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Anatomical Variations Of Confluence Of Cystic Duct In Bulgarian Population: Diagnostic Opportunities Of Magnetic Resonance Imaging

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Introduction

Anatomical variations and anomalies of the biliary tract were found more often after expansion of ERCP and MRCP in clinical practice. They have been seen in up to 65% in autopsy and cholangiographic studies. The incidence of congenital anatomical variations of cystic duct was 18 - 23%. They created a number of difficulties during surgery to the biliary tree, as well as in instrumental extraction of gallstones from ampulla Vateri during the ERCP. Objective of this study was to establish the ability of MRCP to identify insertion of cystic duct (DCy), and determination of the frequency of different anatomical variations of its infusion into extrahepatic bile duct in patients with clinical signs of disease of the bile ducts and the pancreas.

Material and Methods

During the period from 13.4.2010 to 04.13.2013 were examined 351 patients with known or suspected diseases of the biliary tract, liver and pancreas. Patients were directed for examination during their stay in the Department of Surgery and Department of Gastroenterology in University Hospital "Queen Joanna-ISUL", Sofia.

The study was carried out on GE Signa XDe 1.5 T machine with 8ch body upper coil. MR acquisition involved a 3D MRCP ASSET (TR 5455ms, TE 785,7 ms), T2 FIESTA in coronary plane (TR 6,8ms TE 3.0ms), T1 DualEcho (TR 125ms TE 2,37 / 4,71 ms) and T2ssFSE Fat Sat (TR 3818ms TE 99,52ms).

Results

In our study, they were distinguished six different types of cystic duct infusion. It was used modified classification of Turner and Fulcher [15]. They are presented in figure 1.

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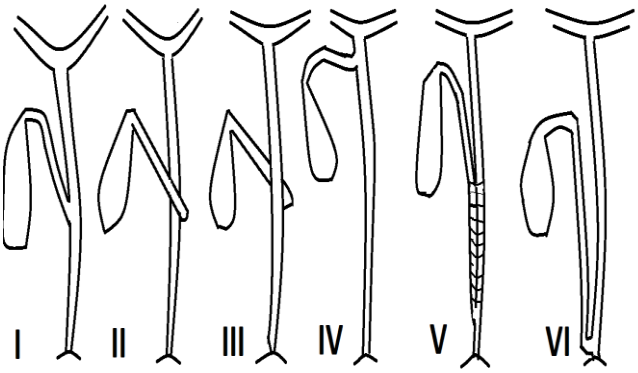
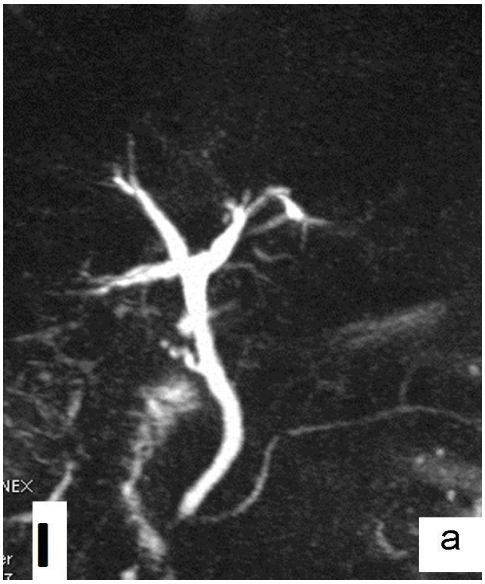


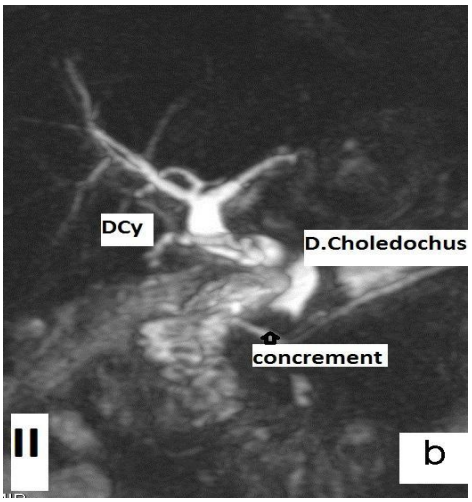
Figure 1: Schematic representation of variations of DCy infusion

The first variant was characterized by infusing of DCy on the right lateral wall in the middle third of the extrahepatic bile duct. This was so-called right lateral insertion (fig. 2a).

In second variant DCy run along the left or front wall of the extrahepatic bile duct. DCy formed a spiral curve and merged into the middle third of extra hepatic canal (anterior spiral insertion, fig. 2b).

In a third variant DCy performed spiral curve along the back wall of the extra hepatic duct and emptied into it at the middle third (posterior spiral insertion, fig. 2c).





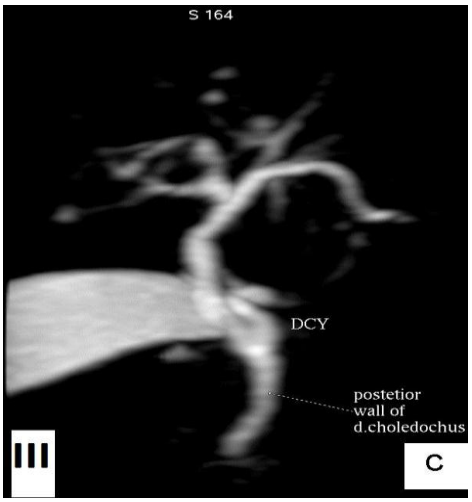


Figure 2: MR representation of variations I (2a), II (2B) and III (2C) of DCy infusion.

In the fourth variant there was “high” inflow of DCy in the upper third of the extra hepatic bile duct or into hepatic ducts draining right lobe of the liver (proximal insertion, fig 3a).

In fifth variant DCy was infused at the lower third of extra hepatic canal. There was a parallel course of the DCy and the common hepatic duct. The two channels were located in a common sheath (low lateral insertion with a common sheath, fig 3b).

In the sixth variant there was medial or lateral inflow in the lower third of the extrahepatic duct. There was no common sheath covering the distal cystic duct and the common hepatic duct (low insertion, fig3c). 5th and 6th variations were accepted so-called “low” infusing DCy.

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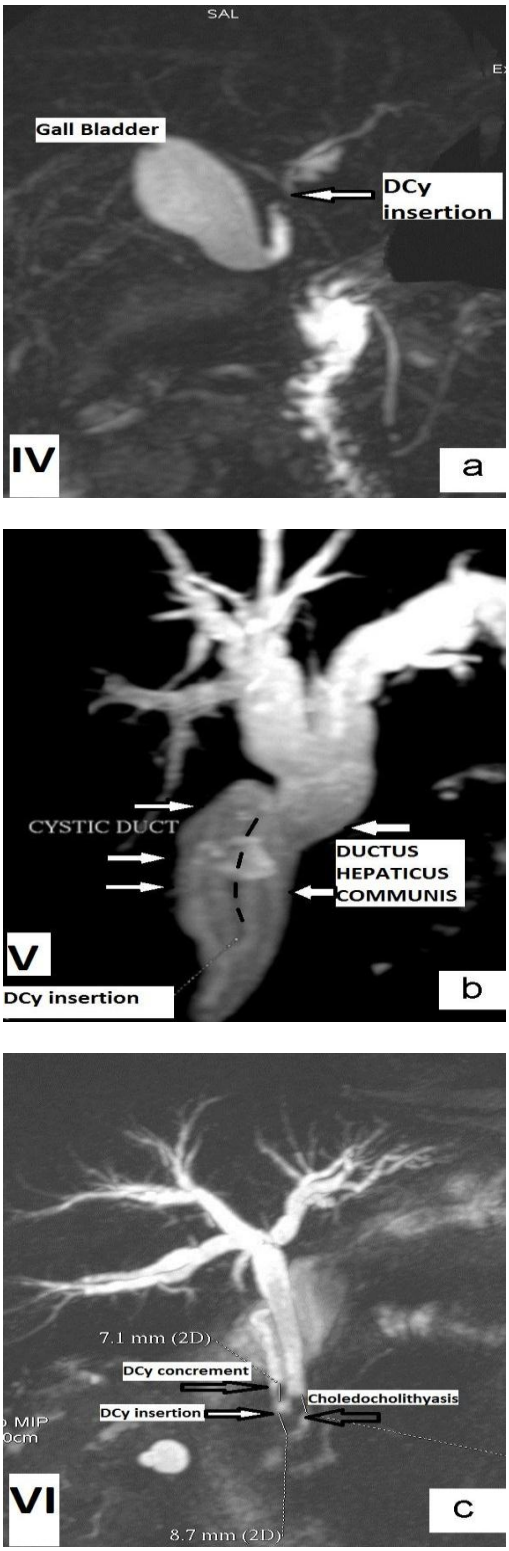

Figure 3: MR representation of variations IV (3a), V (3B) and VI (3C) of DCy infusion.

Of the 351 patients studied, identification of DCy insertion was possible in 301 cases, respectively, in 86%. In 38 of the 50 patients with impossible identification of DCy infusion there was previous cholecystectomy (75%). The distribution of the anatomic variations of the insertion of DCy were presented in Table 1.

Anatomic variation	Number of patients	%
Variant 1	163	54,20%
Variant 2	19	6,30%
Variant 3	51	16,93%
Variant 4	14	4,65%
Variant 5	19	6,30%
Variant 6	35	11,62%

Table 1

Discussion

The length of the cystic duct in autopsy series ranged from 7 to 39 mm (mean 19 ± 7 mm) [3, 15]. Its length in the fetus varied from 4 to 6 mm [14]. The width of canal fluctuated between 1 to 5 mm [15]. It was infused into common hepatic duct (CHD) bellow the merging the right and left hepatic ducts. In 75% of cases cystic duct merged into the middle third of the extrahepatic bile duct [8, 15]. In 50% of cases, the infusion became on right lateral wall of DHC, and in 32% on the front and rear wall [15].

The frequency of anatomical variants of cystic duct was 18 to 23% [1, 5, 6, 8, 14, 15, 18, 19]. In view of the large number of surgical procedures on the biliary tract, a good knowledge of these and their timely detection was important for reducing the risk of complications. Anatomical variations of extrahepatic bile ducts and insertion of DCy to common bile duct impeded endoscopic interventions [18, 19].

There were three important from a clinical point of view variations of DCy: low infusion (occurring in 9-11%), medial merger with inflow on the left side of the CHD and parallel infusion (10-17%). In the latter case, the cystic duct was

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positioned parallel to the CHD along at least 2 cm (frequency of 1,5 to 25%) [6, 11, 12]. Long and parallel course of DCy was particularly important for surgical treatment of chronic cholecystitis. MRCP provided good opportunities for its visualization [12, 15].

„Low" merger of cystic duct deserved special attention. In this case the infusion was carried out in intrapancreatic or intraduodenal parts of CHD. Although rare, there were described cases of separately infusion of DCy into the duodenum [15]. These variations led to misinterpretation in diagnostic imaging, which influenced the therapeutic approach [6, 8]. Low insertion of DCy into common bile duct resulted in mal position of biliary stents during on ERCP [6].

Another complication related sometimes with low infusion was Mirizzi′s syndrome. It was a narrowing of the CHD by concretion stuck in cystic duct or neck of the gallbladder. This condition was firstly described in 1948. It included inflammation of the common bile duct and gall bladder, and may be accompanied by cholecysistobiliary fistula. Mirizzi's syndrome led to acute or chronic inflammatory changes. Acute complications included compression, ischemia and necrosis with communication between the gallbladder and common bile duct. Chronic complications included secondary stricture of the common bile duct and fibrotic shrinkage of gallbladder [16]. It has been observed in the 0,7 to 1,4% of all cases with cholecystectomy and in 0,1% of all cases of cholelithiasis. Recognition of Mirizzi's syndrome before surgery was important because laparoscopic cholecystectomy in these patients is accompanied by a high risk [8,16]. Diagnosis of Mirizzi′s syndrome was not possible with physical exam and required imaging tests [8]. Another consequence of extremely low infusion of cystic duct was occurrence of primary choledocholithiasis [4]. Kubota et al. investigated the incidence of cholecystolithiasis in patients with different infusion of DCy. Patients with low inflow (in the lower third of the extrahepatic bile duct) had a significantly higher incidence of cholecystolithiasis [9].

Rare anatomical variations of ductus cysticus included infusion in right or left hepatic ducts, extremely high infusion in CHD and holecystohepatal canal. Short DCy observed at 2,67% [7]. Double DCy was extremely rare anomaly (0,05%), but its recognition was essential [10].

DCy infusion into right hepatic duct occured in 0,6 to 2,3% of cases [10]. This variation carried a risk for cholecystectomy because the right hepatic duct can be confused with DCy, being slit and ligated with subsequent adverse effects. Infusion into left hepatic duct with a normal gallbladder position was extremely rare and there have been described only 10 cases in the literature. Laparoscopic cholecystectomy in these patients was at risk because the common hepatic duct has a smaller lumen and can be confused with DCy [3,10]. Some authors found association between the length of the ductus cysticus and gallstone disease [3].

Wu et al [17] gave important clinical significance on the front and rear spiral merger of DCy on the left side of the common hepatic duct. Other important options included hypertrophy of the cystic duct (transverse diameter greater than 5mm), short or absent DCy (length less than 5mm) and double DCy. Rare anomaly was the so called hepaticocystic duct. In this case common hepatic duct emptied into the gallbladder and bile entered the duodenum through the ductus cysticus.

After cholecystectomy the length of the remnant of the DCy was between 5-25 mm and width up to 4 mm [13]. Width of the remnant of the canal over 5 mm was considered to be abnormal. The extension of the DCy remnant likened to the image of a light bulb or the formation of pockets considered a result of an inflammatory response. The condition described for the first time in 1936

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by Beye and known as the *ductus cysticus remnant syndrome*. Apart from being a source of infection, this syndrome was accompanied by the formation of gallstones. MRCP has high sensitivity of 95-100% and a specificity (88-89%) in the detection of lithiasis in cystic duct remnant [13]. Inflammation of the DCy remnant was a common cause of postcholecystectomy syndrome. The capabilities of MRCP to identify DCy and its insertion into CBD depends on sequences used and the presence of the biliary pathology. In healthy persons, it reached 88%, and in patients with biliary pathology, 93% [2, 7].

Conclusion

MRCP can provide a clinically important information concerning the anatomic variations of the bile ducts, without using ionizing radiation and contrast agent. In our study group, the insertion of the cystic duct was visible by MRCP in 86% of cases. Inability to identify the confluence of the cystic duct was associated with previous cholecystectomy in 75% of cases. Inflow to the middle third of the extrahepatic bile duct observed in 77,4%. Low infusion settled in 18% and higher in 4,6%. Our results were comparable with those from other autopsy and ERCP studies on the rate of infusion of the cystic duct.

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