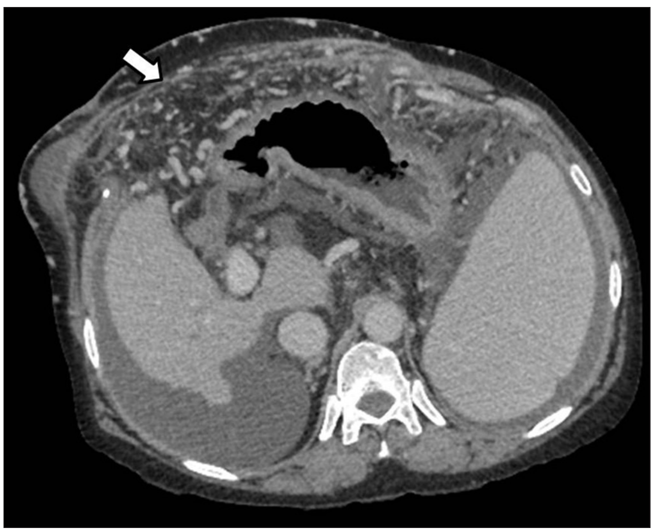

**Figure 25:** Axial CECT image showing post cholecystectomy lateral abdominal wall incisional hernia (arrow). Note is made of changes of chronic liver disease with portal hypertension

and scars in the choledochal region are clinically significant and relatively common causes of abdominal complaints following cholecystectomy.[63]

The incidence of incisional hernia occurring at the port sites after laparoscopic surgery lies between 0.02 and 3.6%[64] [Figure 25]. The hernia that follow laparoscopy usually occurs through the larger ports (size greater than 10 mm), especially the umbilicus.[65] Intercostal neuroma pain due to injury to the intercostal nerves has also been described, which may be misinterpretated as gastrointestinal pain, and the patient may be subjected to unnecessary radiological evaluation.[66] Functional gastrointestinal disorder includes dyspepsia, and irritable bowel syndrome can persist or coexist in patients with gallstone disease post-cholecystectomy; and approximately 10% of the patients may not have experience relief of

**Figure 24:** Axial CECT image showing extravasation of oral contrast (dashed arrow) with pneumoretroperitoneum (arrow) in a case of duodenal perforation post laparoscopic cholecystectomy

symptoms or even get worse after surgery.[67,68] There is an association between cholecystectomy and subsequent risk of depressive disorder among females.[69] Moreover, patients with high trait anxiety are less likely to benefit from surgery and may complain of persistence of symptoms.[70] Imaging does not reveal any abnormality in such patients. Recently, an association has been proposed between various liver diseases and cholecystectomy patients.[71] Nonalcoholic fatty liver disease, cholestasis, fibrosis, and cirrhosis may be more commonly seen post-cholecystectomy, particularly in patients with short bowel and intestinal failure due to increased accumulation of triglycerides and toxins in the liver.[72]

Post-cholecystectomy syndrome (PCS) is defined as the persistence or recurrence of symptoms attributed to gallbladder pathology after cholecystectomy. PCS encompasses all entities that result from removal of reservoir function of gallbladder (e.g., esophagitis, gastritis, and diarrhea) as well as anatomic abnormalities detected post surgery. Virtually, any of the causes listed above in Table 1 can contribute to PCS.

## Conclusion

Although the complication rates of laparoscopic cholecystectomy are low, knowledge of various complications associated with this procedure would be a boon for the radiologist. A multidisciplinary team approach is required for early diagnosis of various complications so that timely intervention and management can be provided.

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## Conflicts of interest

There are no conflicts of interest.

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