

# Role of MRCP and USG in Cases of Choledocholithiasis

Dr. Mohammadali Shabbir Ali Jiwani<sup>1</sup>, Dr. Ashutosh Kharche<sup>2</sup>, Dr. Atieya Ali Jiwani<sup>3</sup>

<sup>1</sup>M.B.B.S, Resident Radiology JR3

<sup>2</sup>M.B.B.S, Resident Radiology JR2

<sup>3</sup>M.B.B.S Intern

**Abstract:** Surgical jaundice is one of the challenging conditions to the surgeons due to its high morbidity and mortality. With successive evolution in techniques of diagnosing choledocholithiasis from ERCP to USG to CT to MRCP one must know utility and advantages and disadvantages of each modality while moving forward for investigation. Out of all causes of obstructive jaundice both malignant and benign choledocholithiasis found to be most common benign cause. We get encounter with choledocholithiasis in daily practices. So is important to know which is best modality of choice for diagnosing choledocholithiasis also we must know limitations and advantages of each modality. USG is primary modality of screening chosen by surgeons while in the era of MRI, MRCP becomes best diagnostic modality. We had included total 100 subjects with suspected obstructive jaundice out of which 44 patients were of choledocholithiasis (27 females and 17 males). Most of the patients presented with yellowish discoloration of sclera and right upper quadrant pain followed by dark coloured urine and clay coloured stools. Out of all serological investigations done by patient there was significant raise in levels of serum total bilirubin(conjugated), serum GGT and serum ALPK seen. Majority of patient in our study were in age group of 31-45 years of age. In our study we have concluded that MRCP is better modality with high sensitivity, specificity and diagnostic accuracy as compared to USG also with use of MRCP invasive procedures like ERCP can be avoided just for diagnostic purpose. We have also noticed few limitations of both USG and MRCP in process of diagnosis.

**Keywords:** MRCP, USG, ERCP, choledocholithiasis

## 1. Introduction

Obstructive jaundice is one of the most challenging condition faced by surgeons due to it high mortality and morbidity<sup>1</sup>. Out of all benign and malignant causes of obstructive jaundice choledocholithiasis is the most common benign cause.<sup>2</sup> we come across cases of choledocholithiasis daily in our practice. Patients with choledocholithiasis presents with variable symptoms like yellowish discoloration of sclera, upper abdominal pain, dark coloured urine, although out of all patients of choledocholithiasis with or without cholelithiasis remain silent in 5-15 percent of cases.<sup>3</sup>

Despite of fact its benign nature diagnosis of choledocholithiasis is important because it is associated with various dreadful complications like pancreatitis, cholangitis, cholangiocarcinoma & carcinoma gall bladder is associated with high mortality and morbidity<sup>4</sup>.

There are various invasive and non invasive methods are available for detection of choledocholithiasis. Invasive modality like ERCP and non invasive modality like USG, MRCP and CT. All modalities have their own advantages and disadvantages with limitations in diagnosing choledocholithiasis. It is must to choose wisely better modality so that there shall be less economical load over patients with good diagnostic out come. It is always USG which is chosen as modality of primary screening by surgeons to differentiate obstructive from non obstructive cause. USG is non invasive radiation free modality however it has limitation in detecting distal common bile duct pathology due to presence of excessive gases and fat <sup>5</sup>. CT found to have lower sensitivity in diagnosing

choledocholithiasis and having disadvantage in its limitation in detecting radiolucent calculi and its radiation hazards<sup>6</sup>.

MRCP is radiation free non invasive modality of choice having diagnostic accuracy reaching approximately up to 100 %

## 2. Aims and Objectives

It is a prospective study with aim to determine role of MRCP and USG in cases of choledocholithiasis taking ERCP as gold standard for final diagnosis.

## 3. Materials and Methods

Approval of study taken from ethical committee of our institution. Consent has been taken from all patients undergoing USG and MRCP. We have prospectively studied 100 patients of obstructive jaundice out which we found 44 cases of choledocholithiasis (27 females and 17 males) in the age range 12-80 years over a period starting from July 2014-August 2016 at AVBRH attached to JNMC sawangi meghe wardha Initial USG evaluation was followed by MRI/MRCP. USG was performed with Aloka (prosound 7 alpha) and MRI/MRCP with 1.5 tesla 4E (model: BRIVO MR355). MRCP was done in all patients using our standard MRCP protocol.

### **Inclusion Criteria:**

Patients referred to the department of radio diagnosis sawangi meghe wardha with clinical suspicion of obstructive jaundice.

**Exclusion Criteria:**

The study will exclude

- Patients not giving consent
- Patient having history of claustrophobia.
- Patient having history of metallic implants or cardiac pacemaker's insertion.
- Patient who requires sedation or ventilation.

**4. Results**

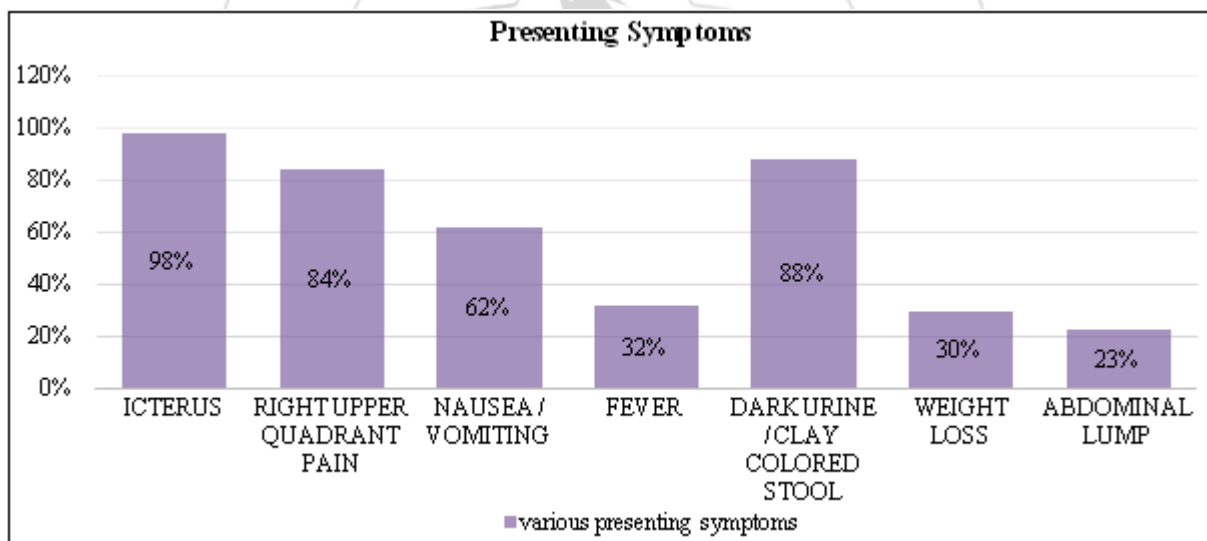
Our study was conducted for determining role of MRCP and USG in cases of choledocholithiasis taking ERCP as gold standard for comparison. We have prospectively studied 100 patients of obstructive jaundice out of which we found 44 cases of choledocholithiasis (27 females and 17 males), all were subjected to USG and MRCP. The youngest patient in our study suffering choledocholithiasis was 18 year female eldest was 64 years male which was associated with carcinoma gall bladder.

Patient in our study presented with various symptoms we have counted each symptoms separately out of which common symptoms are yellowish discoloration of sclera and skin, right upper quadrant pain, nausea, vomiting, fever, dark coloured urine, clay coloured stools weight loss, lump in abdomen etc. Serum alkaline phosphatase, serum GGT, total serum bilirubin and conjugated bilirubin level were assessed in our cases.

Statistical analysis was done by using descriptive and inferential statistic using CHI square test, binary classification and software using analysis where SPSS 17.0 version and graph pad prism 6.0 version and P<0.05 is considered as level of significance .

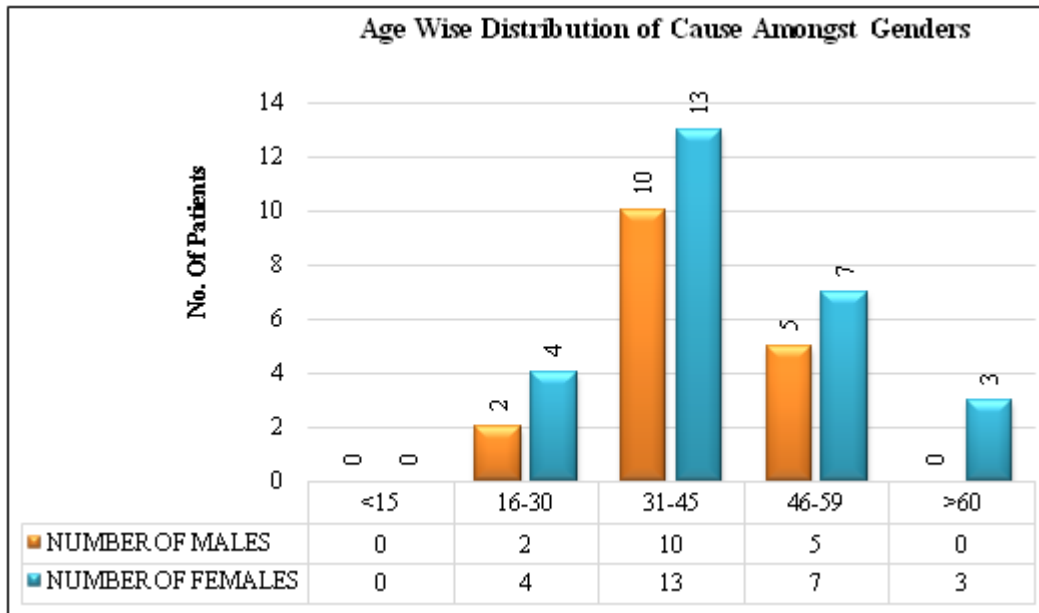
**Table 1:** Showing various presenting symptoms and serological findings in patients with choledocholithiasis:

Presenting symptoms	No of patients	Percentage (%) Total no. of patients (N)=44
Icterus	43	98%
Right Upper Quadrant Pain	37	84%
Nausea / Vomiting	27	62%
Fever	14	32%
Dark Urine / Clay Colored Stool	39	88%
Weight Loss	13	30%
Abdominal Lump	10	23%
Biochemical Parameters	Raised in No.	Percentage
TLC	12	28%
Serum Alpk Levels:	29	66%
Serum Ggt Levels	27	62%
Serum Total Bilirubin:	44	100%
Serum Conjugated Bilirubin	44	100%



**Table 2:** Age wise distribution amongst genders:

Age	Number of Males	Number of Females	Total
<15	0	0	0
16-30	2	4	6
31-45	10	13	23
46-59	5	7	12
>60	0	3	3

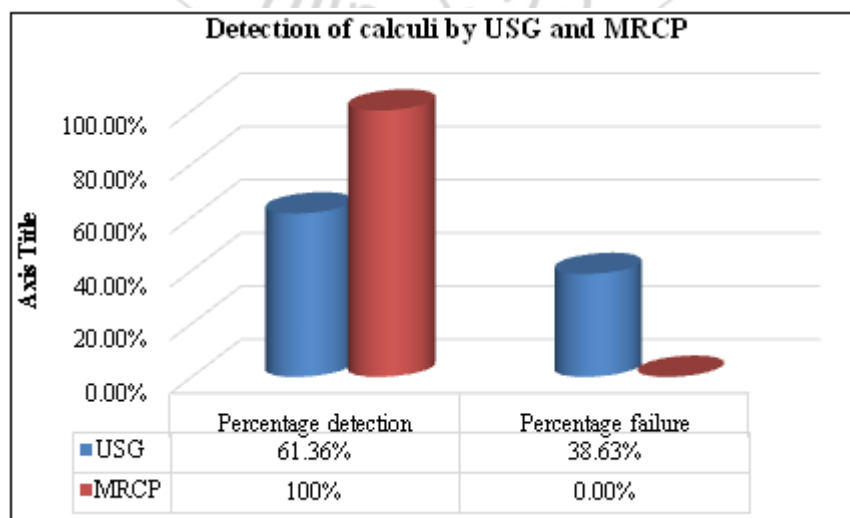
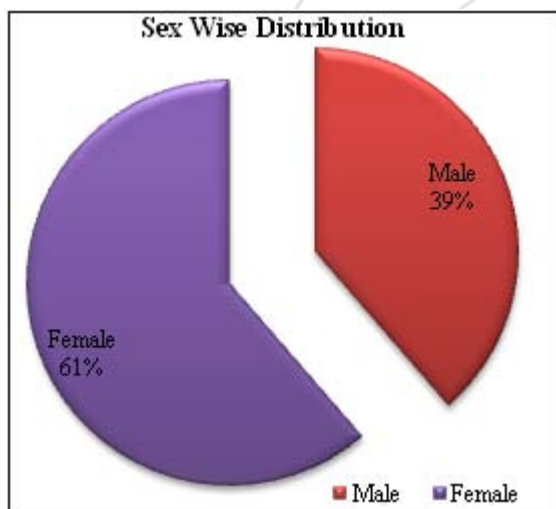


**Table 3: Sex Wise Distribution**

Sex	Male	Female	Total
No of patients	17	27	44

**Table 4: Detection of calculi by USG and MRCP**

Calculi Detected	Yes	Percentage Detection	No	Percentage Failure
USG	27	61.36%	17	38.63%
MRCP	44	100%	0	0



Location, size and number of calculi were studied in our study because of its effect on proximal biliary tract. Knowing about multiplicity of calculi is also important because the therapeutic methods, especially the endoscopic retrograde cholangiopancreatography (ERCP), which extracts them, needs to know exactly their Number prior to the intervention.

**Table 5:** Patients' distribution according to the location of calculi

Level of calculi	Level of calculi		
	Papilla	Proximal	Distal
USG	1	12	14
MRCP	5	14	25

**Table 6:** Patients' distribution according to the number of calculi

Modality	One	Multiple	Total
USG	20	7	27
MRCP	32	12	44

**Table 7:** Patients' distribution according to the calculi size:

Modality/size	<3mm	3-10mm	>10mm	Total
USG	0	16	11	27
MRCP	4	22	18	44

**Table 8:** Showing Diagnosis by USG in Comparison With ERCP.

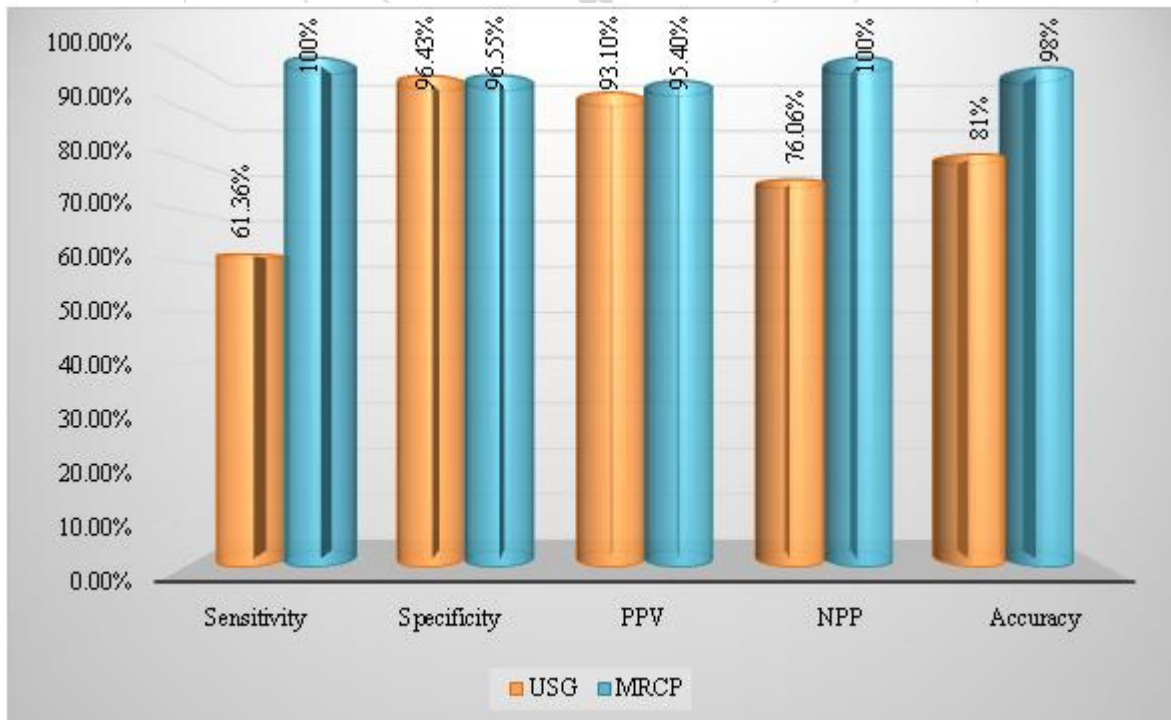
ERCP DIAGNOSIS				
		Test positive	Test negative	Total
USG	Test positive	27	2	45
	Test negative	17	54	55
TOTAL		44	56	100

For USG	Value	RANGE(95% CI)
Sensitivity	61.36%	45.50% to 75.64%%
Specificity	96.43%	87.69% to 99.56%
Positive Predictive Value	93.10%%	77.23% to 99.15%
Negative Predictive Value	76.06%	64.46% to 85.39%
Likelihood Ratio	17.18	4.32 to 68.36
Accuracy	81%	-

**Table 9:** Showing Diagnosis by MRCP in Comparison with ERCP

ERCP DIAGNOSIS				
		Test positive	Test negative	TOTAL
MRCP	Test positive	42	2	45
	Test negative	0	56	55
Total		44	56	100

For MRCP	value	RANGE(95% CI)
Sensitivity	100.00%	91.59% to 100.00%
Specificity	96.55 %	88.09% to 99.58%
Positive Predictive Value	95.45%	84.53% to 99.44%
Negative Predictive Value	100.00 %	93.62% to 100.00%
Likelihood Ratio	29.00	7.43 to 113.20
Accuracy	98%	-



## 5. Discussion

Obstructive jaundice is one of the most challenging condition faced by general surgeons which leads to significantly high mortality and morbidity<sup>1</sup>. Out of all benign causes' choledocholithiasis found to have highest

prevalence in our study which comprises of 44 out of 100 patients. Despite of fact its benign nature diagnosis of choledocholithiasis is important because it is associated with various dreadful complications like pancreatitis, cholangitis, cholangiocarcinoma & carcinoma gall bladder is associated with high mortality and morbidity<sup>4</sup>

Early detection of the cause of obstructive jaundice and nature of the lesion helps surgeon to choose proper line of management. Various radiological investigations play pivot role in diagnosing the lesion, level of obstruction and extent of disease. Our study has been conducted Role of MRCP and USG in cases of choledocholithiasis while keeping ERCP as a gold standard for final diagnosis. The youngest patient in our study suffering choledocholithiasis was 18 year female eldest was 64 years male which was associated with carcinoma gall bladder.

In our study there were total 27 females and 17 males suffering choledocholithiasis; showing female preponderance This result is consistent with a study conducted Khurram Siddique et al<sup>7</sup> and Park et al<sup>8</sup>; stated that presence of gall stones attributed to cholesterol stones are presumed to be related to metabolic disorders, which are more commonly seen in women and malignancy predominates in males due to their habits of alcohol abuse and tobacco chewing. Maximum number of patients were seen in age group 31-45years with mean age of presentation  $38 \pm 10$  years.

In our study majority of patients of obstructive jaundice presented with icterus (98%), right upper quadrant pain (84%), dark coloured urine and clay coloured stools (88%). And out of all serological assessment done significant changes were seen in serum alkaline phosphatase (66%), serum GGT (62%) and serum conjugated bilirubin (100%). Similar study results were given by Verma et al<sup>9</sup> and Hayat JO and co-workers stated that Obstructive jaundice is characterized by the raised levels of serum alkaline phosphatase rather than aspartate transaminase.<sup>10</sup>

In the study of JC Pereira-Lima et al.,<sup>11</sup> alkaline phosphatase had a sensitivity of 74.7%, total bilirubin had a sensitivity of 73.6% and the least sensitive biochemical parameter was aspartate aminotransferase (AST).

All patients in our study underwent USG prior to MRCP, out of all causes 44 were suffering choledocholithiasis. 27 cases were females 17 cases were males. USG successfully detected 27 cases while in 2 cases it misdiagnosed as calculus, 1 out of them was further diagnosed as cholangiocarcinoma and 1 was adenomyomatosis on histopathology and in remaining 17 cases USG was not able to detect the calculus due to fatty patient and excessive bowel gases. MRCP diagnosed all true positive cases of choledocholithiasis while it showed calculus in 2 cases which turned out to be cholangiocarcinoma and adenomyomatosis respectively as MRCP is flow void based study it failed to diagnose specific cause in this two cases. On retrospective examination of films it had observed that calculus do have smooth contour while growth will have asymmetric irregular margin. Still we have no conclusion regarding this observation.

Knowing exact location, size and number of calculus is important because it has direct effect on upstream biliary tract. in our study we had observed out of all 27 calculus detected by USG it has diagnosed 1 case having calculus within papilla, 12 in proximal common bile duct while 14 were seen in distal common bile duct in location. While

MRCP detected 5 patients having calculus within papilla 14 causing proximal common bile duct obstruction and 25 were causing distal common bile duct obstruction.

USG showed 20 patients having single calculus while 7 having multiple calculus. While MRCP diagnosed 32 single calculus and 12 having multiple calculus. MRCP showed to have high sensitivity in diagnosing small calculus as small as 3 mm while USG diagnosed smallest calculus of size 6 mm our study has shown similar results as Petrescu I et al; 6 Norero emphasized too [12]. The effectiveness of MRCP is the greatest especially in very small calculi compared to CT and USG.

Over all sensitivity, specificity and diagnostic accuracy of USG found to be 61.36%, 96.43% and 81% and of MRCP 100 %,96.55% and 98 % respectively. Our study is consistent with Varghese et al<sup>13</sup> who in 1999 reported that USG in the detection of CBD stones showed sensitivity, specificity and accuracy of 91 %, 88 % & 92 % respectively. Other similar studies are Laokpessi et al 2001<sup>14</sup> and Soto et al 2000<sup>15</sup>; in their study they found sensitivity of 94% and specificity of 100% for detecting biliary calculi on MRCP. Meena Suthar et al<sup>16</sup>; in 2015 found sensitivity, specificity and accuracy of 100 %, 100% and 100 % on MRCP. Similar results seen by Kim et al<sup>17</sup>. Ankur Mandelia et al;<sup>4</sup> showed sensitivity of 95% (19 of 20 patients) in the demonstration of common duct stones and a specificity of 90% (9 of 10 patients).

The positive predictive value of MRCP was 95% (19 of 20), whereas the negative predictive value was 90% (9 of 10 patients). Ultrasonography is the initial imaging test which is used in the evaluation of patients with suspected bile duct stones. The sensitivity of trans-abdominal ultrasound in the detection of choledocholithiasis is operator dependent and it varies between 20 and 80% [18-21]. The stone detection rate is also influenced by patient factors such as the number, size and site of stones, patient's body habitus and presence of overlying bowel gas. The sensitivity, specificity and positive and negative predictive values of ultrasonography in detecting CBD stones in the study done by Ankur Mandelia et al;<sup>4</sup> were 65%, 60%, 76.47% and 46.15% respectively.

In our course of study we have observed its association with repeated pancreatitis, cholangio carcinoma and carcinoma gall bladder, choledochal cyst but we need to evaluate more number of patients before reaching any conclusion.

## 6. Summary and Conclusion

In our prospective study of 100 patients we had 44 cases of choledocholithiasis out of which there were 27 females and 17 males showing female preponderance. The main aim of our study was to determine. Role of MRCP and USG in cases of choledocholithiasis. Out of our study we have concluded that MRCP has shown to have high sensitivity, specificity and diagnostic accuracy as compared to USG in detecting presence of calculus, its level, multiplicity and effect on proximal biliary tract. Over all sensitivity, specificity and diagnostic accuracy of USG found to be 61.36%, 96.43% and 81% and of MRCP 100 %,96.55% and 98 % respectively.

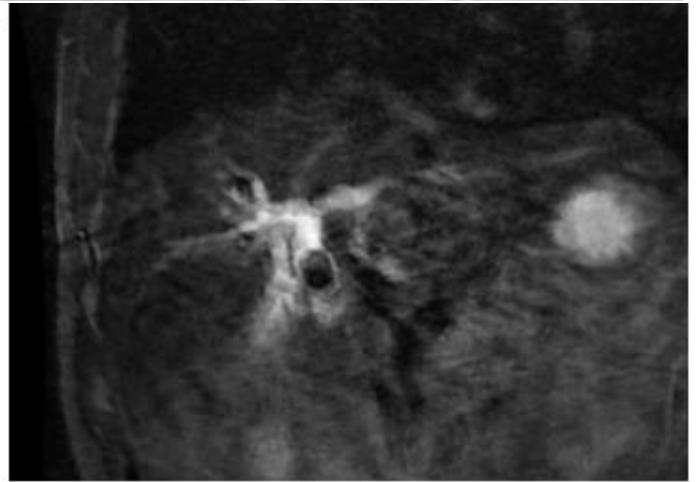
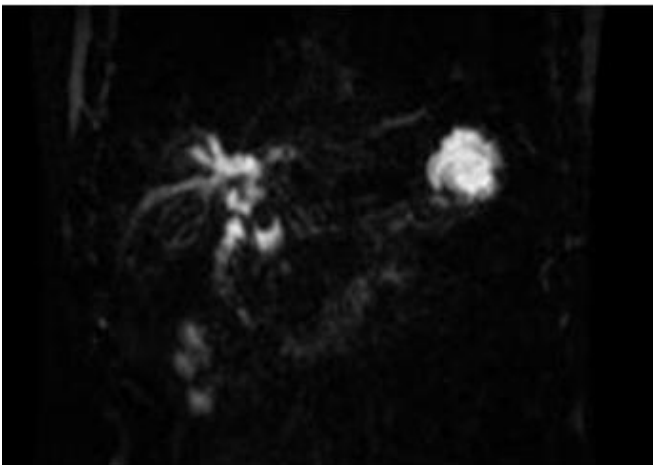
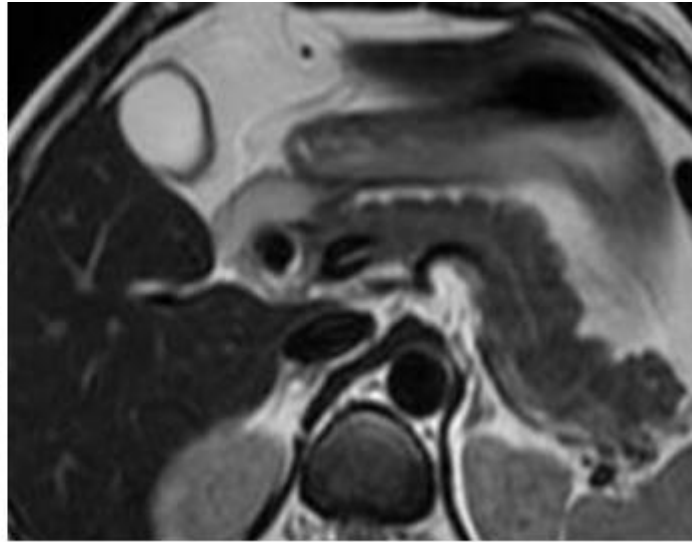
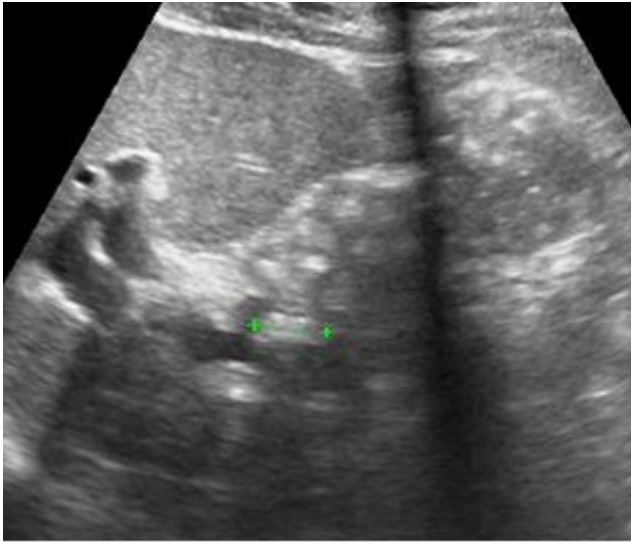
MRCP has shown to have accuracy in diagnosing choledocholithiasis comparable to ERCP. With the use of MRCP we can replace use of ERCP solely for diagnosis. Also we can avoid complications associated with ERCP like cholangitis, biliary leak and pancreatitis.

In suspected cases of calculus as a cause of obstructive jaundice one must go for MRCP prior to ERCP for a diagnosis purpose. Being non-invasive radiation free, multiplaner capability, no use of contrast media and high diagnostic accuracy are advantages of MRCP on other hand its inability as therapeutic modality is its limitation. Also we have observed its limitation in diagnosing distal bile duct calculus in cases where it is associated with ascites or impacted calculus at ampulla of vater and in cases where there was pseudo calculus sign was present due to forceful contraction of ampulla of vater.

USG is better primary screening modality while MRCP is found to have potential to call gold standard as diagnostic modality.

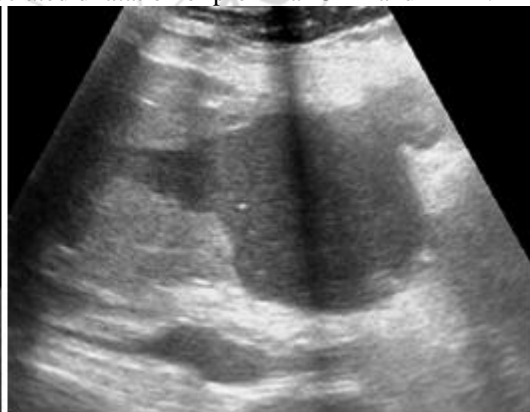
## References

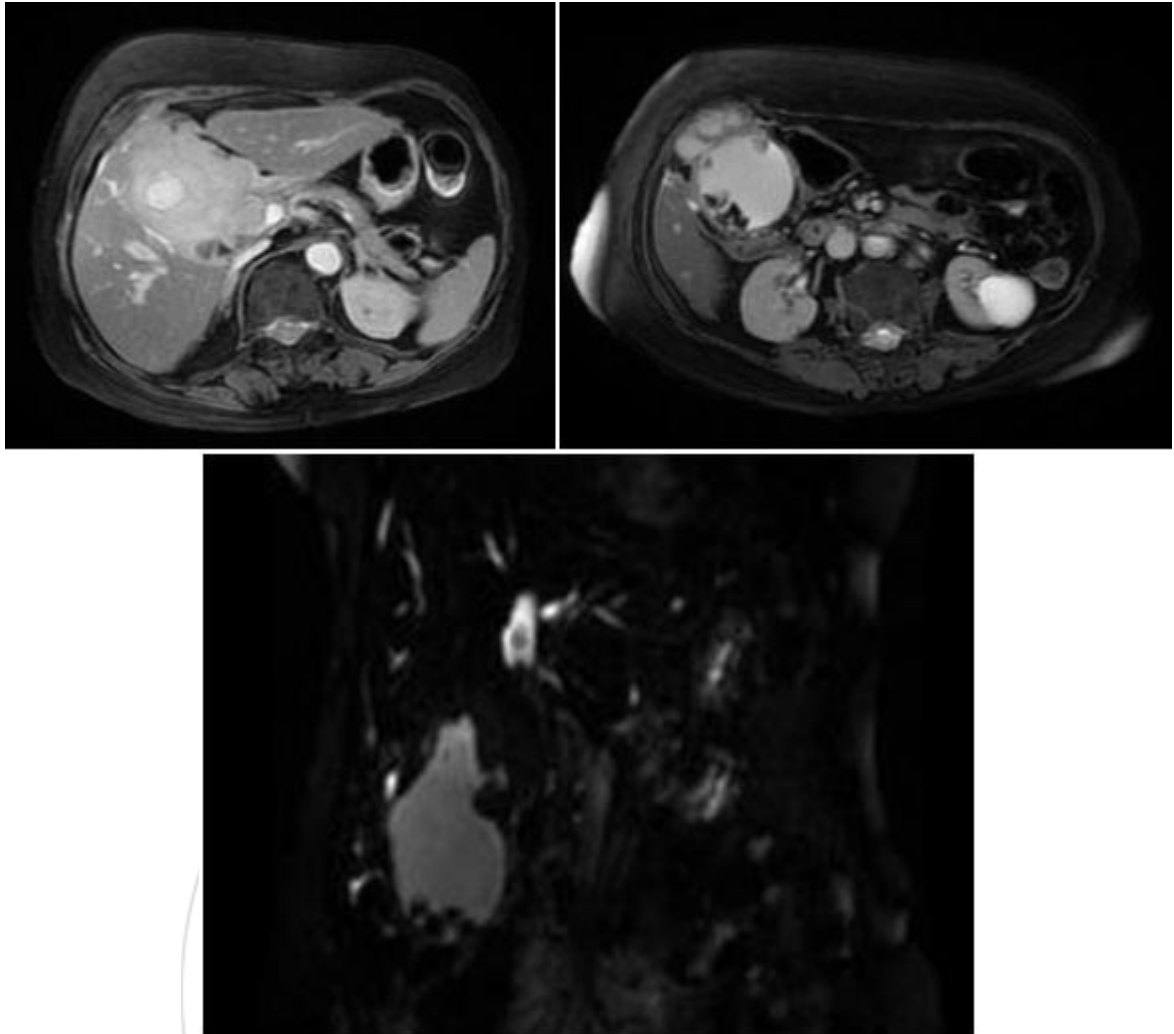
- [1] Ahmad I, Jan AU, Ahmad R. Obstructive Jaundice. *J Postgrad Med Inst* 2001; 15: 194-8.
- [2] Bimal Chandra Roy α, Md. Abu Hanifa σ, Md. Shafiul Alam ρ, Saimun Naher Ϙ & Prosannajid Sarkar PhD Ξ. Etiological Spectrum of Obstructive Jaundice in a Tertiary Care Hospital. *Global Journal of Medical Research: I Surgeries and Cardiovascular System* Year 2015 Volume 15 Issue 4 Version 1.0.
- [3] Topal B, van de Moortel M, Fieuws S, van Beckevoort D, van Steenberg W, Aerts R, et al. The value of magnetic resonance cholangiopancreatography in predicting common bile duct stones in patients with gallstone disease. *Br J Surg.* 2003; 90:42-7.
- [4] Ankur Mandelia et al., The value of Magnetic Resonance Cholangio-Pancreatography (MRCP) in the Detection of Choledocholithiasis. *Journal of Clinical and Diagnostic Research.* 2013 Sept, Vol-7(9): 1941-1945.
- [5] Baron RL: Common bile duct stones. Reassessment of criteria for CT diagnosis. *Radiology* 162:419-424, 1987.
- [6] Petrescu I\*, Bratu AM\*, Petrescu S\*, Popa BV\*\*, Cristian D\*, Burcos T\* CT vs. MRCP in choledocholithiasis jaundice. *Journal of Medicine and Life* 2, April-June 2015 Vol. 8, Issue, pp.226-231.
- [7] Siddique K, Ali Q, Mirza S, Jamil A, Ehsan A, Latif S, Malik AZ. Evaluation of the aetiological spectrum of Obstructive jaundice. *J Ayub Med Coll Abbottabad.* 2008 Oct-Dec; 20(4):62-6.
- [8] Park M.S, Yu J. S, Kim Y H.et al. acute cholecystitis: comparison of MR cholangiography and US. *Radiology* 1998; 209 (3): 781-785.
- [9] S Verma, S Sahai, P Gupta, A Munshi, S Verma, P Goyal. Obstructive Jaundice- Aetiological Spectrum, Clinical, Biochemical And Radiological Evaluation At A Tertiary Care Teaching Hospital. *The Internet Journal of Tropical Medicine.* 2010 Volume 7 Number 2.
- [10] Hayat JO, Loew CJ, Asrress KN, McIntyre AS, Gorard DA. Contrasting liver function test patterns in Obstructive Jaundice due to biliary strictures and Stones. *QJM* 2005; 98(1): 35-40.
- [11] Pereira-Lima JC, Jakobs R, Busnello JV, Benz C, Blaya C, Riemann JF. The Role of Serum Liver Enzymes in the Diagnosis of Choledocholithiasis. *Hepatogastroenterology.* 2000; 47:1522-5.
- [12] F, Cruz F, Ibáñez L, Martínez J, Jarufe N. Accuracy of a magnetic resonance cholangiopancreatography for the diagnosis of common bile duct stones. *Rev. Med. Chil.* 2008 May; 136(5), 600-5. doi: /S0034-98872008000500008.
- [13] J.C. Verghese et al. A prospective comparison of MRCP with ERCP in The evaluation of patients with suspected biliary tract diseases. *Clinical Radiology* 1999; 54:513-520.
- [14] Laokpessi A, Bouillet, P, Sautereau, D .et al. Value of magnetic resonance cholangiography in the preoperative diagnosis of common bile duct stones. *American Journal of Gastroenterology* 2001; 96 (8): 2354-2359.
- [15] Soto J A, Barish M A, Oscar Alvarez, Santiago Medina. Detection of choledocholithiasis with MR Cholangiography: comparison of 3D FSE and Single and Multisection Half Fourier Rare sequences. *Radiology* 2000; 215: 737-745.
- [16] Meena Suthar et al., Role of MRCP in Differentiation of Benign and Malignant Causes of Biliary Obstruction *Journal of Clinical and Diagnostic Research.* 2015 Nov, Vol-9(11): TC08-TC12.
- [17] O'Connor KW et al. A blinded prospective study Comparing four current noninvasive approaches in the Differential diagnosis of medical versus surgical jaundice. *Gastroenterology.* 1983 Jun; 84(6):1498-1504.
- [18] Cronan JJ, Mueller PR, Simeone JF, O'Connell RS, vanSonnenberg E, Wittenberg J, et al. Prospective diagnosis of choledocholithiasis. *Radiology.* 1983; 146:467-9.
- [19] Einstein DM, Lapin SA, Ralls PW, Halls JM. The insensitivity of sonography in the detection of choledocholithiasis. *AJR Am J Roentgenol.* 1984; 142:725-8.
- [20] Laing FC, Jeffrey RB, Wing VW. Improved visualization of choledocholithiasis by sonography. *AJR Am J Roentgenol.* 1984; 143:949-52.
- [21] Cronan JJ. US diagnosis of Choledocholithiasis. A reappraisal. *Radiology.* 1986; 161:133-4.



**USG: There is hyperechoic calculus noted in mid third of common bile duct.**  
**Case: Carcinoma gall bladder with involving liver associated choledocolithiasis and GB diverticuli**

On MRI/MRCP it is showing flow void with associated dilatation of proximal CBD and IHBR.





USG: showing distended gall bladder with wall thickening in the neck region. Multiple hyper echoic calculi and multiple outpouching noted in the fundal region.

T2WI MRI showing hyper intense mass lesion in the region of GB fossa which is involving surrounding liver parenchyma with multiple calculi and diverticuli arising from fundal wall. MRCP image showing irregular thickened wall involving the neck region with multiple calculi within gall bladder.