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Causes Of Obstructive Jaundice As Evaluated By MRCP And Ultrasound Diagnosis

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ABSTRACT

In this present study 38 patients were examined with obstructive jaundice using Ultrasound and MRCP. "The patients taken for present study were suffering from various disease of the biliary tree or the pancreas. The efficiency of MRCP as an imaging modality of choice in comparison with Ultrasound has been examined."

MRCP displays the entire biliary tract and pancreatic duct without any Intervention or use of oral or IV contrast. "The qualities of images acquired are comparable with those of direct cholangiography procedure like ERCP, which is considered as standard of reference in ductal pathologies. The diagnostic accuracy of MRCP gives it strong potential to replace the more invasive procedures like diagnostic ERCP, which should be used only in cases where intervention is being contemplated."

It has shown to have high accuracy in showing bile duct dilatation, stricture and calculi. "In patients with malignant stricture or obstruction of biliaryenteric anastomosis, this noninvasive imaging technique demonstrates the site and extent of the stenosis, the degree of proximal dilatation, the presence and size of biliary stones, and associated findings."

INTRODUCTION

Since the introduction of MRCP by Wallner et al. in 1991, "it has seen a wide range of changes. Its main strength being heavilyT2-Weighted image sequences that display stationary water as high signal (hyperintensity). Multiplanar thin and thick sequence acquisitions are obtained using fast spin– echo techniques. Magnetic Resonance Cholangiopancreatography with its characteristic high contrast resolution, speed, multiplanar capability and almost artefact free display of anatomy and pathology, is proving to be imaging of choice in these patients."

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In this present study 38 patients were examined with obstructive jaundice using Ultrasound and MRCP. "The patients taken for present study were suffering from various disease of the biliary tree or the pancreas. The efficiency of MRCP as an imaging modality of choice in comparison with Ultrasound has been examined."

Research Objectives

a) "To evaluate the diagnostic accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) in diagnosis of the level and cause of obstruction in patients with obstructive Jaundice."

b) "To establish the accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) over ultrasound in assessing the causes of obstructive Jaundice."

Review of Literature

Common hepatic duct:

At the right end of porta hepatis, the right and left hepatic duct unite to form common hepatic duct (about ± 1cm below the edge of liver). On imaging modalities it is seen as round or elliptical structure just right of portal vein. Thenormal measurement is between 3 to 6 cm in short axis diameter. The wall of CHD usually measures less than 1.5 mm. CHD passes downward for about 3 cm and is then joined by cystic duct on right side, forming acute angle; common bile duct is thus formed[(1)].

Gall Bladder:

It is a pear shaped hollow viscus, contained in fossa which is at the inferior surface of right hepatic lobe. It usually measure 7- 10 cm in length, 3-5 cm in width, wall thickness being less than 3 mm and has a capacity of 30 – 50 ml.It has four parts - fundus (part palpable in vivo), infundibulum or Hartmann's pouch (located at free edge of lesser omentum with a bulge towards cystic duct), body and neck. From upper and left wall cystic duct arises. The gall bladder wall appears T2W hypointense and shows intermediate signal on T1W images; shows uniform enhancement after administration of gadolinium based contrast.

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Normal bile shows uniform bright T2W signal intensity and on T1W images bile shows variable signal intensity depending on its concentration.(1)

Cystic duct:

The cystic duct measures 2-4 cm in length, with diameter ranging from 1- 5 mm. It has serpengious course. It gets connected to extrahepatic bile duct, approximately half way between porta hepatis and ampulla of vater and is right of hepatic artery. Cystic duct also has undulating contour due to valves of Heister. Normally it is seen as small tubular fluid containing structurebetween gall bladder and bile duct on T2W and MRCP. (1)

Common bile duct:

It is the portion between papilla and cystic duct. It is usually 7.5 cm in length and 6 cm in diameter, which increases 1mm per decade thereafter. Normally it courses through pancreatic parenchyma, in a groove in posterior aspect of pancreatic head. At the left side of descending part of duodenum CBD and pancreatic ducts comes in contact and accompanies it to wall of second part of duodenum, where they unite to form hepatopancreatic ampulla. The distal part of this ampulla is constricted, which opens into descending duodenum on summit of major duodenal papilla. (1)

Pancreatic duct:

Main pancreatic duct measures 9.5 – 25 cm in length with average diameter being approximately 2 mm. The duct is commonly arranged in either “sigmoid configuration” (ascending – horizontal - ascending) or “pistol” configuration (ascending – horizontal - horizontal). As a rule, only a small anterior part of pancreatic head is drained by accessory pancreatic duct (of Santorini) and enters duodenum at small accessory papilla. It communicates with main pancreatic duct in pancreatic head. (1)

The basic principle of MRCP is to see static fluid structures such as Gall bladder, cystic duct, hepatic duct, bile duct and pancreatic duct using heavily T2 weighted spin echo images and gradient echo images with fat saturation technique.

“As CT was becoming popular MR Cholangiography was introduced by Wallner et al. Authors used the rapid sequence gradient echo acquisition with three-dimensional post processing technique to evaluate the biliary system in five healthy volunteers and 13 patients of obstructive jaundice. The results were compared with other imaging modalities (US, CT scan and conventional radiographs obtained during PTC or ERCP). Authors concluded that MRCP has the capability for noninvasive imaging of the biliary tree in patients with obstructive jaundice but improvement in technique is needed to overcome limited spatial resolution and low signal to noise ratio”[2].

“3D MR cholangiography using contrast enhanced Fourier acquired steady state technique

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(CE-FAST) was evaluated by Morimoto et al in 12 patients with malignancy related obstructive jaundice and the results were correlated with percutaneous transhepatic biliary drainage performed 0-21 days later. Authors found dilatation and obstruction of the bile ducts were clearly demonstrated in all patients on MRCP and there was 100% correlation with PTBD gram. Authors concluded that though spatial resolution of 3D MR cholangiography is slightly inferior to the direct cholangiography the information obtained is similar to PTC and the non-invasive MR Cholangiography procedure is less traumatic for the patient."

Mi Suk Park et al (2004) in their retrospective study of "differentiation of extra hepatic bile duct cholangiocarcinoma from benign stricture. Findings at MRCP versus ERCP, in 50 patients showed that accuracy of MRCP is comparable with that of ERCP. Regardless of modality a long segment of extra-hepatic bile duct stricture with irregular margin and asymmetric narrowing suggests cholangiocarcinoma, and short segment with regular margin and symmetric narrowing suggest benign stricture"[3].

Anderson M et al (2005) in their study of "MRI with MRCP with 51 patients of obstructive jaundice found that MR imaging is more accurate than CT in differentiating between malignant and benign lesions in patients with suspected periampullary tumours mainly due to the information obtained on the MRCP images of biliary and pancreatic duct anatomy"[4].

Bhatt C et al (2005) in their study of "50 patients with biliary and pancreatic pathology determined that USG is the cheap and easily available modality in patients suspected to have biliary and pancreatic pathology and MRCP has high diagnostic value"[5].

Seung Hong Choi et al (2005) in their study of "differentiating malignant from benign common bile duct stricture with multiphasic helical CT with 50 patients showed that hyper-enhancement of involved CBD during the portal phase is the main factor distinguishing malignant from benign CBD strictures"[6].

Several studies done on different modalities have claimed superiority of different modalities. This study aims to compare the commonly availablemodalities in the Indian set up and prove the efficacy of the individual modalities.

Material and Methods

Research Plan

"The study was conducted in the department of Radio Diagnosis, KRISHNA INSTITUTE OF MEDICAL SCIENCES & HOSPITAL. All the patients were referred to the department of Radio diagnosis with the clinical suspicion of obstructive jaundice and elevated serum bilirubin levels."

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Study Population:
All the patients with obstructive jaundice who were referred for USG and were prospectively evaluated by MRCP.

Type Of Study:
Observational.

Study Design:
"Prospective observational longitudinal study."

Total Study Period:
"24 months"

Study Area:
"Department of Radiodiagnosis, KRISHNA INSTITUTE OF MEDICAL SCIENCES & HOSPITAL"

Sample Size:
Rationale for sample size calculation: (Diagnostic accuracy of MRCP as compared to Ultrasound/CT in patients with obstructive jaundice; J Clin Diagn Res. 2014 Mar; 8(3); 103-107. Published online 2014 Mar. doi: 10.7860/JCDR/2014/8149.4120).

	USG – DA (%)	MRCP- DA(%)
Benign Conditions	88	98
Malignant Conditions	88	98

$$N=\frac{(p1q1+p2q2)\ X\ \{Z\ (1-a/2)\ +\ Z\ (1-b)\}}{(p1-p2)^2}$$

i.e.: 95% confidence and 80 % power.

Calculating from above formula and taking into account the prevalence of study in our institute for past 5 years:
Sample Size – 25.

Method Of Data Collection:
All participating patients were made "aware of the study and informed consent to participate in the study was taken from them. Recruitment for the study was done in the USG Room, based on the inclusion and exclusion criteria during the study period."

"Ultrasound was performed on GE{LOGIQ p-5 Ver R-4.0} and Siemens Acuson Juniper machine using a 3.5 MHz curvilinear transducer. **MRCP** was performed on Siemens 1.5

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Tesla MRI Scanner. All images were obtained with breath holding and parameters were individualized."

Sonographic Technique:
First routine intercostal view was done for liver and intrahepatic biliary duct were examined. Then subcostal oblique view, with transducer pointing towards right shoulder was done, sweeping from shoulder to umbilicus to assess porta hepatis. Ninety degree to this was done to see long axis view of CHD & CBD. Distal ducts were difficult to assess and depended on various aspects, but the most favorable view for seeing the distal CBD was through epigastrium.

Inclusion Criteria:

- Symptoms of obstructive jaundice were to be seen in All patients with clinical symptoms suggestive of obstructive jaundice.
- All patients with Total Bilirubin more than 5mg/dl.

Exclusion Criteria:

- "MRI incompatibility (metal implants, dental filling, pacemakers etc...)"

"Claustrophobia"			
"Critically ill patients on life support Patients not giving consent."			
"Patient Satisfies all Inclusion Criteria":	Yes	|	No
"No Exclusion Criteria applies to the Patient":	Yes	|	No
"Patient is eligible for Inclusion in the Study"	Yes	|	No

Study Technique
The study was commenced after Institutional Ethics Committee approvalwas finalized. "Then patient selection was done as per inclusion and exclusion criteria. Written informed consent were collected from the selected patients."

"After a brief initial history and examination, the details were seen from the patient's OPD Card or Bed Head Ticket (if the patient is admitted)."

Data Analysis:
"Data was compiled in MS excel sheet and then analyzed using online statistical calculator. Statistical Analysis was performed with help of Epi Info (TM) 7.2.2.2 EPI INFO isa trademark of the Centers for Disease Control and Prevention (CDC)."

Using this software, "basic cross-tabulation, inferences and associations were performed. Chi-square test was used to test the association of different study variables with the study

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groups. Z-test (Standard Normal Deviate) was used to test the significant difference between two proportions. t-test was usedto compare the means. $p < 0.05$ was considered to be statistically significant."

Study Variables

- Age
- Sex
- Distribution of diseases
- USG findings
- MRI findings
- Level of Obstruction
- Status of CBD
- Status of IHBR
- Status of MPD
- Pancreas
- Associated findings
- FNAC/HPE

Ethical Issues:

a) "Protocol of the study was sent to the Institutional Ethics Committee and hard copy along with soft copy submitted to KRISHNA INSTITUTE OF MEDICAL SCIENCES DEEMED UNIVERSITY for approval."

b) Study will be solely be used for academic purposes only.

c) Anonymity and confidentiality will be ensured.

Observation and Results

Demographic parameters:

Table-1: Distribution of age of the patients

Age Group (in years)	Number	%
<40	1.00	2.6%
40 to 49	7.00	18.4%
50 to 59	10.00	26.3%
60 to 69	10.00	26.3%
70 to 79	9.00	23.7%
More than 80	1.00	2.6%
Grand Total	38.00	100.0%
Mean ± s.d.	59.52±11.22	
Median	60.00	
Range	39 - 86	

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Table-2: Distribution of age and gender of the patients

Age Group (in years)	Gender		TOTAL
	Male (n=24)	Female (n=14)	
<40	1	0	1
Row %	100.0	0.0	100.0
Col %	4.2	0.0	2.6
40 - 49	4	3	7
Row %	57.1	42.9	100.0
Col %	16.7	21.4	18.4
50 - 59	4	6	10
Row %	40.0	60.0	100.0
Col %	16.7	42.9	26.3
60 - 69	8	2	10
Row %	80.0	20.0	100.0
Col %	33.3	14.3	26.3
70 - 79	6	3	9
Row %	66.7	33.3	100.0
Col %	25.0	21.4	23.7
≥80	1	0	1
Row %	100.0	0.0	100.0
Col %	4.2	0.0	2.6
TOTAL	24	14	38
Row %	63.2	36.8	100.0
Col %	100.0	100.0	100.0
Mean ± s.d.	61.00±12.24	57.00±9.09	
Median	60.5	57	
Range	39 - 86	45 - 70	

X^2 =4.84; p=0.34 NS- Not significant

Table-3: Diagnostic distribution of the patients

Diagnosis	Number	%
"Cholangiocarcinoma"	9.00	23.7%
"Common bile duct calculi"	8.00	21.1%
"Gall bladder calculi with Common bile duct calculi"	5.00	13.2%
"Pancreatic carcinoma"	5.00	13.2%

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"Gall bladder calculi"	4.00	10.5%
"Cystic duct calculi"	2.00	5.3%
"Papillary stenosis"	2.00	5.3%
"Biliary cystadenoma"	1.00	2.6%
"Gall bladder carcinoma"	1.00	2.6%
"Hepatic calculi"	1.00	2.6%
Total	38.00	100.0%

"Prevalence of Common bile duct calculi (34.3%) followed by Cholangiocarcinoma (23.7%) were significantly higher than that of other diagnoses (Z (=2.74; p<0.001)."

Table-4: Distribution of level of obstruction of the patients

"Level of obstruction"	**Number**	**%**
"Suprapancreatic"	15.00	39.4%
"Periampullary"	14.00	36.8%
"Suprapancreatic + Periampullary"	6.00	15.8%
"Periampullary + Pancreatic"	2.00	5.3%
"Hepatic"	1.00	2.6%
Total	38.00	100.0%

Table-5: Distribution of IHBR status of the patients

IHBR status	**Number**	**%**
Dilated	26	68.4%
Not dilated	12	31.6%
Total	38	100.0%

In 68.4% of the cases CBD were dilated which was significantly higher thanthat of not dilated

Table-6: Distribution of MPD status of the patients

MPD status	**Number**	**%**
Dilated	11	28.9%
Not dilated	27	71.1%
Total	38	100.0%

Table-7: Distribution of other findings of the patients

Other Findings	**Number**	**%**
Fatty Liver	8	21.1%
Lymphadenopathy + Ascites	8	21.1%

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Lymphadenopathy	3	7.9%
Hepatosplenomegaly + Ascites	2	5.3%
Ascites + Cholecystitis	1	2.6%
Cholecystitis	1	2.6%
GB + CB Cal	1	2.6%
GB Cal	1	2.6%
GB Cal + Ascites	1	2.6%
Heaptosplenomegaly	1	2.6%
Hepatosplenomegaly + GBCal	1	2.6%
Metastatic liver + Lymphadenopathy	1	2.6%
Pancreatic cyst	1	2.6%
Pseudocyst infiltrating into liver	1	2.6%
Normal	7	18.4%
Total	38	100.0%

Table-8: Distribution of gender of the patients for different kind ofobstruction

Gender	**Reason of obstruction**		**Z**	**p-value**
	Common bile duct calculi (n=13)			
	Number	**%**		
Male	7	53.8%	1.13	0.26 NS
Female	6	46.2%		
	Cholangiocarcinoma (n=9)			
Male	5	55.6%	1.69	0.09 NS
Female	4	44.4%		
	Pancreatic carcinoma (n=5)			
Male	4	80.0%	8.48	<0.0001 S
Female	1	20.0%		
	“Gall bladder calculi with common bile duct calculi (n=5)”			
Male	2	40.0%	2.82	0.005 S
Female	3	60.0%		
	Gall bladder calculi (n=10)			
Male	6	60.0%	2.82	0.005 S
Female	4	40.0%		

NS-Statistically not significant S-Statistically significant

For Gall bladder calculi the proportion of females were significantly higher than that of males ($p<0.01$).

Thus “MRCP correctly diagnosed the cause of obstructive jaundice in 89.5% cases whereas

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USG could diagnose it in 78.9% cases. Fisher exact test showed us that the performance of MRCP when compared to USG was statistically more significant ($p<0.05$)."

Table-9: Association between findings of USG and HP findings todiagnose obstructive jaundice

	HP findings		
USG Finding	**Benign**	**Malignant**	**TOTAL**
Correctly diagnosed	18	11	29
Row %	62.1	37.9	100.0
Col %	85.7	64.7	75.2
Not correctly diagnosed	3	6	9
Row %	33.3	66.7	100.0
Col %	14.3	35.3	24.8
TOTAL	21	17	38
Row %	47.7	52.3	100.0
Col %	100.0	100.0	100.0

"Out of the 21 benign cases as per HP findings 18(85.7%) were found to beobstructive by USG."

"Out of the 17 malignant cases as per HP findings 2 (11.8%) were found to beobstructive by USG & MRCP."

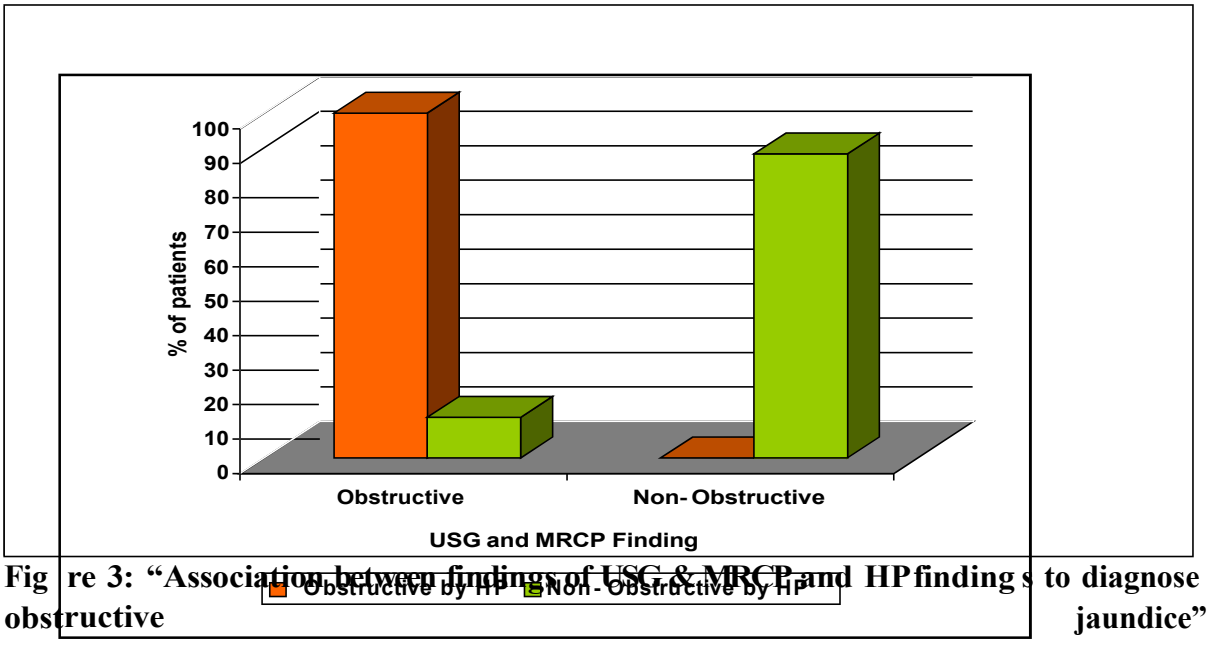

Fig re 3: "Association between findings of USG & MRCP and HP findings to diagnose obstructive jaundice"

Discussion

There was no significant difference between age of presentation between male and female

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patients, however the mean age of presentation for female patients was less than that of male patients, thus female had higher risk of presenting with obstructive jaundice at a younger age than male patients.

"Among the patients participating in the study, after imaging, 60.5 % were found to have benign cause which was significantly higher than malignant causes (39.5%)."

"USG was done before MRCP for all patients. While in USG, features and causes of obstructive jaundice were found thirty patients, it was unable to find the causes in eight patients. Whereas MRCP was successful in finding the causes of obstructive jaundice for thirty four cases." MRCP showed calculus as an area of signal void on T2 sequences and hyperintense on T1 vibe sequences; and USG showed it as hyper-echoic lesion with posterior acoustic shadowing.

"The present study is in accordance with the study of Soto et al, 2000 where they found, sensitivity of 94% and specificity of 100% for detection of biliary calculi in MRCP 56."

"This is comparable to the study conducted by Hunt et al. which stated that sensitivity of approximate 77% on ultrasound" [7].

Cronan et al study found that the sensitivity of ultrasonography was higher in the proximal CBD than in its distal part [8].

Future Scope:

With the advent of MRI guided interventions it can be soon possible in the coming times to use MRCP for diagnostic as well as therapeutic applications for various pathologies of biliary tract and pancreas.

CONCLUSION

Prime role of MRCP was to decrease or eliminate the requirement for diagnostic ERCP, which is invasive procedure and also give detail anatomyfor therapeutic ERCP. MRCP is swiftly developing procedure which is noninvasive and used forevaluation pancreatico-biliary pathologies. MRCP is able to give highly accurate images of biliary tree, which can becomparable to that of direct cholangiography.

Pitfalls of MRCP:

Motion artifacts due to respiratory movement by the patient. There are limitations in image acquisition, especially for breath hold sequences, if the patient is very ill, asthmatic or has respiratory illness. Susceptibility artifact. There is possibility of complete obscuration of a very tiny filling defect in maximum intensity projection 3D reconstructed images, because of partial volume effect; thus the final diagnosis should always be done after evaluation of

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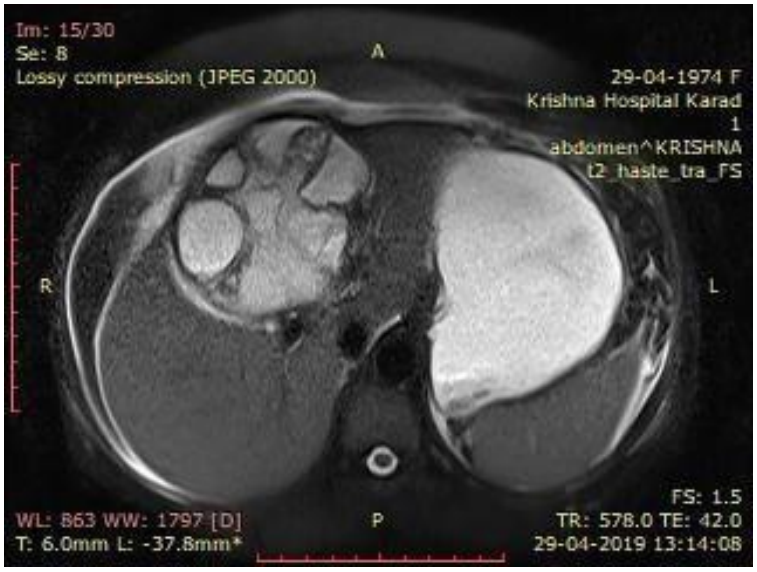
multiple source images. Spatial resolution is limited when compared to ERCP where there is direct opacification of biliary tree with contrast.

IMAGES

Illustration number 1: Biliary cystadenoma



"T2 haste ax FS section shows well defined round hyperintense lesion in liver with multiple round septae within. It was misdiagnosed as hepatic hydatid, but turned out as biliary cystadenoma."

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