Low insertion of a cystic duct into the common bile duct as a cause for a malpositioned biliary stent: demonstration with multidetector computed tomography

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ABSTRACT

Anatomical variations of the extrahepatic biliary system are common. Adequate knowledge of such variations and an appropriate roadmap before any surgical, endoscopic or percutaneous procedure/intervention help in preventing associated complications. Multiple imaging modalities can depict the anatomy of the extrahepatic biliary tree. High resolution magnetic resonance imaging and magnetic resonance cholangiopancreatography are increasingly used to delineate the hepatobiliary system. Multidetector computed tomography allows for high-speed volume scanning with an excellent spatial and temporal resolution. It also allows for multiplanar reconstructions in virtually any plane, with isotropic resolution. We describe an unusual complication of biliary stenting in a 62-year-old man with low insertion of a cystic duct, resulting in the inadvertent placement of the common bile duct stent into the cystic duct. This was demonstrated well by multidetector computed tomography and confirmed thereafter, during surgery.

Keywords: biliary anatomical variants, cystic duct lesions, low insertion of cystic duct, malpositioned biliary stent, multidetector computed tomography

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INTRODUCTION

Anatomical variants of the intra- or extrahepatic bile ducts may cause confusion on imaging studies. A thorough knowledge of the exact configuration of the extrahepatic bile duct is essential to avoid complications during hepatobiliary surgical, endoscopic and percutaneous procedures. Besides iatrogenic trauma to the bile ducts, patients are also prone to complications such as the formation of bile duct stones, recurrent pancreatitis, cholangitis and biliary malignancies. Anatomical variation of the cystic duct is not uncommon and occurs in 18%–23% of cases. The cystic duct can have a variable length, course and site of insertion with the common bile duct. In approximately 9%–11% of cases, the cystic duct joins the common bile duct (CBD) in its distal third.[1-3] We report an unusual complication of biliary stenting in a patient with obstructive jaundice, where the low insertion of the cystic duct resulted in the inadvertent placement of the stent within the cystic duct instead of the CBD. We also highlight the role of multidetector computed tomography (MDCT) with orthogonal and non-orthogonal multiplanar reconstructions in the evaluation of such cases.

CASE REPORT

A 62-year-old man presented with acute onset pain in the right upper quadrant of the abdomen, fever with chills, pruritus, a yellowish discolouration of the conjunctiva and clay-coloured stools for five days. At the time of the hospital admission, he looked toxic and was in a poor general condition. He had clinical, haematological and biochemical features suggestive of septicaemia, with deranged hepatic and renal functions (total leucocyte count 19,500/mm^3 with 80% polymorphs; total bilirubin 11.3 mg/dL with direct fraction of 08 mg; serum glutamic oxaloacetic transaminase 610 IU; serum glutamic pyruvic transaminase 794 IU; serum albumin/globulin 3.62/2.38; blood urea 128 mg/dL; serum creatinine 3.9 mg/dL). Bedside ultrasonography (US) of the abdomen revealed dilated intrahepatic biliary radicles with the presence of pneumobilia. A small 1.5-cm hypoechoic lesion was noted in the right lobe of the liver, suggestive of an abscess. The gallbladder and the common bile duct did not reveal any obvious abnormality. At endoscopic retrograde cholangiopancreatography (ERCP), the

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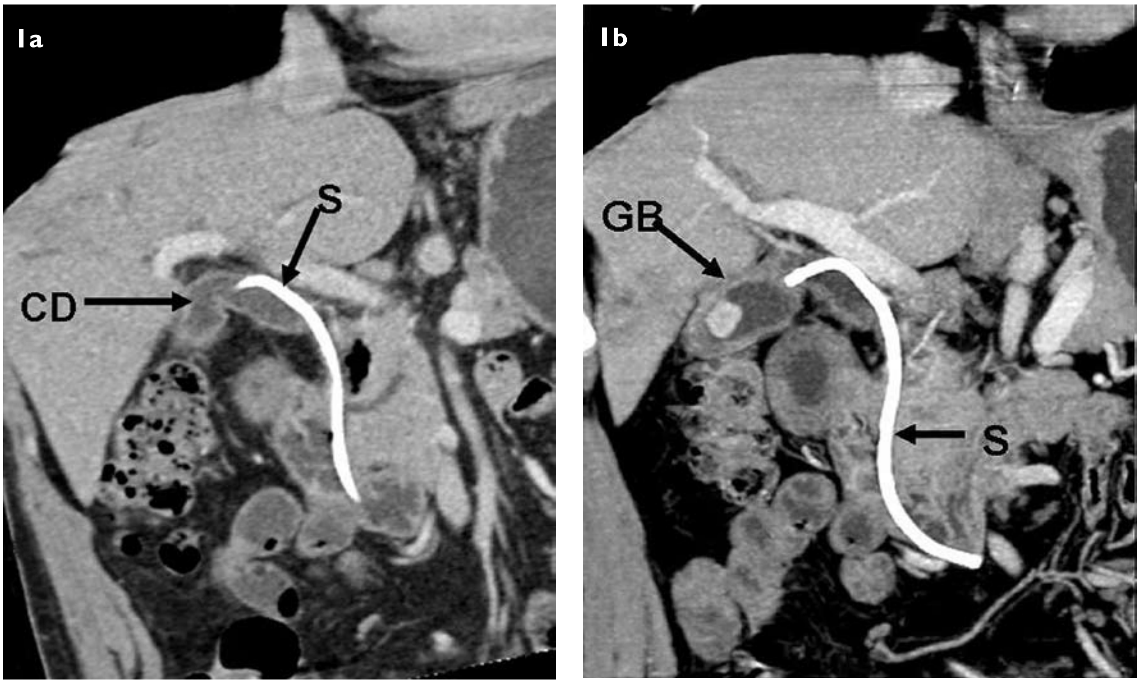

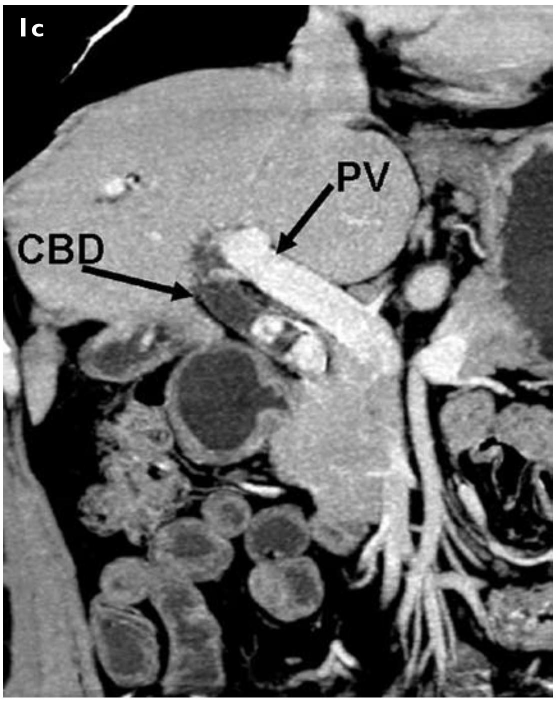

Fig. 1 Contrast-enhanced MDCT images of the hepatobiliary system taken in the portal venous phase. Coronal oblique reconstructions show: (a & b) the stent within the dilated cystic duct. Note that the superior end of the stent points towards the GB neck, with the inferior end in the third part of the duodenum; (c) the dilated CBD containing two radiopaque calculi.
CD: cystic duct; S: stent; GB: gallbladder; CBD: common bile duct; PV: portal vein

CBD was found to be obstructed, and the bile mixed with pus was drained from the CBD. A 7F plastic stent was introduced to facilitate further drainage of the infected bile. There was no obvious abnormality of the pancreatobiliary junction, and the ampulla was normal on endoscopy. Meanwhile, the patient was placed on supportive therapy along with broad-spectrum antibiotics.

The patient showed a gradual improvement in his general condition, as well as in his hepatic and renal function over two weeks, and was discharged from the hospital. At review in the surgical outpatient department, he complained of mild right hypochondrium pain, low-grade fever and decreased appetite. A review US showed a biliary stent *in situ*, with extensive pneumobilia and multiple small hypoechoic lesions in the liver, suggestive of pyaemic abscesses. A magnetic resonance cholangiopancreatography (MRCP) study confirmed the presence of pneumobilia and multiple small (2–3 cm) abscesses in both lobes of the liver. Detailed evaluation of the extrahepatic biliary system, including CBD by magnetic resonance (MR) imaging, was limited due to the presence of pneumobilia, stent *in situ* and poor breath-hold by the patient. Hence, CT of the abdomen was carried out.

After oral ingestion of water, an unenhanced, followed by a contrast-enhanced study (slice thickness 2 mm; collimation 0.75; mA 500; kV 120) was carried out using a 16-slice MDCT (Somatom Sensation 16, Siemens, Forchheim, Germany). Besides studying the axial slices, coronal and coronal oblique multiplanar reconstructions were carried out from the volume datasets. CT showed the superior end of the biliary stent within the cystic duct reaching almost up to the gallbladder (GB) neck (Figs. 1 & 2). The stent was

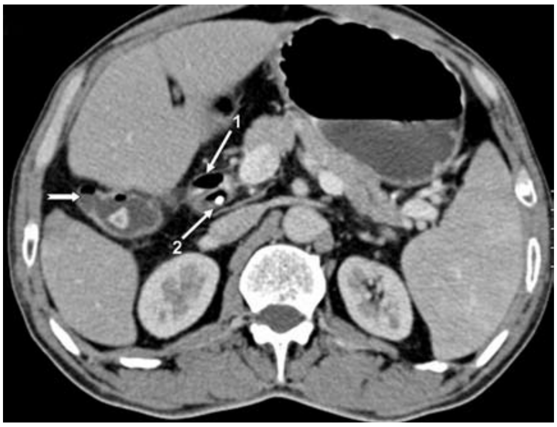

Fig. 2 Contrast-enhanced axial MDCT image of the hepatobiliary system taken in the portal venous phase, at the immediate suprapancreatic plane shows a dilated CBD with pneumobilia, and a dilated cystic duct containing the stent within as well as the presence of pneumobilia. The cystic duct is seen lying posterior to the CBD. Note the GB with a calculus and pockets of gas within (arrows).

seen to be separate from the CBD throughout its course except in the inferior-most aspect, where it was seen to enter the CBD. In its inferior half, the stent was seen to be lying posterior and parallel to the CBD, with the distal end of the stent located in the third part of the duodenum. Based on these findings, it was concluded that the biliary stent was possibly positioned within the cystic duct, having had a low insertion into the CBD. There was evidence of pneumobilia with air within the intrahepatic as well as extrahepatic biliary ductal systems, including the CBD and the cystic duct. Multiple calculi were noted within the dilated CBD and a solitary calculus was seen at the GB neck.

The patient underwent cholecystectomy and surgical exploration of the CBD along with the extraction of the CBD stones. At surgery, the position of the stent within the cystic duct was confirmed. The cystic duct was elongated, and followed a parallel course in its distal aspect to join the CBD in the immediate suprapancreatic region. The patient showed progressive improvement in the postoperative period and was discharged at the end of three weeks. He was doing well on follow-up after surgery.

DISCUSSION

Anatomical variations of the intra- or extrahepatic bile ducts are common. The commonest anatomical variations of the cystic duct relate to its site and level of insertion. Normally, the cystic duct joins the CBD from a right lateral position approximately halfway between the porta hepatis and the ampulla of Vater. Alternately, the cystic duct can have: (a) anterior spiral insertion, (b) posterior spiral insertion, (c) low lateral insertion, (d) proximal insertion, or (e) low medial insertion. Instead of the CBD, the cystic duct may join the right hepatic duct, left hepatic duct or common hepatic duct. The cystic duct may also join low in the intrapancreatic, intraduodenal CBD or at the ampulla of Vater. Rarely does the cystic duct insert into the duodenum.[2] In addition, it is rare for a double cystic duct to be encountered as an incidental finding during ERCP or laparoscopic surgery.[4,5] In an era of ever-increasing laparoscopic, endoscopic and percutaneous surgical/interventional procedures of the hepatobiliary system, it is extremely important to have adequate knowledge of such variations before the actual procedure is performed.[6,7] It could prevent many potential surgical complications due to unrecognised anatomical variations of the biliary tree.

The anatomy of the extrahepatic biliary tree can be depicted by multiple imaging modalities which include US, CT, infusion CT cholangiography, direct cholangiography (percutaneous transhepatic cholangiography, ERCP, T-tube and intraoperative cholangiography), in addition to MR imaging, MRCP and cholescintigraphy.[1,2,6,8] In the last decade, high resolution MR imaging and MRCP have gained increasing acceptance as a very accurate and non-invasive means of evaluating the extrahepatic biliary system. MRCP allows for the optimal visualisation of the extrahepatic biliary system in the coronal and coronal oblique planes. It is difficult to demonstrate the normal calibre cystic duct by US or conventional CT. The entire course of the cystic duct, including conjunction with the CBD, can be routinely delineated with MRCP.[2,3] Although MRCP is widely used in the evaluation of the extrahepatic biliary tree, several associated pitfalls may either simulate or mask pancreatobiliary disease. Hence, it is important to be familiar with such pitfalls of MRCP.[9] Respiratory motion artefacts, susceptibility artefacts due to endoprosthesis or pneumobilia, and limited spatial resolution are only a few of the well-known factors responsible for diagnostic confusion, as was well exemplified in our case.

The MDCT done later showed the anatomy of the biliary tree accurately. It was possible to follow the cystic duct from its origin to its insertion into the CBD, which thereby enabled us to consider the possibility of a low insertion of the cystic duct with biliary prosthesis within the cystic duct. The diagnosis of choledocholithiasis and cholecystolithiasis could be made easily with the MDCT. MDCT has the inherent advantages of high speed with greater Z-axis coverage, thinner collimation with sub-millimetre slice thickness, and acquisition of volume datasets allowing for multiplanar reconstructions in virtually any direction (orthogonal as well as non-orthogonal), with isotropic resolution. On a 16-slice or higher generation MDCT, the entire hepatobiliary system can be scanned in less than a breath-hold amount of time for most patients. Hirano et al found drip infusion CT cholangiography to be very useful and comparable to MRCP for the preoperative evaluation of the biliary tree in patients undergoing laparoscopic cholecystectomy.(10) The newer generation MDCT with improved software has great potential for the evaluation of the hepatobiliary system, and should be optimally utilised for this purpose.(11)

Our case highlights a rare complication of biliary stenting due to low insertion of the cystic duct, which was well-delineated and correctly diagnosed with MDCT. The diagnosis of cholelithiasis and choledocholithiasis in the presence of pneumobilia was also easily made with MDCT, in a patient whose MRCP study was technically limited due to the presence of pneumobilia and a biliary stent, compounded by respiratory motion artefacts. These limitations of the MRCP study require timely recognition, and the use of MDCT can be made in appropriate cases to increase diagnostic accuracy.

REFERENCES

1. Taourel P, Bret PM, Reinhold C, Barkun AN, Atri M. Anatomic variants of the biliary tree: diagnosis with MR cholangiopancreatography. Radiology 1996;199:521-7.
2. Turner MA, Fulcher AS. The cystic duct: normal anatomy and disease processes. Radiographics 2001; 21:3-22.
3. Tsitouridis I, Lazaraki G, Papastergiou C, Pagalos E, Germanidis G. Low conjunction of the cystic duct with the common bile duct: does it correlate with the formation of common bile duct stones? Surg Endosc 2007; 21:48-52.
4. Tsutsumi S, Hosouchi Y, Shimura T, et al. Double cystic duct detected by endoscopic retrograde cholangiopancreatography and confirmed by intraoperative cholangiography in laparoscopic cholecystectomy: a case report. Hepatogastroenterology 2000; 47:1266-8.
5. Shivhare R, Sikora SS. Double cystic duct: a rare biliary anomaly encountered at laparoscopic cholecystectomy. J Laparoendosc Adv Surg Tech A 2002; 12:391-2.
6. Ochiai T, Yamazaki S, Ohta K, et al. Is drip infusion cholecystocholangiography (DIC) an acceptable modality at cholecystectomy for cholecystolithiasis, considering the frequency of bile duct maljunction and intraoperative bile duct injury? J Hepatobiliary Pancreat Surg 2004; 11:135-9.
7. Ausch C, Hochwarter G, Taher M, et al. Improving the safety of laparoscopic cholecystectomy: the routine use of preoperative magnetic resonance cholangiography. Surg Endosc 2005; 19:574-80.
8. Hirao K, Miyazaki A, Fujimoto T, Isomoto I, Hayashi K. Evaluation of aberrant bile ducts before laparoscopic cholecystectomy: helical CT cholangiography versus MR cholangiography. Am J Roentgenol 2000; 175:713-20.
9. Irie H, Honda H, Kuroiwa T, et al. Pitfalls in MR cholangiopancreatographic interpretation. Radiographics 2001; 21:23-37.
10. Hirano Y, Tatsuzawa Y, Shimizu J, et al. Efficacy of multi-slice computed tomography cholangiography before laparoscopic cholecystectomy. ANZ J Surg 2006; 76:693-5.
11. Sata N, Endo K, Shimura K, Koizumi M, Nagai H. A new 3-D diagnosis strategy for duodenal malignant lesions using multidetector row CT, CT virtual duodenoscopy, duodenography, and 3-D multicholangiography. Abdom Imaging 2007; 32:66-72.