

Recurrent pyogenic cholangitis
-comparison between MR cholangiography and
direct cholangiography -

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Recurrent pyogenic cholangitis

Directed by Professor Jin-Suck Suh

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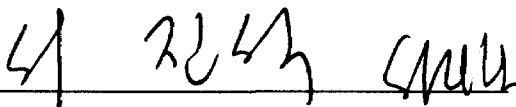
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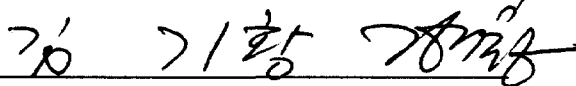
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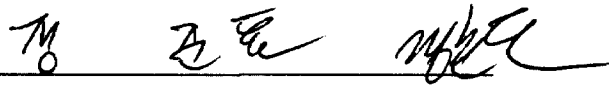
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Contents

Abstract.....	1
I. Introduction	3
II. Materials and Methods	5
1. Patients Population	5
2. Imaging Studies	5
3. Image Analysis	6
III. Results	9
. Discussion	14
. Conclusion	17
Reference	18
Abstract in Korean.....	19

Table

Table 1. Distribution of diseased segments on surgical specimen...	10
Table 2. Detection rate of IHD abnormalities	10

Figure

Figure 1. A 53-year-old woman with typical appearance of recurrent pyogenic cholangitis.....	11
Figure 2. A 44-year-old man with right posterior ductal abnormalities depicted only by MR cholangiography	12
Figure 3. A 65-year-old woman with recurrent pyogenic cholangitis with abscess	13

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Abstract

Recurrent pyogenic cholangitis : comparison between MR cholangiography and direct cholangiography

PURPOSE: To compare magnetic resonance (MR) cholangiography with direct cholangiography for the evaluation of recurrent pyogenic cholangitis.

MATERIALS AND METHODS: Twenty-four patients with recurrent pyogenic cholangitis underwent MR cholangiography before surgery, and 18 of them were evaluated with direct cholangiography, also. Two reviewers evaluated MR cholangiographic and direct cholangiographic images focusing on identifying intrahepatic duct dilatation, stricture, and calculi and coexistent parenchymal abnormalities based on the classification of the internal lobation and segmentation of the liver. These observations were compared with surgical findings.

RESULTS: According to the surgical specimen, 24 patients had 46 segmental abnormalities. MR cholangiography depicted all 46 (100%) segments with ductal dilatation, 22 of 23 (96%) segments with focal ductal stricture and 43 of 44 (98%) segments with ductal calculi. Eighteen patients who underwent direct cholangiography had 32 segmental abnormalities on surgical specimen. Direct cholangiography depicted 15 of 32 (47%) segments with ductal dilatation, 8 of 18 (44%) segments with focal ductal stricture and 14 of 31 (45%) segments with ductal calculi.

CONCLUSION: MR cholangiography is superior to direct cholangiography for the accurate topographic evaluation of patients with recurrent pyogenic cholangitis, because it is able to depict all of the biliary trees in spite of obstruction or stenosis.

Key words: bile ducts,calculi, bile ducts, MR, cholangiography, cholangitis.

Recurrent pyogenic cholangitis

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I. INTRODUCTION

Recurrent pyogenic cholangitis is a complex hepatobiliary disease recognized by various synonyms as oriental cholangiohepatitis, intrahepatic pigmented stone disease, or hepatolithiasis. Recurrent pyogenic cholangitis is characterized by recurrent attacks of abdominal pain, fever, and jaundice caused by intrahepatic duct strictures and calculi¹. Repeated medical and surgical treatments are frequently required in patients with recurrent pyogenic cholangitis. The therapeutic goal for the management of recurrent pyogenic cholangitis should include the complete clearance of calculi and debris from the biliary tract and the elimination of bile stasis, to prevent recurrent attacks of the disease. Therefore, for effective treatment, accurate topographic evaluation of the distribution of the disease is required prior to surgical intervention.

Direct cholangiographic techniques, such as endoscopic retrograde

cholangiopancreatography (ERCP) and percutaneous transhepatic cholangiography (PTC), have been the most accurate way to define biliary ductal anatomy, by providing visualization of strictures, stones, and ductal ectasia². However they have limitations, especially in the face of high grade stenosis, impacted stones or complete ductal obstruction^{1,3} and they are invasive.

Recently, magnetic resonance (MR) imaging technology has made it possible to visualize the biliary system without the use of contrast material or endoscopy. Several studies have compared the usefulness of MR cholangiopancreatography and ERCP for the evaluation of biliary and pancreatic disorders. To our knowledge, however, no studies have compared MR cholangiography and direct cholangiography in terms of the diagnosis of recurrent pyogenic cholangitis. The aim of this study was to compare the accuracy of MR and direct cholangiographic assessments of recurrent pyogenic cholangitis.

II. MATERIALS AND METHODS

1. Patients Population

Between March 1996 and November 1999, 45 patients with recurrent pyogenic cholangitis underwent MR cholangiography at Severance Hospital, Yonsei University College of Medicine, Seoul, Korea. The accurate topographic spectrum of their hepatic pathology was confirmed by surgery in 24 of 45 patients. These 24 patients (13 men and 11 women; age range, 48 - 67 years; mean age, 59 years) constituted our study population. Six of them had previously undergone cholecystectomy and 2 of them had undergone subtotal gastrectomy. All 24 patients had acute cholangitis (abdominal pain, fever, or jaundice) at the time of admission. Nineteen of them had experienced recurrent attacks of the disease on more than three occasions and the remaining five patients had had the recurrent attacks twice.

All patients underwent MR cholangiography. Fifteen of them were also evaluated with ERCP: Of the remaining 9, 6 of them were not able to undergo ERCP due to septic condition (n=2), previous subtotal gastrectomy (n=2), technical failure (n=1), and patients' intolerance (n=1). Three out of nine patients underwent PTC and percutaneous transhepatic biliary drainage (PTBD) for preoperative decompression.

2. Imaging Studies

MR Imaging studies were performed with a 1.5-T superconducting unit (Magnetom Vision; Siemens Medical Systems, Erlangen, Germany and Horizon; GE Medical

Systems, Milwaukee, WI, USA) and a phased array multicoil. MR cholangiography was performed using a half-Fourier rapid acquisition with relaxation enhancement (RARE) sequence and single-shot fast spin echo (SSFSE) sequence.

We used a sequential multiple thin-slice technique (3-5 mm slice thickness) followed by a maximum intensity projection reconstruction and a single thick-slab technique (50-70 mm slice thickness). Imaging parameters were as follows: effective echo time, 85-95 msec and 915-1,050 msec (for less heavily T2 weighted and heavily T2 weighted imaging, respectively); matrix, 256x256; field of view, 30-36 cm. Fat saturation was routinely used. All of the source, maximum intensity projection, and single thick-slab images were available for review on an independent workstation. Patients were asked to fast for a minimum of 4 hours. Per-oral contrast agents and antispasmodic agents were not used.

All ERCP examinations were performed by two experienced gastroenterologists with technologist-assisted fluoroscopy. The standard ERCP procedure was used. All PTC examinations were performed by one experienced interventional radiologist with technologist-assisted fluoroscopy. The standard PTC procedure was used. All printed images were included for review.

3. Image Analysis

Hard-copy images of MR cholangiography and direct cholangiography were interpreted separately in a blinded, retrospective fashion. The readers were two experienced radiologists and final conclusions were made by consensus.

MR cholangiographic images were reviewed by two radiologists who were blinded to the patients' clinical information and direct cholangiographic findings. Image analysis focused on identifying intrahepatic ductal dilatation and stricture, intrahepatic duct calculi and common duct calculi, and coexistent parenchymal abnormalities, such as parenchymal atrophy, abscess, biloma, and cancer. The distribution of the intrahepatic abnormalities was interpreted based on the classification of the internal lobation and segmentation of the liver (four segments; left lateral, left medial, right anterior, and right posterior)⁴. Intrahepatic ductal dilatation was diagnosed when the diameter of a duct was greater than 3mm and stricture was diagnosed when focal caliber change was present at any segment⁴. Calculi were considered present on MR cholangiographic images when a signal void was identified within the bile duct in at least two different projections.

Direct cholangiographic images were randomly reviewed by the same two radiologists without knowledge of the patients' clinical information and MR cholangiographic findings. Image analysis focused on identifying intrahepatic ductal dilatation and stricture, intrahepatic duct calculi and common duct calculi as was used for the MR cholangiographic images. The distribution of intrahepatic ductal abnormalities was evaluated based on the division of four segmental branches (left lateral, left medial, right anterior, and right posterior). In cases of non-visualization of intrahepatic ducts on direct cholangiography, we investigated the reason for those abnormal findings. Coexistent parenchymal abnormalities, such as abscess and biloma which might or might not have communicated with bile duct, were also evaluated.

Surgical exploration confirmed the presence of cholangitis by findings of dilated, thick, intra-, and extrahepatic ducts containing pigmented stones and biliary debris, and coexistent parenchymal lesions. MR and direct cholangiographic findings were compared with surgical and pathologic records (including intraoperative cholangiography) with respect to intrahepatic duct abnormalities, calculi, and coexistent parenchymal abnormalities based on the classification of the internal lobation and segmentation of the liver⁴.

The significance of the differences in the detection rate of intrahepatic abnormalities between MR and direct cholangiography was calculated with the Chi-square (dilatation and calculi) and Fisher's exact test (stricture). A p-value less than .05 was defined as statistically significant.

III. RESULTS

According to the surgical specimen, the total number of the diseased segments was 46 in 24 patients (Table 1). Intrahepatic bile duct dilatation was present at all 46 segments, stricture was present at 23 of 46 segments, and intrahepatic duct calculi were present at 44 of 46 segments. Common bile duct calculi and ductal dilatation were present in 15 patients. Parenchymal atrophy was present at 37 of 46 segments and hepatic abscesses were present at 7 segments. Cholangiocarcinoma and biloma were present in 1 patient, each.

MR cholangiography depicted all 46 (100%) segments in 24 patients with ductal dilatation, 22 of 23 (96%) segments with focal ductal stricture, 43 of 44 (98%) segments with ductal calculi, 14 of 15 (93%) common bile duct calculi, all 37 (100%) segments with atrophy, and 6 of 7 (86%) segments with abscesses and 1 cholangiocarcinoma and 1 biloma. There was not a false positive case with MR cholangiography.

Of the fifteen patients who underwent ERCP, ERCP films of two patients were not adequate to evaluate the hepatobiliary system due to incomplete filling. In three patients who underwent PTC, all of the PTC images were adequate. Therefore, 16 direct cholangiographic images were analysed. Sixteen patients who underwent adequate direct cholangiography had 32 segmental abnormalities according to the surgical specimen. Direct cholangiography depicted 15 of 32 (47%) segments with ductal dilatation, 8 of 18 (44%) segments with focal ductal stricture, 14 of 31 (45%) segments with ductal calculi, and all 15 (100%) common bile duct calculi. Seventeen of the 32 (53%) segmental abnormalities were not visualized on direct cholangiography due to high grade stenosis (Fig 1) or impacted stones (Fig 2). Any of the coexistent parenchymal abnormalities was

not seen. There was no false positive case with direct cholangiography.

The detection rate of intrahepatic duct dilatation ($P = .001$), stricture ($P = .0003$), and calculi ($P = .001$) were significantly different between MR and direct cholangiography (Table 2).

Table 1. Distribution of diseased segments on surgical specimen

Patient' s number	
Single segment	
Left lateral	4
Right posterior	2
Two segments	
Left lateral and medial	4
Left lateral and right posterior	9
Right posterior and anterior	1
Three segments	
Left lateral, medial and right posterior	1
Left lateral, right posterior and anterior	3

Table 2. Detection rate of IHD abnormalities

	Dilatation	Stricture	Stones
MR cholangiography	46/46(100%)	22/23(96%)	43/44(98%)
Direct cholangiography	15/32(47%)	8/18(44%)	14/31(45%)
P value	.001	.0003	.001

Note.- Data are the number of segments.

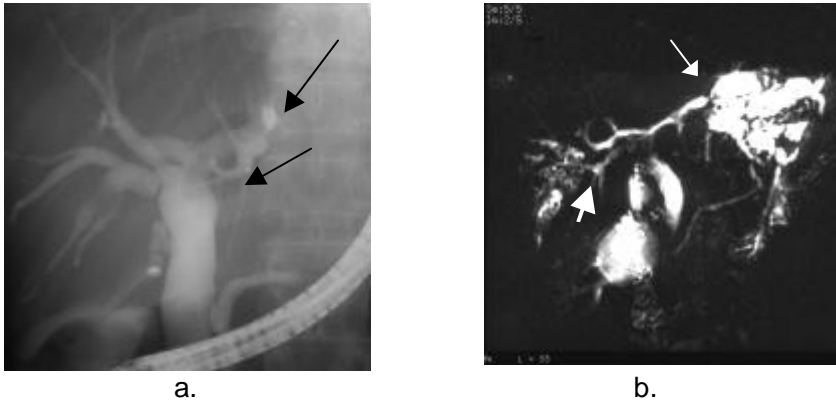


Figure 1. A 53-year-old woman with typical appearance of recurrent pyogenic cholangitis. **(a)** Endoscopic retrograde cholangiography shows abrupt tapering of the left lateral segmental duct (arrows) without visualization of calculus and peripheral duct, resulting in an “arrowhead” appearance and missing duct, and it fails to show any intrahepatic ductal abnormality in the right lobe. **(b)** Right posterior oblique coronal single-shot fast spin echo MR cholangiography (2047/1040 [effective], 50mm slice thickness) shows irregular crowding of dilated ducts with multiple filling defects and severe strictures in both the left lateral segmental duct (thin arrow) and the peripheral branch duct of the right posterior segment (arrow).

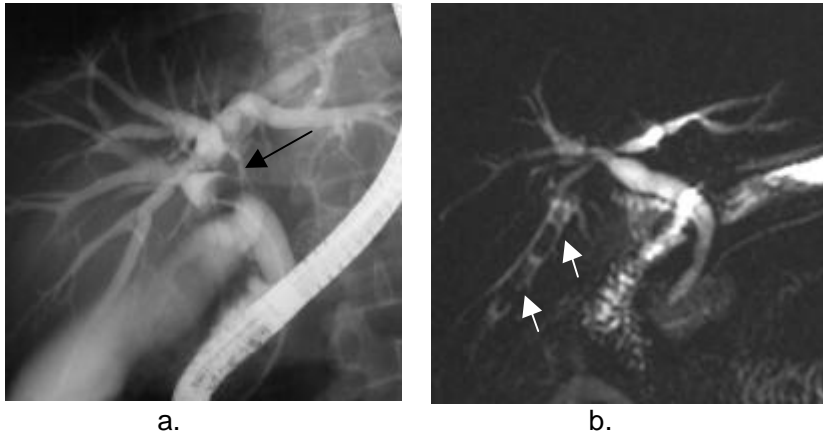


Figure 2. A 44-year-old man with right posterior ductal abnormalities depicted only by MR cholangiography. **(a)** An endoscopic retrograde cholangiography does not show any ductal abnormality such as calculus, stricture or abrupt tapering except for slight dilatation of the entire duct. A circular filling defect (arrow) is a balloon. **(b)** A single-shot fast spin echo MR cholangiography (16366/1004 [effective], 50mm slice thickness) shows multiple calculi (arrows) in the peripheral branch of the right posterior duct with dilatation.

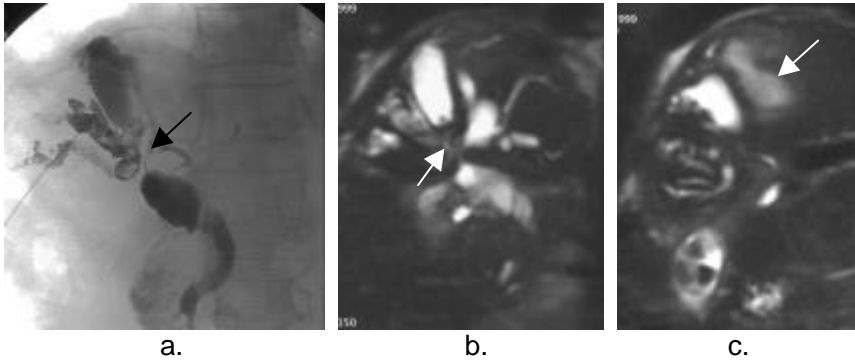


Figure 3. A 65-year-old woman with recurrent pyogenic cholangitis with abscess. **(a)** A percutaneous transhepatic cholangiography shows severe stricture (arrow) with dilated ducts and multiple filling defects and an abrupt tapering in the right anterior segment. **(b)** Thin-slab half-Fourier RARE ($\infty/95$ [effective], 5mm slice thickness) image shows severe stricture (arrow) with dilated ducts and multiple filling defects and an abrupt tapering which are similar to the findings of percutaneous transhepatic cholangiography. **(c)** Thin-slab half-Fourier RARE ($\infty/95$ [effective], 5mm slice thickness) image shows parenchymal high signal intensity foci confirmed as abscess (arrow) in addition to ductal abnormalities.

IV. DISCUSSION

The primary pathologic changes of recurrent pyogenic cholangitis are proliferative fibrosis of the bile duct walls with inflammatory infiltration of the portal tracts, calculi, and periductal abscesses. Bile pigmented calculi could lead to progressive biliary obstruction and recurrent infection resulting in the formation of multiple cholangitic liver abscesses, biliary strictures, and eventually severe liver destruction, cirrhosis, and portal hypertension.⁵ Hepatolithiasis has been difficult to eradicate and no single effective treatment exists for this disease. Historically, the treatment of choice has been surgical resection of the affected portion of the liver and biliary-enteric anastomosis to allow adequate drainage of bile.^{3,6} In the last decade, the advances in hepatobiliary imaging, the availability of flexible choledochoscopy, the application of stone-fragmentation technology, and the innovative surgical approaches to the biliary tract have modified the management of this condition. Some researchers have suggested that a combination of all treatment modalities, on a selective basis, is required to achieve optimum result and they reported an improvement in the result of treatment for recurrent pyogenic cholangitis by a systematic approach.^{2,7} It is essential, therefore, to know the accurate distribution of the bile duct calculi, ductal changes, and coexistent parenchymal lesions prior to surgical intervention.

Direct cholangiography has been an important imaging study in patients with recurrent pyogenic cholangitis, because it demonstrates the full spectrum of ductal changes and calculi.¹ The abnormal ductal changes of recurrent pyogenic cholangitis on

cholangiography include disproportionately severe dilatation of the extra-, and intrahepatic ducts and acute tapering, straightening, rigidity, decreased branching pattern, and multiple severe focal strictures.¹ Calculi produce filling defects in the opacified bile ducts. When the calculi completely obstruct the orifice of the segmental or subsegmental bile ducts, they cannot be detected (missing duct sign).¹ Similarly, when there is a severe stricture at the segmental or subsegmental bile ducts, the proximal bile ducts cannot be opacified, which may lead to an erroneous interpretation of no ductal calculus or stricture.¹

Complete obstruction of the intrahepatic ducts due to stricture or impacted calculi is one of the hallmarks of recurrent pyogenic cholangitis. In our study, direct cholangiography failed to detect such ducts, as many as 17 (53%) of the segmental ducts, whereas MR cholangiography depicted all such ducts. Because MR cholangiography can depict the proximal and distal parts of the obstruction or stricture,^{8, 9} it is much more accurate in delineating the entire biliary tree in patients with recurrent pyogenic cholangitis, regardless of obstruction or stricture.

In this study, patients with recurrent pyogenic cholangitis had a relatively high prevalence of septic conditions and previous gastrectomies. Therefore, ERCP was not available in relatively many patients (6 patients). On the other hand, MR cholangiography has no complications or contraindications because of its non-invasiveness and no contrast use. Thus, MR cholangiography is much more available than ERCP in patients with recurrent pyogenic cholangitis.

Recurrent pyogenic cholangitis has a high prevalence of coexistent parenchymal abnormalities, such as segmental atrophy, abscess, biloma, and cancer. Parenchymal atrophy is seen as a slightly hyperintense area with reduced volume and with or without crowding of dilated ducts or calculi on MR cholangiography. Some researchers reported that mild enhancement was seen on delayed gadolinium-enhanced images, probably because of increased fibrosis with decreasing normal parenchyma.⁹ In our study, MR cholangiography was more accurate than direct cholangioraphy for detection of abscess and biloma. The reason may be that, in contrast to direct cholangiography, MR cholangiography is able to depict them regardless of the presence or absence of communication with the bile ducts.

This study has two limits. Firstly, we have chosen the surgical and pathologic findings as the reference for confirmations of our data, but there could be a possibility of false negative results even at the operation fields, because a pathological investigation of entire liver, except for the resected segments, could not be done. At the operation fields, however, there was an effort of direct inspection and palpation for the unresected segments, and intraoperative cholangiography could have supplemented surgical findings. Secondly, this study was not a complete direct comparison of MR and direct cholangiography, because only 18 of 24 patients had both MR and direct cholangiography, and the remaining six patients had only MR cholangiography. However, even with this small number of patients, a statistical significance was present and this may reflect the easy applicability of MR cholangiography.

V. CONCLUSION

MR cholangiography is superior to direct cholangiography for the accurate topographic evaluation of patients with recurrent pyogenic cholangitis because it is able to depict all of the biliary tree in spite of obstruction or stenosis, it has neither contraindication nor technical failure, and it can show the coexistent parenchymal abnormality. It is our belief that MR cholangiography should replace purely diagnostic direct cholangiography, especially ERCP, as a road map in patients with recurrent pyogenic cholangitis.

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