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RESEARCH ARTICLE

Intrahepatic duct calculi. Role of imaging compared with surgical and histopathological finding

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Abstract

PURPOSE: To determine the accuracy of imaging tools in the evaluation of intrahepatic duct stones in recurrent pyogenic cholangitis.

MATERIALS AND METHODS: Sixty patients with recurrent pyogenic cholangitis underwent MRC and ERCP followed by surgery. MRC and ERCP images were interpreted independently by radiologist and gastroenterologist respectively before surgery and focused on intra bile duct dilatation, stones, strictures and parenchymalabnormalities.These observations were compared with final diagnosis obtained at surgery, histopathological findings, removal of stones and intraoperative cholangiography findings.

RESULTS: At final diagnosis 111 intrahepatic segments were diseased in 56 patients. MRC depicted disease in 106(95.5%) segments and ERCP in 67 (60.4%) segments ($P < 0.001$). Left lateral and right posterior segments accounted for 76.5% of 111 segments, 62 segments were involved in left lobe and 49 segments in right lobe. MRC accurately identified involvement in 60 of 62 (96.8%) segments of left lobe but ERCP depicted disease in 44 (71%) segments ($P < 0.001$). In right lobe segments, the sensitivity of MRC for correct diagnosis was 46 of 49 (93.9%) segments and that of ERCP in 23 of 49 (46.9%) segments ($P< 0.001$). MRC was significantly superior to ERCP ($P=0.002$)

CONCLUSION: MRC is superior to ERCP for accurate topographic evaluation of intrahepatic duct stones in recurrent pyogenic cholangitis. Delineates the entire biliary tract regardless of the presence of strictures, is non-invasive, requires no contrast material and is devoid of complications. ERCP ($P = 0.002$) is superior for identification of dilatation, stones and stricture in the left and right hepatic ducts.

INTRODUCTION

Recurrent pyogenic cholangitis (RPC) also known as oriental cholangiohepatitis (OCH) is an endemic disease in Southeast Asia and is characterized by recurrent attacks of abdominal pain, fever and jaundice. Pathologically intra and extra hepatic ducts are dilated containing soft pigmented stones and pus. There is proliferation of bile ducts and infiltration of inflammatory cells along the periportal spaces and hepatic parenchyma. Localized intrahepatic segmental ductal stenosis may be present, especially in the lateral segment of the left lobe or posterior segment of the right hepatic lobe. The cause of the disease is not known, but associations with clonorchiasis, ascariasis, and nutritional deficiency have been suggested.[1-3]The recent influx of Asian migrants has resulted in more cases appearing in the West.[4]Endoscopic cholangiopancreatography (ERCP) findings include common bile duct (CBD) stones, disproportionately severe dilatation of the extra hepatic ducts with mild or no dilatation of the intrahepatic ducts, and focal strictures, acute peripheral tapering, straightening, rigidity, decreased arborization and an increased branching angle of the intrahepatic bile ducts.[5] Magnetic resonance cholangiography (MRC) is an application of MR imaging that combines the advantages of projectional and cross- sectional imaging techniques. YL Chan et al[6] studied prospectively comparison of magnetic resonancecholangiography (MRC) withendoscopic cholangiopancreatography (ERCP) in the diagnosis of choledocholithiasis. Sensitivity with MRC was 95%, specificity was 85%, positive predictive value was 82%, and negative predictive value was 96%. Two of the false-positive findings were due to pneumobilia.TaeKyoung et al [7] carried out a study to compare the efficacy of MRC and ERCP for the diagnosis of intrahepatic stones. The sensitivity and specificity of MRC for detecting intrahepatic stones were 97% and 93%, respectively, whereas those of ERCP were 59% and 97%, respectively. MRC showed a significantly higher sensitivity than ERCP in the diagnosis of intrahepatic stones ($p < 0.001$).

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Hintze RE et al[8] studied the clinical significance of MRC compared to ERCP. Using ERCP as the gold standard, this study determined in a prospective, blinded fashion the sensitivity and further statistic values of MRC findings for evaluation of the biliary and pancreatic tract. MRC showed sensitivities and positive predictive values of 71% (62%) for recognition of normal bile ducts, 83% (91%) for recognition of dilation, and 85% (100%) for recognition of strictures, 77% (91%) for correct stricture location, and 80% (100%) for diagnosing bile duct calculi. Griffin N et al [9] compared MRC versus ERCP in the diagnosis of choledocholithiasis. MRC showed a sensitivity of 84%, specificity of 96%, positive predictive value of 91%, and negative predictive value of 93% and diagnostic accuracy of 92% when compared to ERCP as the gold standard. MRC has high sensitivity and high specificity for stones greater than 5 mm in diameter and MRC should be performed in preference to ERCP as first-line investigation.[10-12]MRC has been shown to be of higher sensitivity in diagnosis ofintrahepatic duct stones.[13]

We conducted this study to evaluate whether MRC can provide useful information in patients with RPC which is characterized by the intrahepatic duct stones, strictures and dilatation compared with ERCP and surgery as reference method, which is essential before planning management modality.

MATERIALS AND METHODS

This study was conducted jointly by the departments of Gastroenterology, Surgical Gastroenterology, Pathology and Radio diagnosis at Sher-i-Kashmir Institute of Medical Sciences, Srinagar Kashmir, over a period of three years and was approved by the Postgraduate Clinical Research and Ethical Committee of Medicine. Of the 235 patients who were identified to suffer from RPC either on the basis of clinical history, physical findings, liver biochemistry, US, CT abdomen, ERCP, MRC, surgery and or histopathological findings. Only 60 consecutive patients of RPC were studied who underwent MRC, ERCP and surgery. MRC was performed before ERCP except in those patients who required ERCP for biliary drainage for pyogenic cholangitis. The endoscopist was unaware of MRCP findings, ERCP preceded MRC in 21 patients Cholangiograms were interpreted for the following abnormalities1), left and right hepatic ducts, four Intrahepatic segments such as left medial segment, left lateral segment, right posterior segment, right anterior segment. 2) Distribution of stones in intrahepatic ducts 3) Presence and distribution of strictures. 4) Intrahepatic ductal changes such as acute tapering, straightening, increased or right-angle branching pattern, and decreased arborization of the peripheral ducts. 5) Parenchymal abnormalities such as intrahepatic collections, masses, parenchymal atrophy.

Exclusion criteria

1) Inability to provide written informed consent.
2) Contraindication for performing MRC such as pacemakers, prosthetic valve implant, cerebralclips or claustrophobia.
3) Inability to perform ERCP.

4) Poor quality of printed images of MRC or ERCP.

Imaging Techniques

MR imaging studies were performed with a 1.5 Tesla MR scanner (MagnetomAvanto Siemens) using a phased array body coil. All sequences were performed during breath holding. After localized imaging, heavily T2-weighted sequences were obtained in the coronal and transverse planes during a breath holding period of 18 seconds. MRCP was performed as follows:T1 FLASH 2d –tra-mbh-P2 (TR-265ms, TE- 4.7ms, BW-140, slice thickness 6mm/3.5, matrix-320x265) fov-300x263T2 HASTE 2d-tra-mbh-P2 (TR-1000ms, TE-85ms, BW-390 slice thickness 6/1.5mm, matrix-320x265) fov-300x263T2 HASTE cor-fs-mbh (TR -1200ms, TE- 85ms, BW-420, slice thickness/overlap-6/1.5mm, matrix-320x265) fov-300x300T2 TRUFI-TRA-mbh-P2 (TR-4.9ms, TE-2.4ms, BW-500, SL thickeness-3mm/00, matrix 256x156) fov-300x300T2 HASTE-COR-THIN slab (TR-1200ms, TE- 85ms, BW-390, SL 3MM/00, matrix-256x156) fov-300x263.T2 HASTE thick slab in different angles (TR-4500ms, TE-754ms, BW-150, SL-40mm, matrix-384x308) fov-300x300 (0, 15, 30, 45,-15,-30,-45 in orientation to confluence of CBD/PD)3D-SPC-rst-cor-p3-180 (TR-2500ms, TE-682ms, BW-360, SL-1.0mm, matrix-357x384) fov- 380 x 384.MR Cholangiograms were interpreted prospectively in a blinded fashion by two radiologists who were unaware of clinical details, laboratory values and all imaging findings including those of USG, CT or ERCP and final decisions were made with consensus. Coexisting parenchymal abnormalities like parenchymal atrophy, abscess were recorded

ERCP was performed after obtaining MRC under antibiotic cover using local pharyngeal anesthesia and intravenous midazolam (injection MIZAD – Nicholas Piramal India Limited), using a side view endoscope (Olympus TJF 150/Pentax ED-3490TK). Duodenal relaxation was obtained by intravenous Hyoscine butyl bromide (injection IP Buscopan – German Remedies Ltd, Goa, India). All patients were monitored with pulse oximeter. Papilla was cannulated and biliary tree was opacified under technologist-assisted fluoroscopic control by dilute contrast mixed with gentamycin (1mg/dl).The endoscopist was unaware of MRCP finding. Attempt was made to avoid overfilling of biliary tree and to totally avoid filling of gall bladder, although no endoscopic intervention was performed but endoscopic nasobiliary drainage tube was inserted into one of the hepatic ducts which were kept in the bile duct till the patient underwent surgery. At least eight pictures were obtained in various planes and patient positions to reveal the presence of stones and air bubbles. ERCP Cholangiograms were interpreted separately in a blinded prospective fashion by two senior gastroenterologists who were unaware of clinical details, laboratory values and all imaging findings including those of USG, CT or MRC and final decisions were made with consensus.

Imaging Analysis

At ERCP, intrahepatic ductal dilatation was diagnosed when ductal diameter exceeds 5mm. Stones at ERCP present as radiolucent filling defect in contrast-filled duct. Stricture was considered present as focal narrowed segment of the ductal lumen with proximal dilatation. Intrahepatic ductal changes such as acute tapering, straightening, increased or right-angle branching pattern, and decreased arborization of the peripheral ducts.[4, 14]

At MRC stones were diagnosed as oval, round or multiangular void signal in the lumen. The strictures were seen as focal narrowing of the ductal lumen with proximally dilated lumen. Coexisting parenchymal abnormalities were recorded.[15, 16]

Surgery

After resolution of cholangitis patients were subjected to surgery**.** The results of direct surgical inspection, palpation of unresected segments, intraoperative Cholangiograms and histopathology of resected segments were used to confirm the presence of dilated ducts containing pigmented calculi, biliary debris, strictures and coexistent parenchymal disease which were used as gold standard reference for comparison of MRC with ERCP. Of the 56 patients who underwent surgery 15(26.8%) had previous history of cholecystectomy, 2patients (3.6%) had cholecystectomy with choledochoduodenostomy, 2 patients (3.6%) had cholecystectomy with CBD exploration. The surgical interventions included lobectomy in 9 patients, segmental resection in 19 patients, choledochoduodenostomy in 9 patients, cholecystectomy with T-tube exploration in11 patients and hepaticojujenostomy with drainage procedure in 8 patients. Intraoperative Cholangiograms were performed in 18 patients. All resected specimens were subjected to histopathology, 28 patients had liver biopsy at surgery.

Statistical analysis

The significant differences between ERCP and MRC with respect to detectable abnormalities like dilatation, strictures and stones were determined by sensitivity, specificity, positive predictive value, negative predictive value and overall accuracy rates. 95% confidence intervals were calculated. A two-tailed p value of 0.05 or less was considered significant for each test using McNemara's test.[17] Final agreement between the MRCP reviewers for stones in intrahepatic duct was evaluated using kappa values. Interobserver agreement was interpreted as very good (κ > 0.80), good (κ = 0.80-0.61), moderate κ = 0.60-0.41), fair (κ = 0.41-0.21), or poor (κ =0.20) [18].

RESULTS

During the study period a total of 60 eligible patients underwent MRC and ERCP followed by surgery. Four patients were excluded one patient had poor quality MRC pictures, one patient had claustrophobia,ERCP; failure in two patients, in one due to Billroth 2nd gastrectomy.and other had duodenal stenosis. The study population consisted of 18 men and 38 women with a mean age of 39.6 years ranging from 11 to 65 years. (Table 1) The clinical symptoms included recurrent attacks of upper abdomen pain, fever, chills and jaundice with mean duration of 29.5 months (ranging from 1 to 192 months). (Table 2)

Table 1: Distribution of disease as per age and sex

Age	Sex of the patient		Total no.
	Male	Female	
11-20	3 (16.7%)	5 (13.2%)	8 (14.2%)
21-30	4 (22.2%)	8 (21.1%)	12 (21.4%)
31-40	4 (22.2%)	7 (18.4%)	11 (19.6%)
>40	7 (38.9%)	18 (47.4%)	25 (44.6%)
Total	18 (100%)	38 (100%)	56 (100%)

Table 2: Clinical parameters of 56 patients with RPC

	Mean ± SD	Median	Range	Percentile	
				25	75
Age of patient(Years)	39.6 ± 15.04	40	11-65	26	50
Total duration of illness(Months)	29.4 ± 37.94	12	1-192	4	36
Total no. of biliary colic Episodes	11.2 ± 8.94	7	2-32	4	18
Total no. of hospitalizations(Days)	2.0 ± 1.33	2	1-7	1	3
Longest hospital stay (Days)	8.8 ± 6.02	7	2-28	5	10
Shortest hospital stay(Days)	4.4 ± 2.33	4	2-15	3	5
Frequency of attacks per year	7.9 ± 6.46	6	2-36	4	9

Table 3: Comparison of MRC and ERCP in Left hepatic duct abnormalities

Abnormalities	Reference methods	ERCP	MR C	P-value
Dilatation	46 (82.1%)	36 (78.3%)	45 (97.8%)	0.007
Stones	32 (57.1%)	21 (65.6%)	30 (93.8%)	0.008
Strictures	22 (39.2%)	9 (40.9%)	20 (90.9%)	0.001

Table 4: Comparison of MRC and ERCP in Right hepatic duct abnormalities

Abnormalities	Reference method	ER Cholangiography	MR Cholangiography	P-value
Dilatation	40 (71%)	30 (75%)	38 (95%)	0.002
Stones	30(53.5%)	20(66.6%)	28 (93.3%)	0.013
Strictures	20(35.7%)	10 (50%)	18(90%)	0.008

Table 5: Distribution of diseased intrahepatic ductal segments

Diseased intrahepatic segments	No of cases	Total diseased segments
Left lateral	10	10
Right posterior	5	5
Left lateral and right posterior	20	40
Left lateral and left medial	7	14
Right anterior and right posterior	2	4
Left lateral, left medial and right posterior	4	12
Left lateral, right posterior and right anterior	3	9
Left medial, right posterior and right anterior	3	9
All four segments	2	8

Total	56	111

Table 6: Distribution of diseased intrahepatic segments

Liver segment	No. of diseased segments
Left Lateral	46 (41.4%)
Left Medial	16 (14.4%)
Right Posterior	39 (35.2%)
Right Anterior	10 (9.0%)
Total No	111(100.0%)

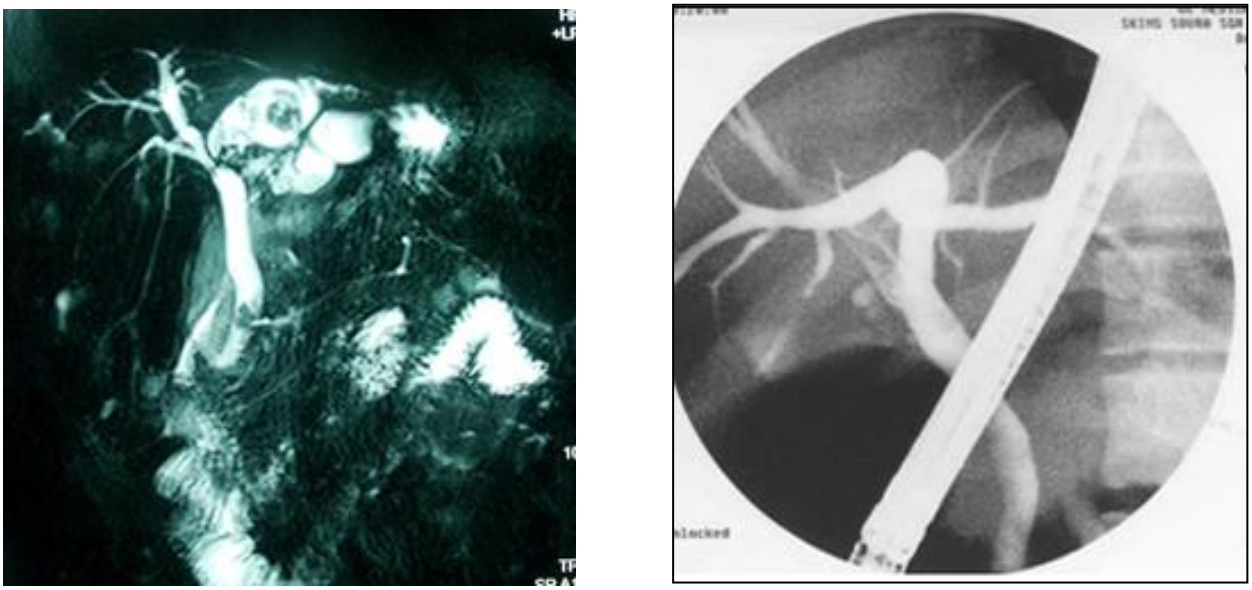
Table 7: Sensitivity of ERCP and MRC for detection of intrahepatic ductal abnormalities (Total diseased segments)

Segmental Intrabiliary abnormalities	MRC	P-value
No of diseased segments depicted	106 (95.5%)	<0.0001
Dilatation	104 (98.1%)	<0.0001
Stones	103 (98.1%)	<0.0001
Stricture	49 (94.2%)	<0.0001
Parenchymal atrophy	59 (83.1%)	<0.0001
Abscess	5 (100%)	0.03

Table 8: Sensitivity of ERC and MRC for abnormalities of intrahepatic ductal segments

Site of segments	Reference methods	ERCP	MRCP	P-value
Left lobe	62	44 (71%)	60 (96.8%)	<0.0001
Right lobe	49	23 (46.9%)	46 (93.9%)	0.0001

Total	111	67 (60.4%)	106 (95.5%)	<0.0001

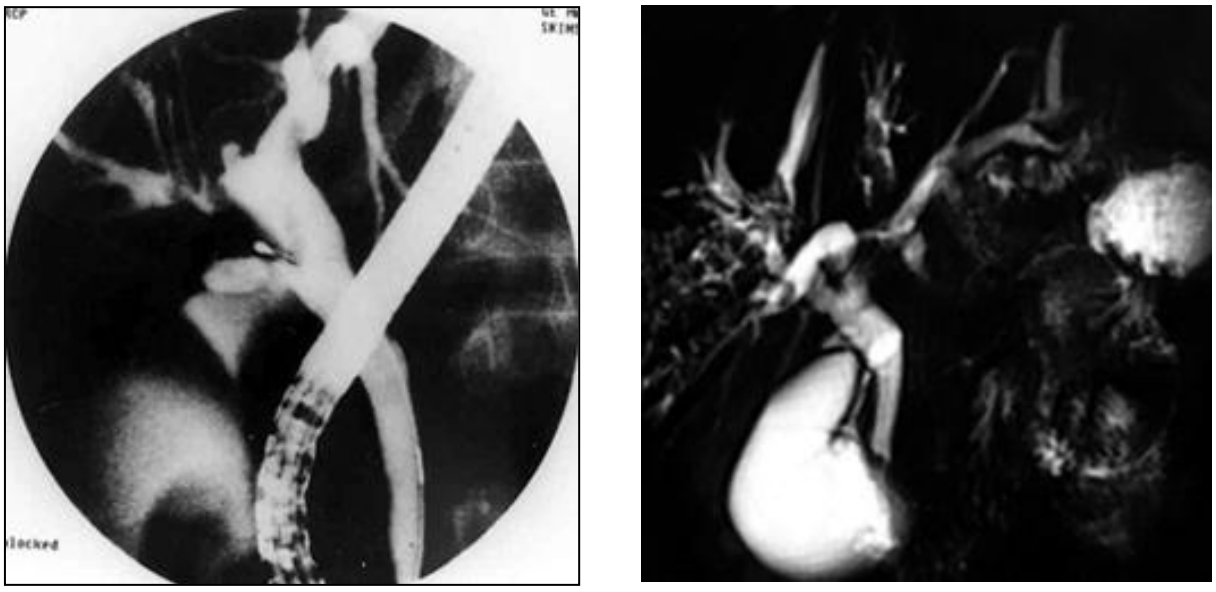


(A) (B)

Figure1: A 45 years old female had 2 episodes of cholangitis with Ultrasound evidence of RPC; she underwent MRCP (A) which shows multiple stones in involving LHD and extensive disease and it's both segments with multiple stones and strictures. After 48 hours of MRCP, patient was hospitalized with pyogenic cholangitis and ERCP (B) revealing stones in CBD, stricture in LHD. Note at MRCP better visualization of major hepatic ducts and branches

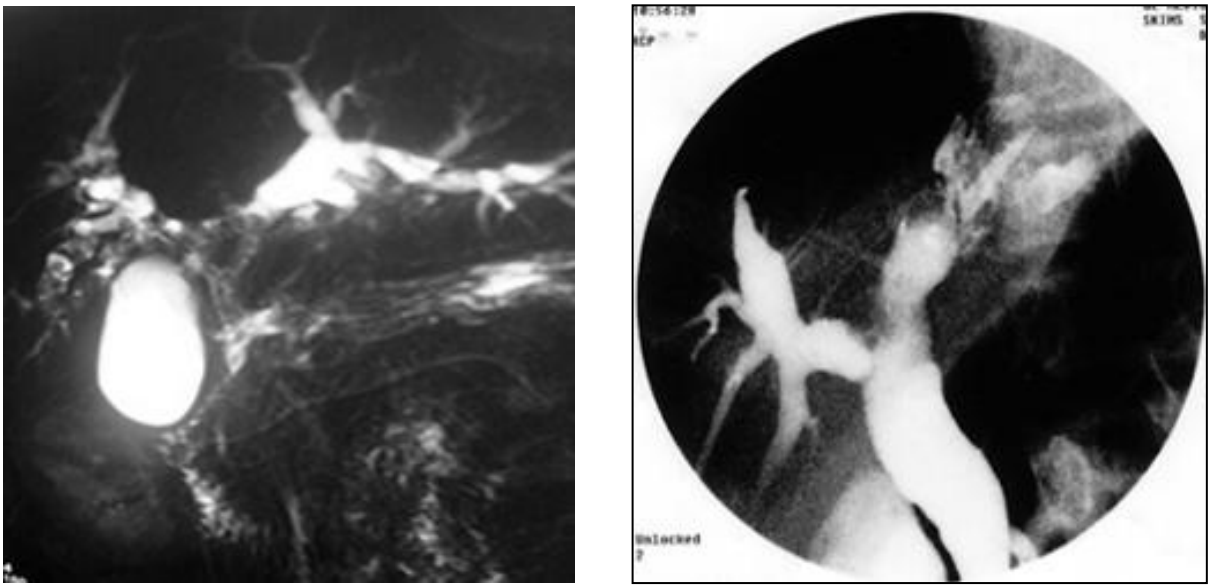
(A) (B)

Figure2:A 40 years old male had 2 episodes of cholangitis with ultrasound evidence of RPC.She underwent MRCP (A) which shows multiple stones in involving LHD and extensive disease in it's both segments with multiple stones and strictures. ERCP(B) done revealing stones in CBD, stricture in LHD with ENBD in place. Note at MRCP better visualization of major hepatic ducts and branches.



(A) (B)

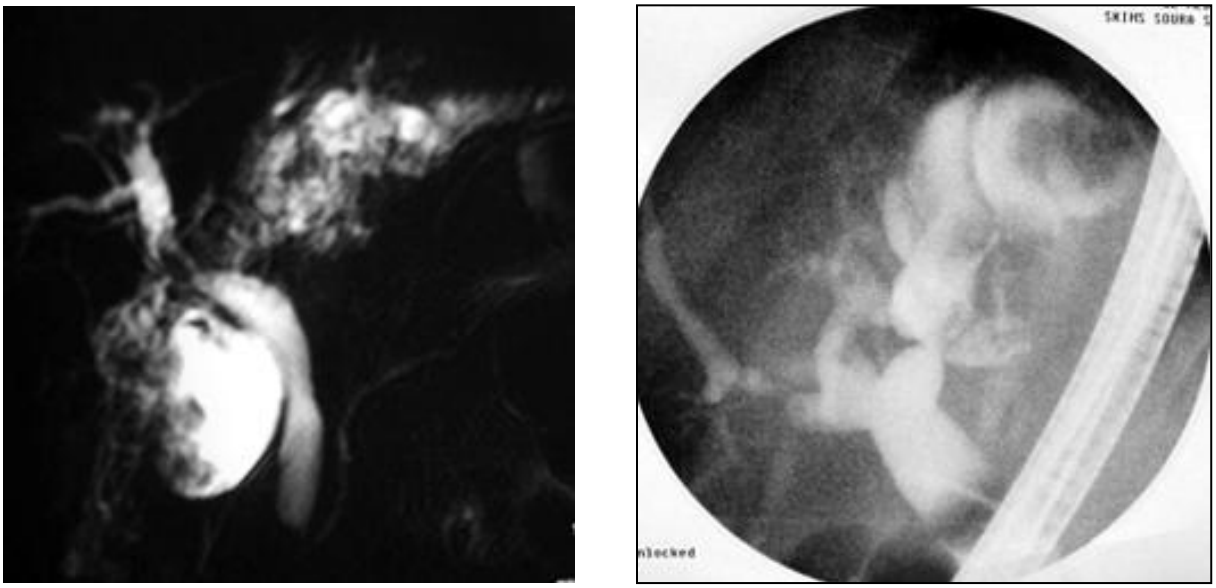
Figure3: 32 year old male patient presented with multiple episodes of cholangitis for 3 years. ERCP (A) was done showing dilated CBD and stricture in RHD. MRCP (B) in the same patient revealing CBD and RHD stones but there is in addition better delineation of intrahepatic ducts with stones in right lobe which were missed on ERCP.



(A) (B)

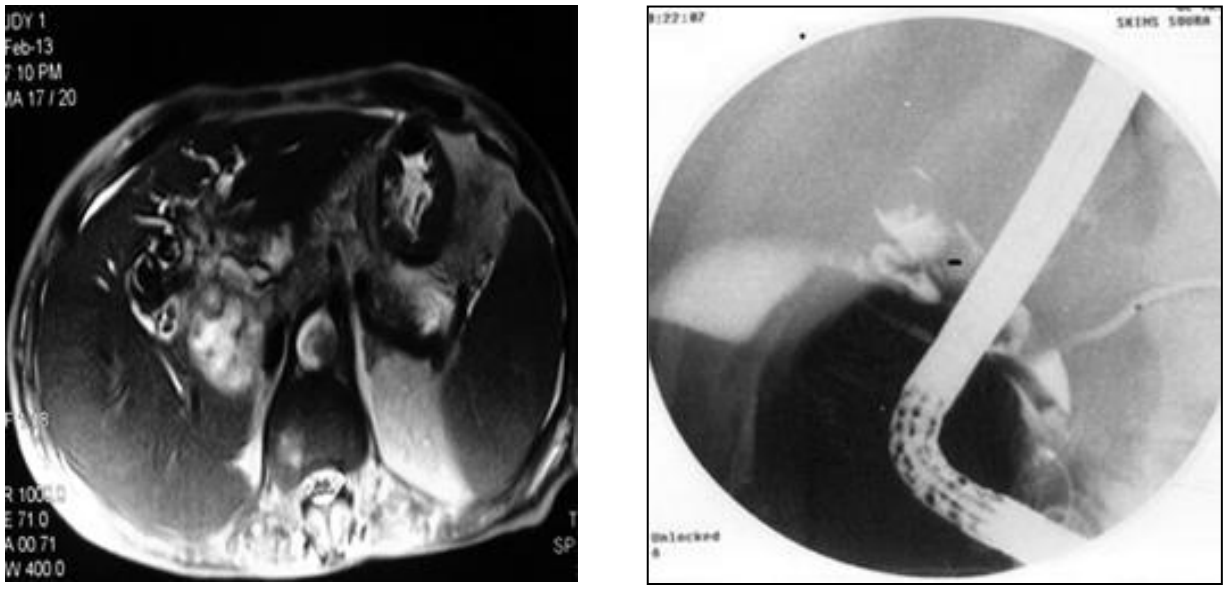
Figure: 4

A 43 year old female with history of recurrent pyogeniccholangitis for last 5 years. An ultrasound abdomen was done showing changes of OCH followed by MRCP (A) revealing dilatation and stones in CBD, LHD and RHD and disease in all the four segments. Note adequate visualization of gallbladder and arrow heads in peripheral intrahepatic ducts. ERCP (B) in the same patient showing multiple strictures', LHD and RHD but failed to fill the intrahepatic ducts.



(A) (B)

Figure 5: A 30 years old male had 2 episodes of cholangitis with Ultrasound evidence of RPC, she underwent MRCP(A) which shows multiple stones in involving LHD and RHD both segments with multiple stones and strictures. ERCP(B) done revealing stones in CBD, stricture in LHD and RHD. Note at MRCP better visualization of stones and strictures in major hepatic ducts and its' branches



(A) (B)

Figure 6: Elderly male had 4 episodes of cholangitis. MRCP showing multiple cholangiolar abscess in addition to dilated biliary ductal system and stones(A).ERCP showing multiple CBD stones, inability to fill IHD and does not show liver abscess (B)

Figure 7: Leftlobectomy surgical specimen showing stones and strictures.

Image diagnostic quality

MR cholangiograms giving complete delineation of the CBD were obtained in all 56 cases and were technically adequate for interpretation. The quality of the images was considered to be adequate in 53 cases but only fair in 3 because of slight blurring. Cholangiograms of diagnostic quality were obtained in all the patients who underwent ERCP.

Left hepatic duct

Left hepatic duct (LHD) was dilated in 46 of 56 (82.1%) patients, with stones in 32 of 56 (57.1%) patients and strictures in 22 (39.3%) patients. MRC identified correctly dilatation in 45 of 46 (97.8%) patients, stones in 30 of 32 (93.8%), (Fig: 1, 2) and strictures in 20 of 22 patients (90.9%). The corresponding figures for ERCP were 36 of 46(78.3 %) for dilatation, 21 of 32 (6 5.6%) for stone detection and 9 of 22 (40.9%) patients for stricture identification. MRC was significantly superior to ERCP (P = 0.002) for identification of dilatation, stones and stricture in the left hepatic duct (Table3).

The strictures were located at mouth of LHD in 12 patients and at distal end in the remaining 10 patients. At ERCP the Left hepatic duct was not well delineated in nine patients because of presence of strictures at the distal end of the LHD in three patients, impacted stone at its distal end in four patients and both stricture and impacted stone in two patients. MRC missed stones in two patients; both of them had two stones each measuring less than 7 mm in size. MRC failed to depict strictures in two patients as a result of overlapping of dilated intrahepatic ducts.

Right hepatic duct

Right hepatic duct (RHD) was dilated in 40 of 56 (71%) patients, with stones in 30 of 56 (53.5%) patients and strictures in 20 (35.7%) patients. MRC identified correctly dilatation in 38 of 40 (95%) patients, stones in 28 of 30 (93.3%) and strictures in 18 of 20 (90%) patients (Fig3).The corresponding figures for ERCP were 30 of 40(75%) for dilatation, 20 of 30(66.6%) for stone detection and 10 of 20(50%) patients for stricture identification. MRC was significantly superior to ERCP (P = 0.002) for identification of dilatation, stones and stricture in the right hepatic duct (Table4). The strictures were located at mouth of RHD in 11 patients and at distal

end in the remaining 9 patients. At ERCP the right hepatic duct was not well delineated in seven patients because of presence of strictures at the distal end of the RHD in two patients, impacted stone at its distal end in three patients and both stricture and impacted stone in two patients. MRC missed stones in two patients; each of them had more than two stones measuring less than 7 mm in size. MRC failed to depict strictures in two patients as a result of overlapping of dilated intrahepatic ducts. In the diagnosis of left and right intrahepatic ducts, interobserver agreement between the two MRCP reviewers was very good, with kappa values of 0.91 and 0.82 respectively.

Intrahepatic segments

On the basis of final diagnosis obtained at surgery, histopathological findings, removal of stones and intraoperative cholangiography, 111 liver segments were diseased in 56 patients (Table 5). Left lateral and/or right posterior segments accounted for 85 of 111 (76.5%) segments in all 56 patients (Table 6). Intrahepatic segmental ductal dilatation was present in 106 segments in all 56 patients, stricture was present in 52 of 111 segments in 49 of 56 patients, and ductal calculi were present in 105 of 111 segments in all 56 patients, parenchymal atrophy was present in 71 of 111 segments in 24 patients and hepatic abscesses were present in three segments in five patients. Abscess was diagnosed at MRC in all five patients by both reviewers, but it was detected in only one patient at ERCP. MRC identified atrophy in 59 segments (83.1%) and ERCP in none. MRC correctly diagnosed on the basis of presence of stones, dilatation and/or stricture, the disease in 106 (95.5%) segments in 54 of 56 (96.4%) patients which was significantly higher than for ERCP (67 segments, 60.4%, P = <0.0001) (Table 7). The segments of left lobe alone were involved in 17 (30.4%) patients, right lobe alone in 7 (12.5%) and both lobes in the remaining 32 (57.1%) patients. (Fig: 4, 5). A total of 62 segments were involved in left lobe and 49 segments in right lobe. MRC accurately identified involvement in 60 of 62 (96.8%) segments of left lobe but ER cholangiography depicted disease in 44 (71%) segments (P = 0.0001) (Fig4). Likewise in right lobe segments, the sensitivity of MRC for correct diagnosis is 46 of 49 (93.9%) segments and that of ERCP in 23 of 49 (46.9%) segments (P <0.0001) (Table 8). There was no false-positive case at MRC.

Complications.

After ERCP two patients developed mild pancreatitis which responded to conservative treatment .Five patients had distention of abdomen with colicy pain which responded to parentral analgesics. No complication was recorded due to MRC.

DISCUSSION

The results of the present study indicate that MRC is significantly superior to ERCP for the detection of intrahepatic biliary segmental disease. Of the 111 diseased segments, the sensitivity of MRC and ERCP was 95.5% and 60.4% respectively (P <0.0001). The sensitivity of MRC was comparable for both left and right sided segments (96.8% and 93.9% respectively). However, for ERCP the detection of abnormalities in right-sided segments (right anterior and right posterior segments) was significantly lower than in left-sided segments (46.9% *vs.* 71% respectively). The lower sensitivity of ERCP for identification of intrahepatic biliary segments was because of non-visualization of peripheral intrabiliary ducts as a result of presence of strictures, impacted stones or cast of stones. Our patients had endoscopic nasobiliarydrainage catheter placed in the hepatic duct till patient underwent surgery.

The adequate imaging of the whole biliary tree is essential before planning endoscopic, percutaneous, and/or surgical interventions in patients with recurrent pyogenic cholangitis. A number of imaging techniques have been employed to achieve this objective of delineating the whole biliary tree completely. These techniques include ultrasonography[14, 19, 20] conventional CT [5, 6, 21, 22] ERCP [5, 6, 23] percutaneous transhepaticcholangiography[4] MRC [7, 8, 25, 26] and CT cholangiography.[27] In CT cholangiography, exogenous contrast agents are used to opacity the bile ducts. This technique has been shown to be highly effective for the diagnosis of bile duct stones but needs administration of cholangiography contrast agents intravenously or orally. The toxicity of intravenously administered contrast agents' limits their usefulness[28]another drawback of CT cholangiography is inadequate opacification of bile ducts that may occur in patients with elevated bilirubin levels or liver insufficiency. However, in recent years MRC has begun to replace ERCP for examination of variety of bile duct diseases including bile duct stones and its diagnostic accuracy has been shown to comparable to that of ERCP but without the complications of ERCP.[9] With the result, MRC is evolving as a popular technique because it is noninvasive, produces projectional and cross sectional images of good quality of the bile ducts, and does not require administration of contrast material, sedation

or analgesia. In addition, MRC can be performed without pre procedure preparation, even in patients with a relatively poor condition.

The main drawback of MRC is that it is purely a diagnostic tool and ERCP is both diagnostic and therapeutic. Whereas this great potential of ERCP enables treatment of common bile duct stones but the situation is entirely difficult for RPC. The management of common bile duct stones is possible at ERCP, but extraction of intrahepatic stones in RPC is extremely difficult through the ampulla of Vater because stones are trapped beyond stenotic intrahepatic ducts and impacted in angulated ducts. ERCP has limited therapeutic potential in RPC; MRC being non-invasive, effective and safe should replace ERCP in the accurate diagnosis of RPC as its diagnostic accuracy is comparable to ERCP.

The management of RPC is dependent on the location of the stones, extent of involvement of the liver and presence of associated complication, the management is multidisciplinary involving surgical and nonsurgical means.[1]In our study we did not include common bile duct stones because it has been well studied and most of the results show that sensitivity for the detection of abnormalities of extra hepatic ducts for dilatation, stones and stricture were not significantly different between MRC and ERCP.[11,13]

MRC imaging is based on the use of heavily T2 weighted sequences to highlight static or slowly flowing fluid which provide high signal intensity whereas the background appears hypointense. Patient cooperation for breath holding techniques which was considered necessary earlier, have now been found to be not necessary using fast spin echo sequences that provided an excellent T2 contrast. The calculi on MRC can be clearly depicted as discrete filling defects with high contrast between bile and calculi. Calculi are visible as dark signal intensity, but some may be isointenseto the liver or hyperintense and may be missed. On T2-weighted images most calculi are hypo intense or decreased signal intensity. The sensitivity of MRC for detection of CBD stones and stenosis ranges from 71 to 100%. To expand the clinical use of this less invasive diagnostic imaging modality, technical refinements such as the use of fast spin echo variants allowing rapid acquisition within a few seconds (HASTE) have been proposed.[29]Of the 111 diseased segments, the sensitivity of MRC and ERCP was 95.5% and 60.4% respectively ($P < 0.0001$). This figure is close to reported in the literature. [30, 31]

A number of Parenchymal abnormalities, such as segmental atrophy, abscess, biloma, and cancers are associated with RPC.[32]Visualization of liver parenchyma is an advantage of MRC (Fig: 6).Parenchymal atrophy is seen as a slightly hyper intense area with reduced volume and with or without crowding of dilated ducts or calculi at MRC. Our results indicate that diagnostic accuracy of MRC was higher than ERCP for identification of hepatic parenchymal atrophy, abscess and biloma because of ability of MRC to identify parenchymal lesions regardless of their communication with the bile duct. Bile stasis and chronic infection have been suggested to lead to epithelial adenomatous hyperplasia and cholangiocarcinoma[14, 33]

We did not have any case of cholangiocarcinoma in our study. ERCP can be used for diagnosis and intervention, while MRCP is used for diagnosis only and is devoid of complication associated with ERCP, thus both can be used as complementary techniques.[34]

There are some limitations in our study. We studied only those patients, who were having cholangitis and required endoscopic drainage before surgery, but not all consecutive patients of RPC or other hepato biliary disease that were seen during the study period. This was done to use the most sensitive method as a reference standard to confirm our imaging finding. The use of combined surgical, intraoperative cholangiography and pathological findings as gold standard reference may offer the best methods, but the possibility of false-negative results cannot be excluded altogether because pathological examination of entire liver except for resectablesegment cannot be performed.(Fig:7**)** Though RPC is prevalent in South East Asia, this disease may be frequently seen in migrant population in West largely as a result of increased migration from Asian countries. The gastroenterologist, radiologist and surgeons in West should be aware of such condition in these migrant populations. Combination of endoscopic, radiologic interventions & surgical techniques are often required.[35]

CONCLUSION:

In conclusion, MRC is superior to ERCP for accurate topographic evaluation of intrahepatic stones in RPC. Findings in our study show that MRC has the great potential to delineate the entire biliary tact regardless of the presence of strictures. Is non-invasive, requires no contrast material and is devoid of significant complications associated with ERCP. Patients should be screened for contraindications such as pacemakers, prosthetic valve implant, cerebral clips, and claustrophobia. MRC should be performed in RPC as a diagnostic tool to plan modality of treatment.

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