X-ray Corner

Imaging of the Biliary System

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Modern imaging modalities used in biliary system include ultrasound (US), CT, and MRI. US is usually the first imaging modality performed when biliary abnormality is suspected. This is because US is sensitive for visualization of dilated intrahepatic bile ducts, as well as non-opacified stones. Although sensitive, US has a blind spot around the distal CBD because of obscuration by bowel gas. CT or MRI is usually needed to investigate and confirm findings initially detected by US. A combination of MRI and MRCP allows visualization of both upper abdomen and biliary system. MRCP is mostly replaced ERCP for diagnostic purpose because of its high safety, high accuracy, and lacking radiation. ERCP is usually reserved for interventional purpose.

In this article, several biliary abnormalities will be demonstrated, using case-based approach, and emphasizing on imaging findings.

Case 1. A 56-year-old woman presenting with RUQ pain.

US shows an echogenic lesion with posterior acoustic shadow. D/Dx includes gallstone, calcified wall of the GB (porcelain GB), and emphysematous GB. CT is performed and shows dense calcification of the wall of the GB, consistent with a porcelain GB.

Porcelain gallbladder refers to extensive calcium encrustation of the gallbladder wall. Patients are usually asymptomatic and porcelain GB is incidentally found at plain radiograph, US, or CT. Earlier studies suggest high correlation between porcelain GB and GB carcinoma, approximately 22-30%, and cholecystectomy is usually performed[1]. However, most recent studies show the association is much lower, around 5-7%[2]. Annual incidence of developing gallbladder cancer is likely to be <1% per year, and CT follow-up is likely unhelpful[2].

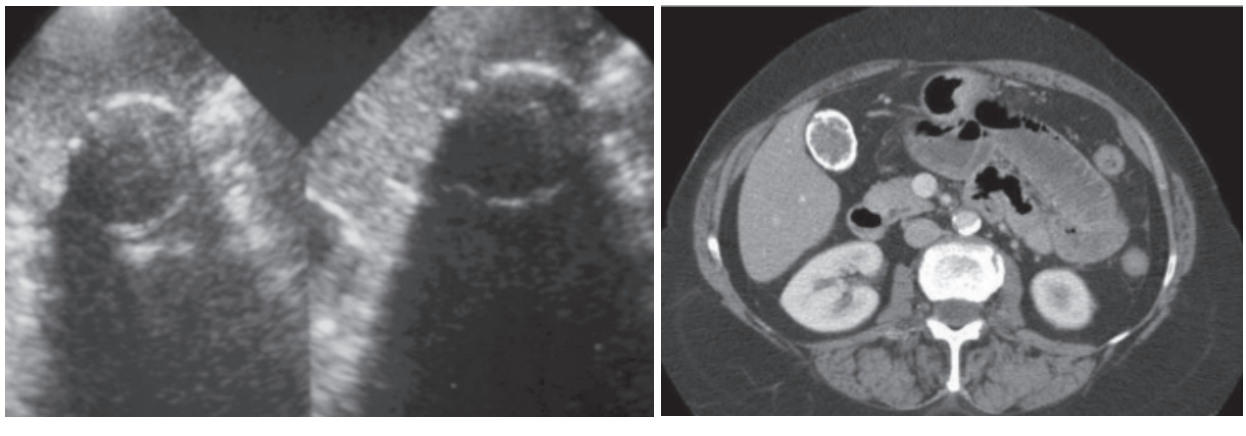

Figure 1. Case 1.

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Case 2. A 75-year-old man presenting with RUQ pain.

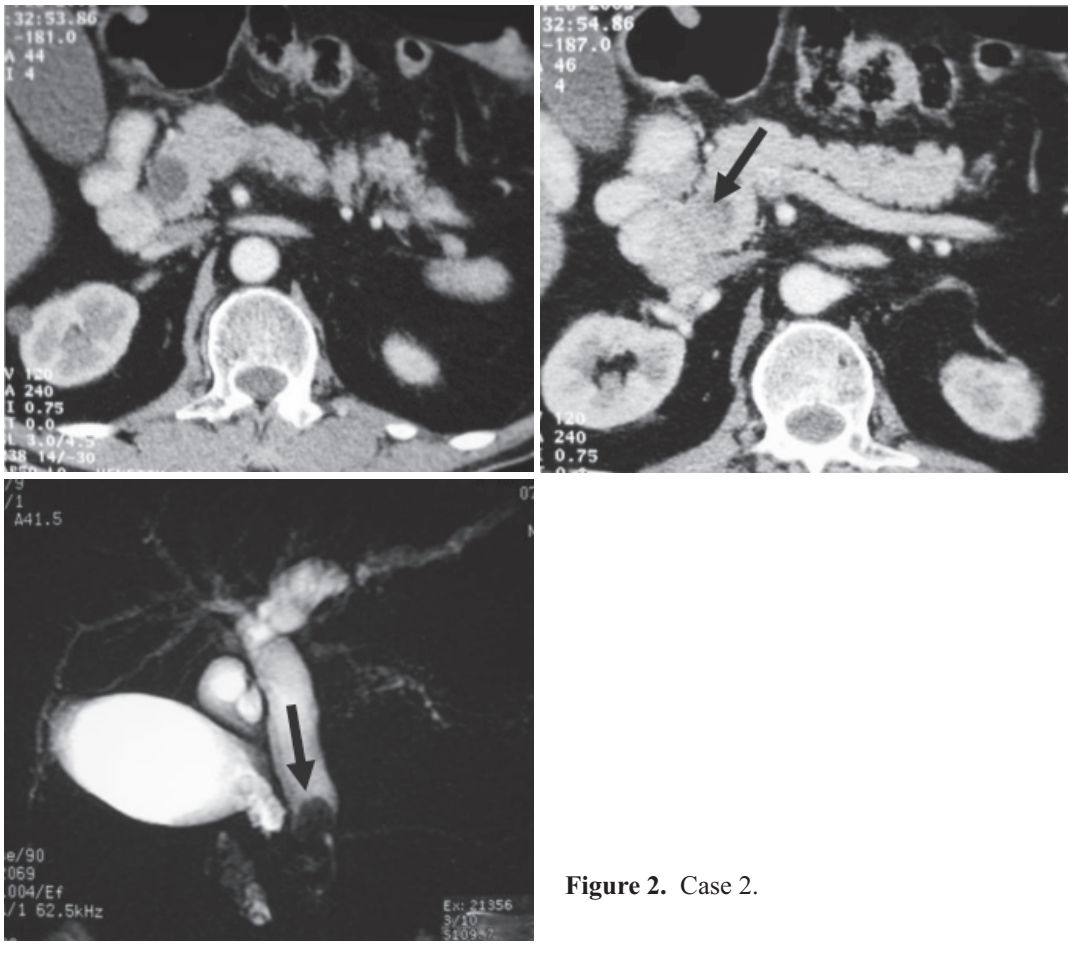

Figure 2. Case 2.

CT shows dilated CBD with intraluminal hyperdense lesion (arrow). D/Dx includes stone, blood clot, and neoplasm. MRCP reveals a well-defined, oval-shaped, signal void filling defect at the distal end of the CBD, consistent with CBD stone (arrow). The stone causes obstruction and moderate dilatation of the proximal CBD. ERCP with stone removal is successfully performed.

Choledocholithiasis (bile duct stone) is relatively common, seen in 6-12% of patients who undergo cholecystectomy[3]. Patients may present with biliary colic, ascending cholangitis, obstructive jaundice, or acute pancreatitis. Stones within the bile duct may form either in situ or pass from the gallbladder.

MRCP has largely replaced ERCP as the gold standard for diagnosis of choledocholithiasis. Both MRCP and ERCP achieve similar high sensitivity and specificity, but MRCP has an advantage of no ionizing radiation, no intravenous contrast, and no complication inherent in ERCP[4].

Case 3. A 48-year-old woman, presenting with abdominal pain, fever, and jaundice.

Plain CT shows calcification at the porta hepatis (arrow), associated with mild intrahepatic duct dilatation. D/Dx includes stones within CHD/CBD or cystic duct stone compressing the adjacent CHD (Mirizzi syndrome). ERCP reveals a stone with in the cystic duct (arrow), compressing the CHD at its insertion. Final diagnosis is Mirizzi syndrome.

The Mirizzi syndrome was initially described by

Pablo Luis Mirizzi (1893-1964), an Argentinian surgeon, in 1948[5]. It is an uncommon phenomenon secondary to extrinsic compression of extrahepatic bile duct from stone within the cystic duct or gallbladder. Fistula may develop between the gallbladder and the common duct, and the stone may pass into the common duct. A low insertion of the cystic duct is thought to be a risk factor.

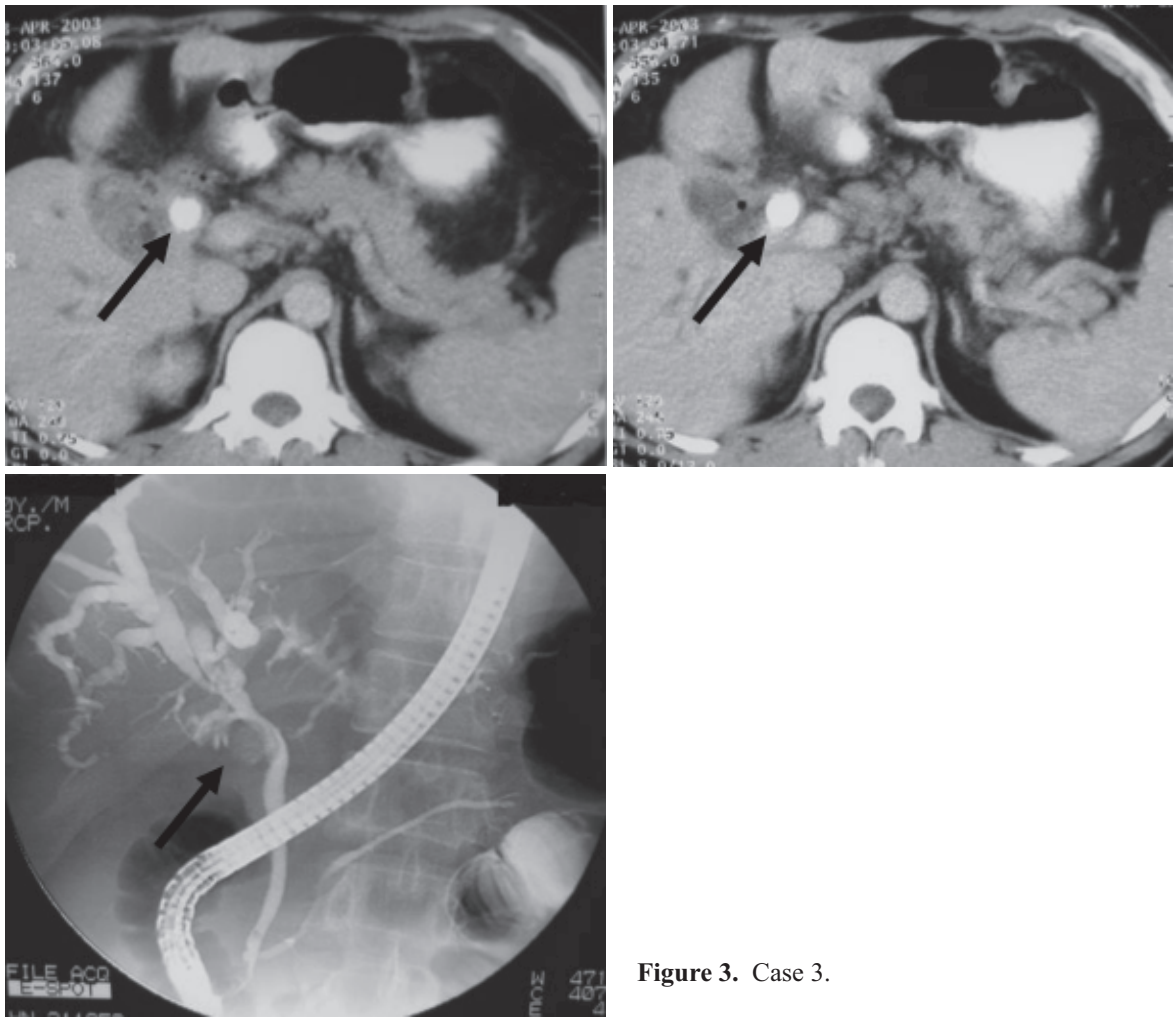

Figure 3. Case 3.

Case 4: A 40-year-old woman presenting with abdominal pain and fever.

US reveals diffuse thickened wall of the GB showing striation pattern. A gallstone is noted at the GB neck (arrow). Striation pattern suggests friable and sloughed-off mucosa, indicative of gangrenous cholecystitis.

Gangrenous cholecystitis is an acute surgical emergency, which requires early cholecystectomy. Increased intraluminal pressure may cause gallbladder wall ischemia and necrosis, resulting in gangrenous cholecystitis. Perforation is more common than in uncomplicated cholecystitis, leading to increased morbidity and mortality. Murphy sign may be negative in up to 66% of cases[6], probably because of denervation of the gallbladder wall by gangrenous changes.

Gall bladder wall thickening with signs of delamination (striation pattern), gas within the GB, and decreased wall perfusion at color Doppler are important signs at US. At CT, findings with high specificity for gangrenous cholecystitis are gas in the wall or lumen, intraluminal membranes, irregular or absent wall, and abscess[7].

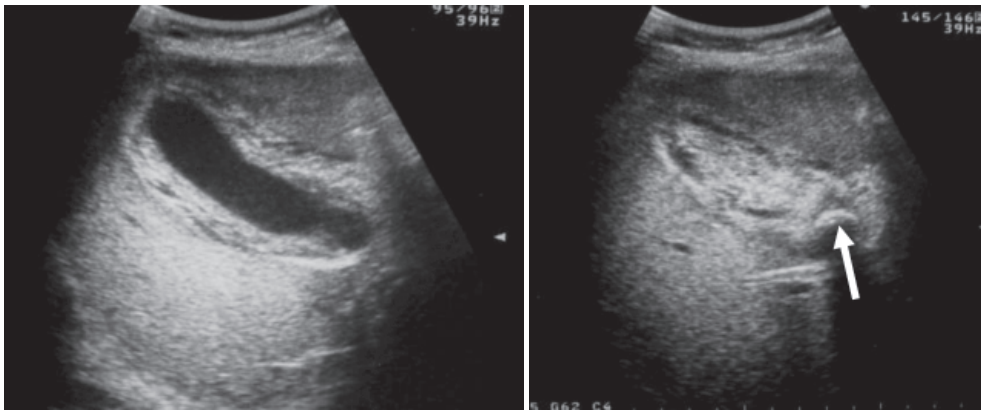

Figure 4. Case 4.

Case 5. A 64-year-old man presenting with abdominal pain and jaundice.

CT shows a large, low-density mass at right hepatic lobe, assoicated with capsular retraction and mild intrahepatic duct dilatation. GB and CBD are mildly dilated, probably secondary to compression by multiple lymphadenopathy at the para-aortic region (arrows). Findings are favorable for malignant neoplasm, particularly mass-forming cholangiocarcinoma. Biopsy shows adenocarcinoma and CA 19-9 is markedly increased, confirming the diagnosis of cholangiocarcinoma (CHCA).

Cholangiocarcinoma is a malignant tumour arising from cholangiocytes in the biliary tree. It tends to have a poor prognosis and high morbidity. Liver flukes and hepatolithiasis are common risk factors in eastern Asia, whereas PSC, liver cirrhosis, alcohol-related liver disease, and diabetes are relatively common risk factors in Western countries

CHCA can be either intra or extrahepatic. They are also classified according to macroscopic growth pattern as mass-forming, periductal infiltrating, and intraductal types[8]. Currently, biliary intraepithelial neoplasia (BilIN) and intraductal papillary mucinous neoplasm of bile duct (IPMN-B) are believed to be a precursor of CHCA[8].

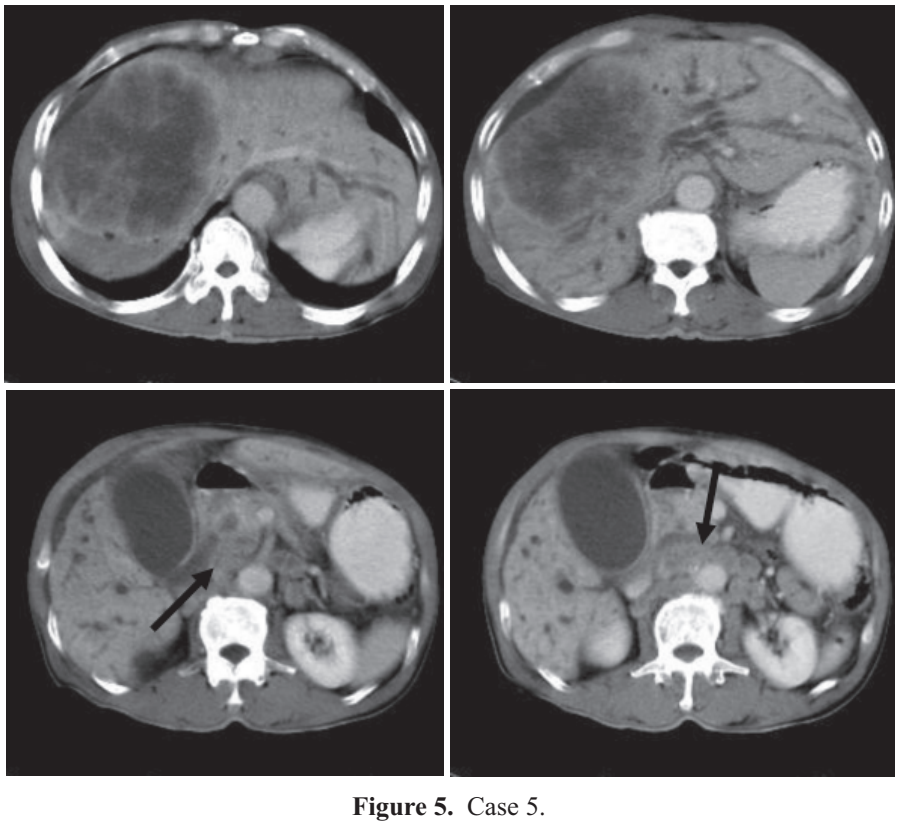

Figure 5. Case 5.

Case 6. A 75-year-old woman presenting with abdominal pain.

US shows an intraluminal polypoid mass of the GB. D/Dx includes sludge ball, GB cancer, and GB metastasis. Color Doppler reveals highly vascular mass, therefore, able to exclude sludge ball. CT scan confirms a highly vascular mass within the GB (arrows). Additional CT finding of absent right kidney gives rise to possibility of right nephrectomy from renal cell cancer. Further history exploration confirms the diagnosis of renal cell carcinoma. Cholecystectomy is performed and the mass is proved to be metastatic GB from primary renal cell carcinoma.

Renal cell carcinoma is well known for its propensity to metastasize to unusual places. However, metastasis to the GB is rare, found in less than 0.6% in autopsy series[9]. Hallmark of renal cell carcinoma is hypervascularity, which usually visualized in metastatic sites as well. Metastases to the GB accounted for 4.8% of all GB malignancies[10]. Malignant melanoma and renal cell carcinoma are the two most common primary tumors. However, primary cancer from GI tract has also been reported[10].

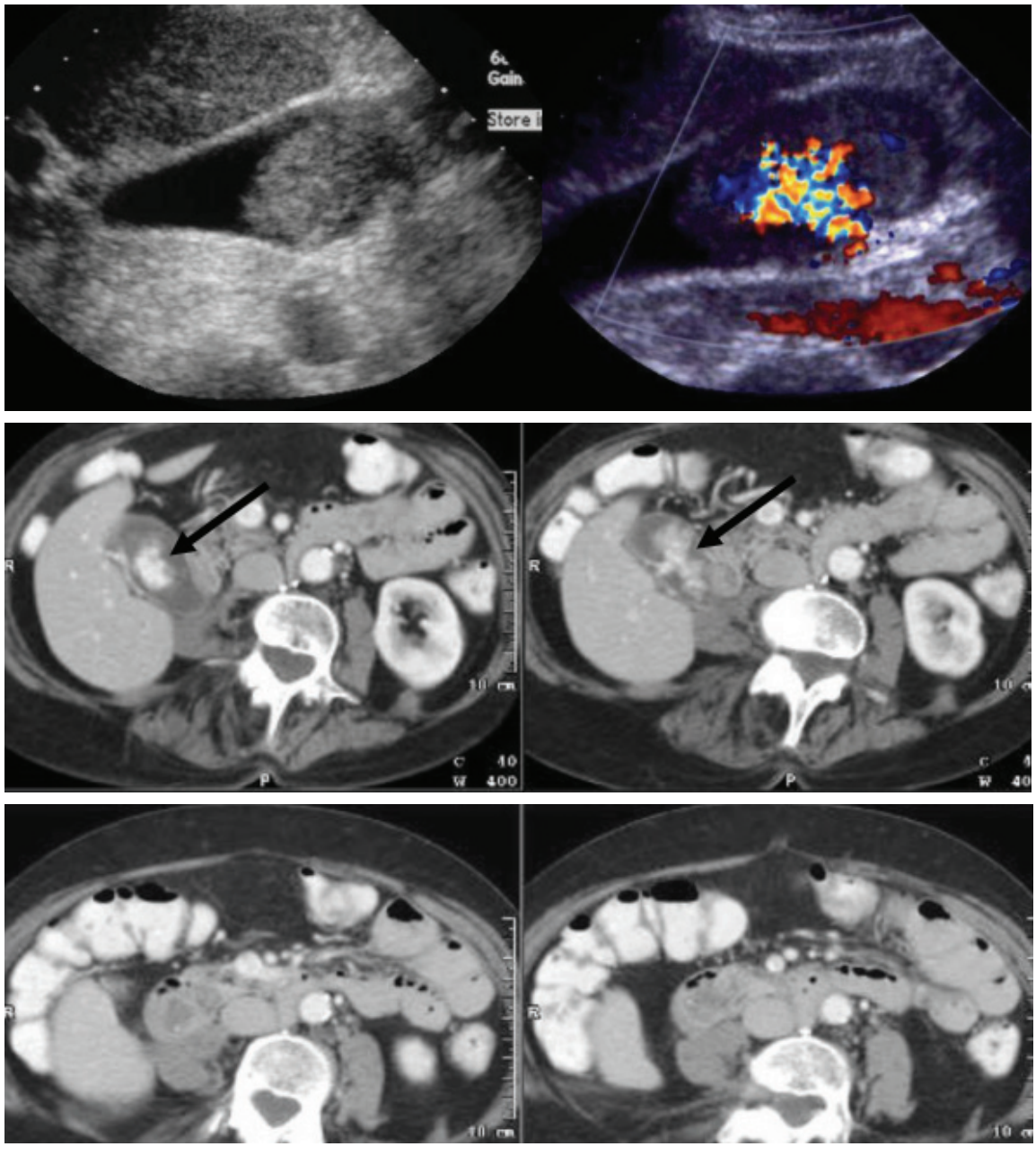

Figure 6. Case 6.

Case 7. A 48-year-old woman presenting with abdominal discomfort.

Plain scout view of the abdomen shows a large intra-abdominal mass, displacing bowel loops inferiorly. CT scans reveals a large cystic mass of the liver showing fine internal septation. D/Dx includes simple cyst with complication and biliary cystadenoma. Given the additional findings of obstruction and mild dilatation of the upstream intrahepatic bile ducts, as well as no other co-existing cysts, this mass are favorable for biliary cystadenoma.

Biliary cystadenoma and biliary cystadenocarcinoma are rare neoplasms of the liver and constitute less than 5% of intrahepatic cysts of biliary origin[11]. Many pathologists believe that all biliary cystadenomas are premalignant. However, tumors with ovarian stroma below epithelial lining have a better prognosis than tumors without ovarian stroma[12]. Although imaging features cannot reliable distinguish biliary cystadenoma from biliary cystadenocarcinoma, thick internal septation and nodularity favors cystadenocarcinoma, whereas fine septation without nodularity favors cystadenoma[13].

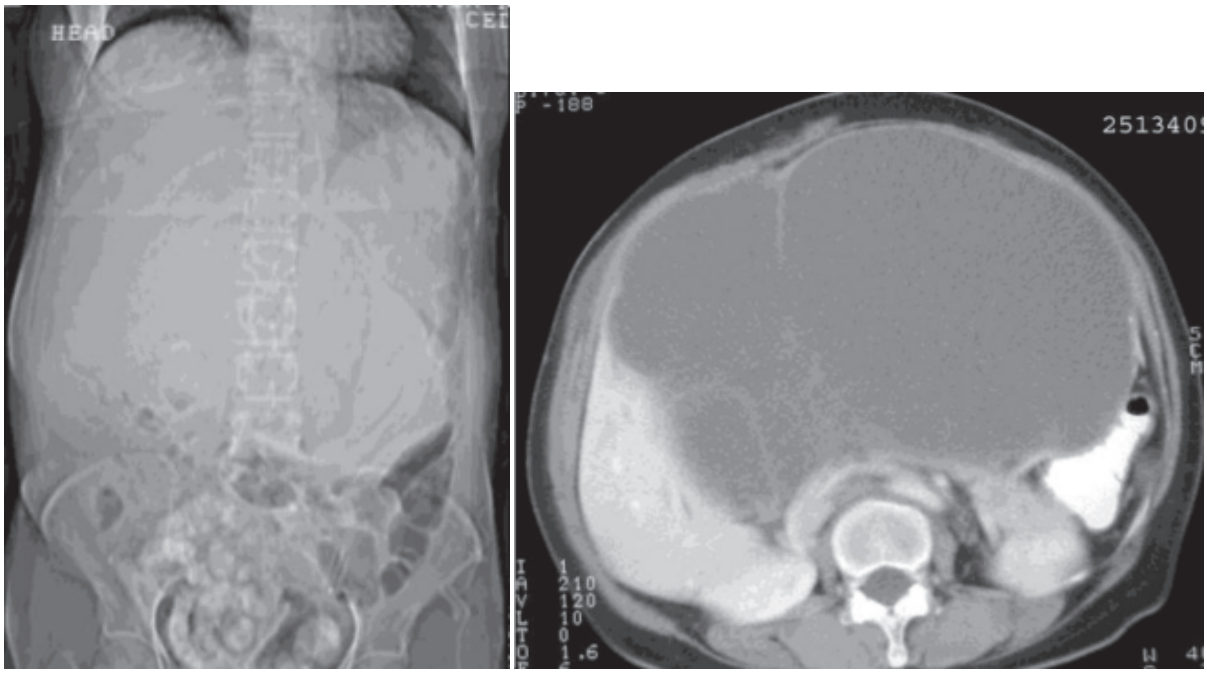

Figure 7. Case 7.

Case 8. A 52-year-old man presenting with abdominal pain and jaundice.

Coronal view of CT and MRI shows diffuse dilatation of the intra- and extra-hepatic bile ducts, predominantly on the left side. A large intraluminal polypoid mass within the left intrahepatic duct is observed (arrows). Given massive dilatation of the left bile duct, and minimal dilatation of the rest of the biliary system, intraductal papillary mucinous neoplasm of the bile duct (IPMN-B) is suggested.

Intraductal papillary mucinous neoplasms of the bile ducts secrete a large amount of mucin, which results in intermittent obstruction of the biliary tree. When generalized biliary dilatation is accompanied by disproportionately more severe or aneurysmal dilatation of the segmental branch, excessive mucin production should be considered. US, CT, and MR images should be carefully scrutinized for evidence of mucin-producing papillary tumor in the dilated bile ducts, especially in the disproportionately more dilated part of the biliary tree[14].

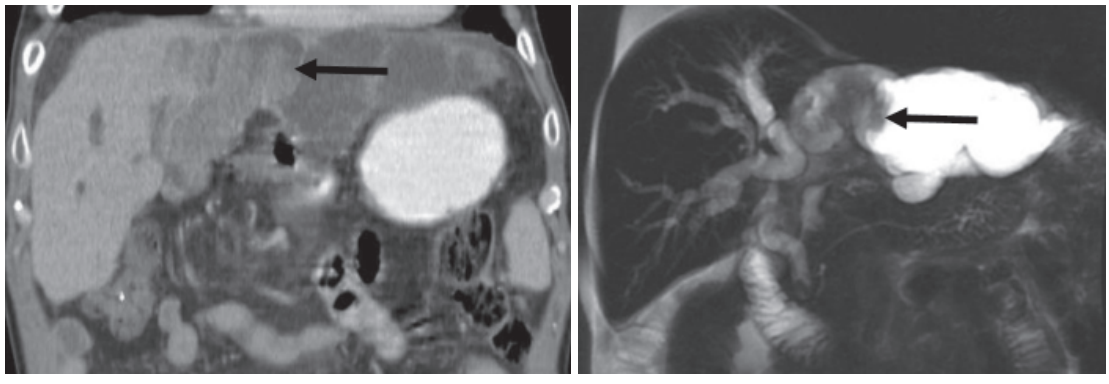

Figure 8. Case 8.

Conclusions

Eight cases of biliary diseases are illustrated, emphasizing on the imaging appearances. These cases are as following:

1. Neoplastic pathology:
   a. Intraductal papillary mucinous neoplasm of bile duct (IPMN-B)
   b. Biliary cystadenoma
   c. Mass-forming type of CHCA
   d. GB metastasis, primary renal cell carcinoma
2. Infectious/inflammatory pathology:
   a. Gangrenous cholecystitis
3. Miscellaneous
   a. Porcelain GB
   b. CBD stone
   c. Mirizzi syndrome

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