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Diagnosing Causes of Obstructive Jaundice with MRCP and Ultrasound

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Abstract

The imaging modalities commonly used are Ultrasonography (USG), ComputedTomography (CT), Endoscopic Retrograde Cholangiopancreatography (ERCP) and Magnetic Resonance Cholangiopancreatography (MRCP). "Percutaneous Transhepatic Cholangiography (PTC) is used for drainage procedures. A relatively new MR imaging technique that has revolutionized the biliary and pancreatic duct imaging and has emerged as an accurate, noninvasive means ofvisualization of the biliary tree and pancreatic duct without radiation & injection ofcontrast material is MRCP."

The patients taken for present study were suffering from various disease of the biliary tree or the pancreas. "We have examined the efficiency of MRCP as a imaging modality of choice in comparison with Ultrasound."

Introduction

The imaging modalities commonly used are "Ultrasonography (USG), ComputedTomography (CT), Endoscopic Retrograde Cholangiopancreatography (ERCP) and Magnetic Resonance Cholangiopancreatography (MRCP). Percutaneous Transhepatic Cholangiography (PTC) is used for drainage procedures. A relatively new MR imaging technique that has revolutionized the biliary and pancreatic duct imaging and has emerged as an accurate, noninvasive means ofvisualization of the biliary tree and pancreatic duct without radiation & injection ofcontrast material is MRCP."

The patients taken for present study were suffering from various disease of the biliary tree or the pancreas. "We have examined the efficiency of MRCP as a imaging modality of choice in comparison with Ultrasound."

Magnetic Resonance Cholangiopancreatography (MRCP) has few extra Advantage as follows:-

- Modality is non-invasive
- No exposure to ionizing radiation.
- Contrast media is not required
- Multiplanar imaging capability
- No complications in post procedure period
- Ability to show the biliary tracts both proximal and distal to pathology

Research Objectives

To establish the accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) over ultrasound inassessing the causes of obstructive Jaundice.

Review of Literature

ANATOMY

The biliary passage consists of:

- "Intra hepatic bile ducts"
- "Common hepatic duct"
- "Gall bladder"
- "Cystic duct"
- "Common bile duct & Pancreatic Duct"

Intra hepatic bile ducts:

Normally they measure less than 3 mm in diameter. They are seen throughout liver [(2)] and show linear water density. They are parallel to portal vein. "The right hepatic duct has two main branches – posterior (dorso-caudal) drains segment VI and VII and anterior (ventro-cranial) which drains V and VIII. The left hepatic duct is formed by segmental tributaries draining segment II-IV. Bile duct draining caudate lobe joint either left or right hepatic duct."

Common hepatic duct:

On imaging modalities it is seen as round or elliptical structure just right of portal vein. The normal measurement is between 3 to 6 cm in short axis diameter. The wall of CHD usually measures less than 1.5 mm.

Gall Bladder:

It usually measures 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.

Cystic duct:

The cystic duct measures 2-4 cm in length, with diameter ranging from 1- 5 mm. It gets connected to extrahepatic bile duct, approximately half way between porta hepatis and ampulla of vater and is right of hepatic artery.

Common bile 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 partof duodenum, where they unite to form hepatopancreatic ampulla.

Pancreatic duct:

The 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."

Fluid gives bright signal on these sequences because of its long T2 relaxation time. Hence hepatobiliary tree including pancreatic duct will appear bright within background of low signal intensity liver and other structures.

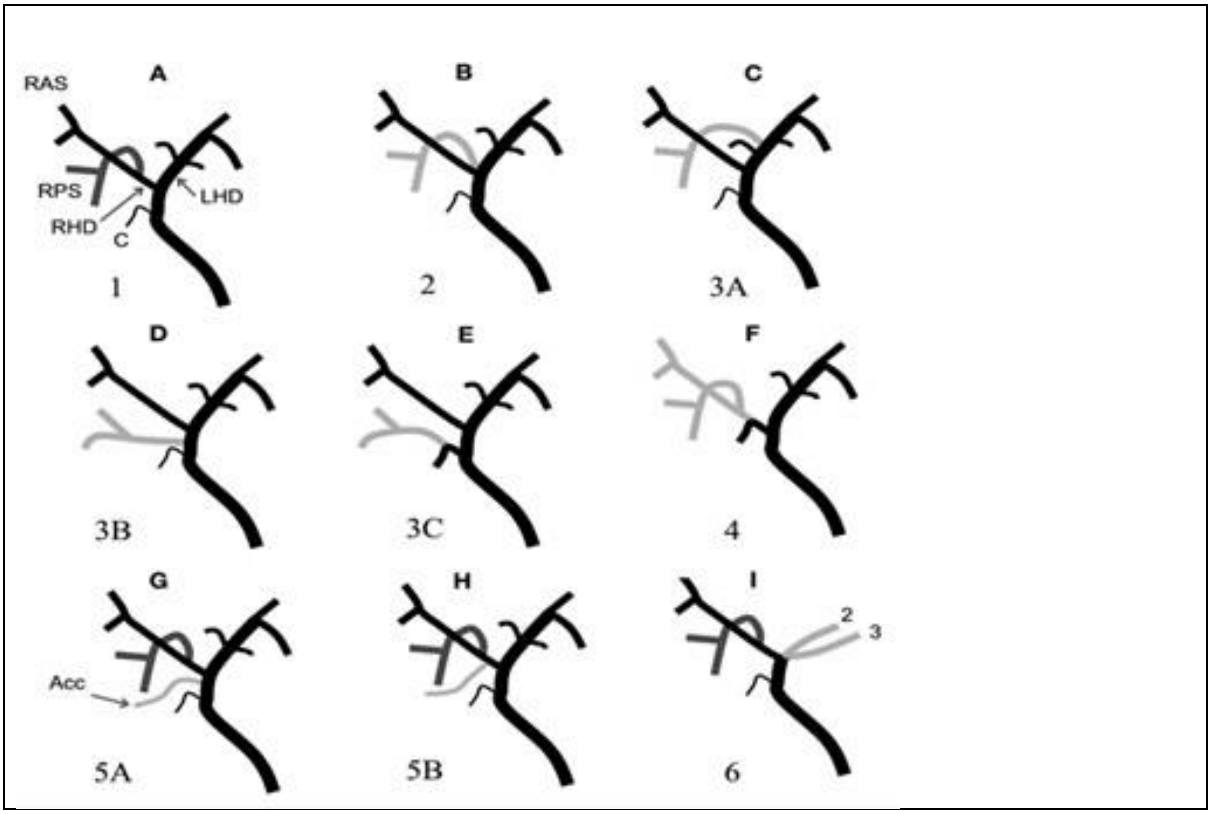

Figure 1: Schematic diagram of right hepatic duct (RHD) anatomy variants. Shows typical anatomy which is found in 58% of population, Type 1- is Conventional branching (A). "Type 2 is -Triple confluence: right posterior segmental (RPS) duct (gray line) (B). Types 3 is (A, B, C) - RPS anomalous drainage into left hepatic duct (LHD), common hepatic duct (CHD) and cystic duct respectively (C, D, E). Type 4- is Right hepaticduct (RHD) draining into cystic duct(F). Types 5 is (A, B) –Right accessory duct drains into CHD or RHD (G, H). Type 6is: - Segments II and III draining individually into RHD or CHD(I)."

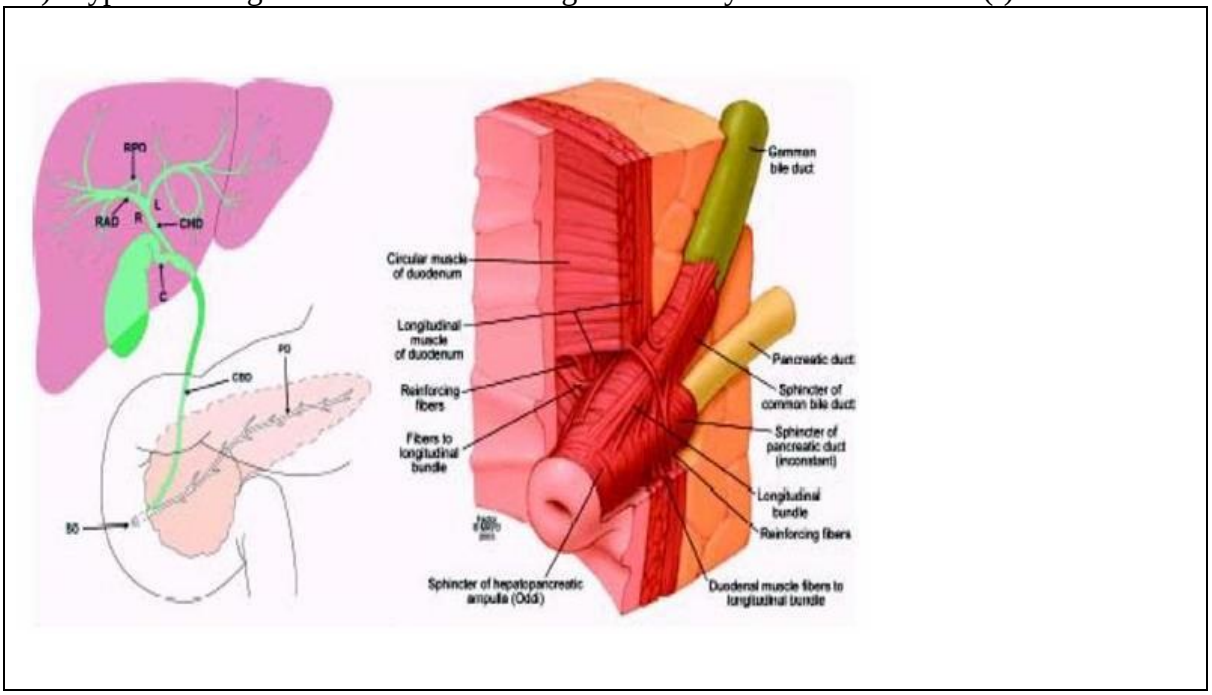

Figure 2: Schematic representation showing normal biliary passage anatomy. "Anterior (RAD) and posterior (RPD)segmental right hepatic ducts (RHD) joins to form the main right

hepatic duct, which varyin length. The right and left main hepatic ducts become extrahepatic proximal to their confluence in common hepatic duct (CHD),which goes on to join with the cystic duct(CD) to drain into the common bile duct(CBD). Biliary tracts and pancreatic duct (PD) flow are regulated by sphincter of Oddi. Diagram of Sphincter of Oddi."

Pathophysiology

The commonest presentation of biliary obstruction is obstructive jaundice. The role of imaging is to determine the site of obstruction and the cause. Imaging is also useful in determining the nature of lesion if present. In cases ofmalignant lesions characterization, its extent and staging are important for optimal management of the disease. "General protocols dictate use of diagnostic US followed by CECT. However, it has been proposed that when complete MR imaging is done, including T1W, T2W and gadolinium enhanced MR along with MRCP, it has the capacity to provide all information pertaining to the obstructive lesion, thus obviating the need for any other investigations such as CT/PTC/ERCP".

Aberrant bile ducts:

The normal anatomy of intrahepatic bile ducts are noted in approximately 60% of individuals. However, determining the anatomical variants are important before surgery to reduced both risk of complication and operating time. Trifucation of intrahepatic bile duct is noted in about 12 % individuals. The most common variation is however when right posterior duct drains into left hepatic duct and they together make confluence with right anterior hepatic duct to form common hepatic duct. Occasionally a right sectorial duct crosses inferiorly to enter CHD directly. [(1)]

Choledochal cysts:

These are cystic dilations of extrahepatic bile duct with or without involvement of intrahepatic bile ducts. It is an uncommon entity, and is 3-4 times more common in females. The exact genesis is not known. In USG they are seen as cystic structures which may contain internal sludge, solid component or stones. The CECT appearance depends on the extent of duct involvement and its dilation. It can be mild to large water density mass in the region of porta hepatis or head of pancreas. 60% of these cases will have intrahepatic bile duct dilation. The diagnostic feature is demonstration of direct communication of cystic duct with dilated bile duct. This is often difficult to demonstrate on CT, unless the cyst is large. MR imaging shows it as markedly dilated extrahepatic bile duct saccular in configuration as

hallmark of entity[1]

Classification of Alonzo-lej modified by Todani et al: [2].

Type IA : "Cystic dilatation of the CBD"

Type IB : "Focal segmental dilatation of the distal CBD"

Type IC : "Fusiform dilatation of both the CHD & CBD"

Type II : "True diverticula arising from the CBD"

Type III : "Cystic dilatation involving only the intraduodenal portion of theCBD"

Type IVA: "Multiple intra and extra hepatic cysts"

Type IVB : "Multiple extra hepatic cysts"

Type V : "Single or multiple intrahepatic cysts (Caroli's Disease)"

Type VI : "Cystic dilation of cystic duct."

Mirizzi Syndrome:

It is obstruction caused by "extrinsic compression of the CHD from an impacted stone in the gallbladder neck or cystic duct or by associated periductal inflammation. Two types, are known simple and fistulous type are seen". On USG it presents as biliary obstruction with dilatation of the biliary ducts to the level of CHD in conjunction with a picture of acute or chronic cholecystitis. "On CT dilated bile ducts and CHD are seen upto the level of gallbladder neck or cystic duct. CHD diameter abruptly decreases below the level of stone at neck or cystic duct. On MRCP, simple type shows smooth focal laterally scalloped narrowing of CHD caused by stone in gallbladder neck or cystic duct and in fistulous type there will be no smooth lateralcompression"[3]

Extrahepatic Biliary Atresia:

Atresia of CBD with patent intrahepatic bile ducts. Two subtypes are known, subtype1- perinatal type, subtype2- fetal type. It is a very rare disease with frequency of less than 10 in 1 lakh live births. Obviously there is no role of USG or CT, and they are used to detect associated anomalies. On MRCP there is non-visualization of extrahepatic bile duct, atrophic gall bladder, periportal thickening[3].

Chronic Pancreatitis:

Chronic Pancreatitis is a inflammatory disease of pancreas which is not reversible. The pancreatic size is variable and gland atrophy is very commonly seen. The other most

commonly observed finding is calcification of parenchyma and dilation of pancreatic duct and its branches beyond its normal limit. Other finding which can be seen are multifocal stenosis, intraductal filling defect because of protein plugs and decrease in diameter of intrapancreatic segment of CBD. On MRI pancreatic parenchyma shows decrease in its intensity on T1Weighted images and decreased contrast enhancement. The atrophy of pancreatic parenchyma, pancreatic duct dilation, calcification of parenchyma and focal enlargement are findings commonly seen on helical CT scan images.[4]

Biliary hamartoma:

These are cystic neoplasms usually found intrahepatic. It can be unilocular or multilocular. Patients present with complains of abdominal pain and obstructive jaundice. On ultrasound they appear as anechoic structure with posterior acoustic enhancement, however debris are also frequently seen. OnMR the content of the cyst determines the signal characteristics.[5]

A close differential and often a diagnostic dilemma to biliary cystadenoma is hepatic hydatid cyst. "These often present as septated cyst with daughter cysts and echogenic material between cysts. These can show double echogenic shadow due to pericyst. On MR the cysts are often hypointense on T1 Weighted images and hyperintense on T2 weighted images". On single shot T2 sequences the daughter cysts and septa can be easily visualised. On contrast study the walls and septae enhances.[6]

Table 1: Common causes of biliary obstruction

Intrahepatic biliary obstruction	**Portahepatic biliaryObstruction**	**Suprapancreatic biliary obstruction**	**Intrapancreatic biliary obstruction**
1. Primary Sclerosing	1.Cholangiocarcinoma	1.Pancreaticcarcinoma	1.Pancreatic carcinoma 2.Pancreatitis.
cholangitis	2.PSC	2.Metastasis.	3.Choledocholithiasis
(PSC)	3.Primary Ca GB	3.Pancreatitis	4.Ampullary Ca
2.Space	4.Metastatic disease	4.Cholangiocarcinoma	5.Duodenal Ca
occupying	5.Strictures	5.Choledocholithiasis	6.Cholangiocarcinoma
lesions and		6.Strictures.	
liver			
diseases.			

Gibson N. Robert et al (1986) in prospective study of "15 patients with bile ductobstruction with various radiologic modalities were compared for their capability to demonstrate the level and cause of obstruction, and found that USG appears to be the single most useful modality in evaluation of bile duct obstruction, compared to CT & Direct cholangiography"[7].

Malini et al (1981) in her study of "35 patients with obstructive jaundice concluded that USG had a sensitivity of 85% in finding the site of obstruction. USG being a simple, safe and non-invasive tool, it can be used in the first line of investigation in patients with obstructive jaundice".[8]

Soto et al (1995) in their study of "patients with suspected pancreaticobiliary diseases concluded that the projectional images rendered by MRCP are as good as that of PTC or ERCP. They showed MRCP to be extremely accurate in showing pancreatic dilatation, strictures, stones, cystic dilatation with sensitivity approaching 100%"[9].

Reinhold et al (1996) in their study proved "MRCP to provide important diagnostic information in isolation and also MRCP can clearly provide valuable information when ERCP is unsuccessful or inaccurate"[10].

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

Material and Methods

Detail Research Plan

"The study was done in the department of Radio Diagnosis, KRISHNA INSTITUTE OF MEDICAL SCIENCES & HOSPITAL. Ultrasonography followed by MRCP were done for all the patients. Two radiologists reviewed the images separately and evaluated the cause and site of obstruction in patients."

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 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.

MRCP SEQUENCES used:

T2 HASTE – coronal, transverse, transverse FS, coronal thin slab, FScoronal thick slab,.

T2 TRUFI coronal

T1 VIBE – FS transverse, FS transverse Dynamic, FS sagittalT1 FS transverse.

The following Parameters were studied for USG and MRCP;

1. "Level of obstruction (five Anatomical Segments)"
   - "Hepatic"
   - "Suprapancreatic"
   - "Pancreatic"
   - "Ampullary"
   - "periampullary"
2. Common bile duct status
   - Dilated
   - Not dilated.
3. Status of IHBR
   - Dilated
   - Not dilated.
4. Status of pancreatic duct
   - Dilated
   - Not dilated.

5. Pancreatic atrophy, calcifications, and pseudocysts.
6. Gall bladder pathology including size, wall, stones.
7. Presence of masses.
8. Invasion of viscera, fascial planes.
9. Presence of enlarged lymph nodes, ascites
10. Presence of fatty liver, hepatosplenomegaly.
11. Presence of metastasis.

Assessment of imaging findings as malignant or benign cause ofobstructive jaundice is based on the given scale of confidence.

a) **Definitely Benign: "**Biliary duct dilatation with a visible calculi in the ductwith no associated mass or stricture."
b) **Probably Benign: "**Cystic dilatation of bile passage. Pancreatico-biliary duct dilatation considered benign (i.e. Sign of chronic pancreatitis)."
c) **Inconclusive**: "Not confidently labelled as benign or malignant."
d) **Probably Malignant: "**Isoenhancing to hypoenhancing mass with indirect signs of neoplasm such as duct dilatation with ductal cut-off adjacent to the mass or atrophic distal parenchyma or pancreato-biliary dilatation considered malignant without sign of a mass or lesion in pancreatic head without duct dilatation."
e) **Definitely Malignant**: "Mass in the pancreatic head with duct dilatation. Isolated CBD dilatation with an abrupt narrowing located cranial to the level of mass lesion."

MRCP and ultrasound studies were analyzed one by one in a double blinded fashion with no knowledge of the result of the other study, or of clinical findings. The final diagnosis was made with ERCP, or surgical orhistopathological correlation.

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 thepatient's OPD Card or Bed Head Ticket (if the patient is admitted).

- Interview of the patients and record analysis.
- After that, they were carefully evaluated by high frequency ultrasound, colour Doppler and power Doppler as required. Tracking of patient was done via phone call.

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 groups. Z-test (Standard Normal Deviate) was used to test the significant difference between two proportions. t-test was used to 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:

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.

Observation and Results

Statistical Analysis:

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Using this software, "basic cross-tabulation, inferences and associations were performed. Chi-square test was used to test the association of different study variables. Z-test (Standard Normal Deviate) was used to test the significant difference between two proportions. t-test was used to compare the means. Diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value were calculated to compare the findings of different diagnostic tools. $p<0.05$ was considered to be statistically significant."

Demographic parameters:

Table-2: 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%
Total	38.00	100.0%
Mean ± s.d.	59.52±11.22	
Median	60.00	
Range	39 - 86	

"The ratio of male and female (Male**:** Female) was 1.7:1.0. Test of proportion showed that proportion of males (63.2%) was significantly higher than that of females (36.8%) (Z=3.73;p<0.001)."

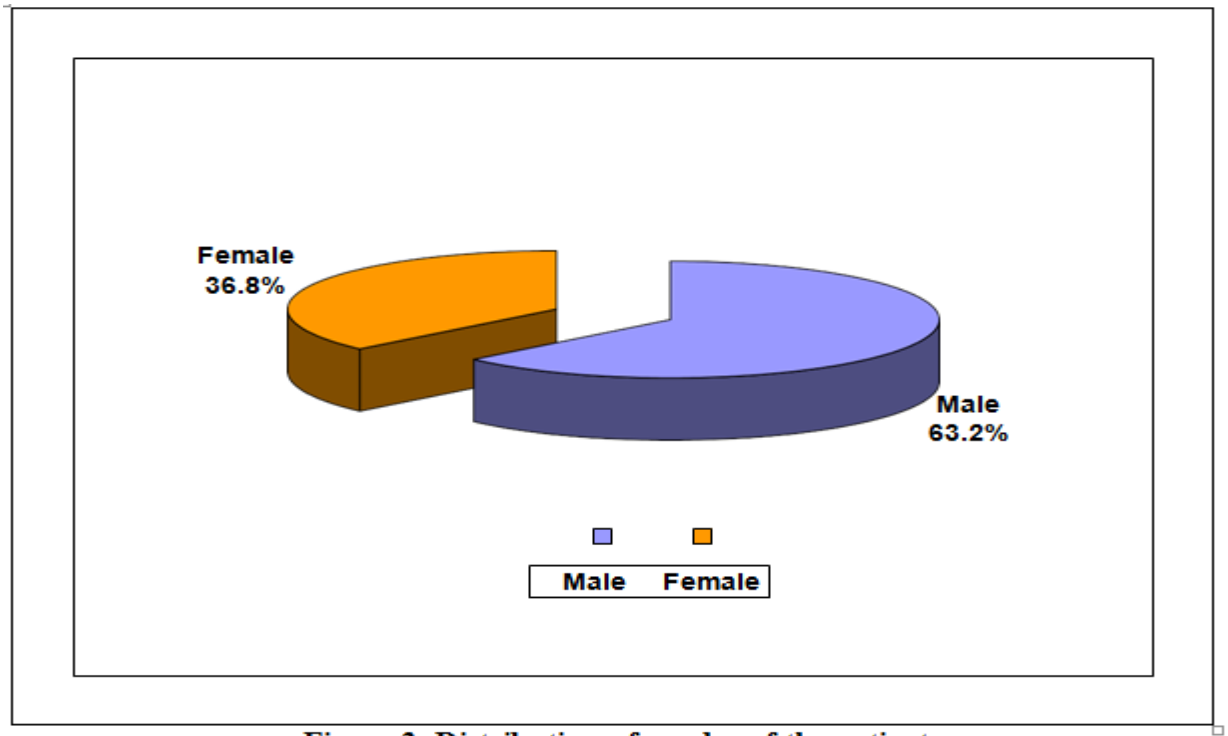

Figure 3: Distribution of gender of the patients

Figure 3: Distribution of gender of the patients

Corrected Chi-square (x^2) test showed that there was no significant association between age and gender of the patients (p=0.34). Thus obstructive jaundice was more or less equally prevalent over the age of male

and female patients.

"60.5% of the cases were benign which was significantly higher than that of themalignant cases (39.5%) (Z=2.96;p<0.001)."

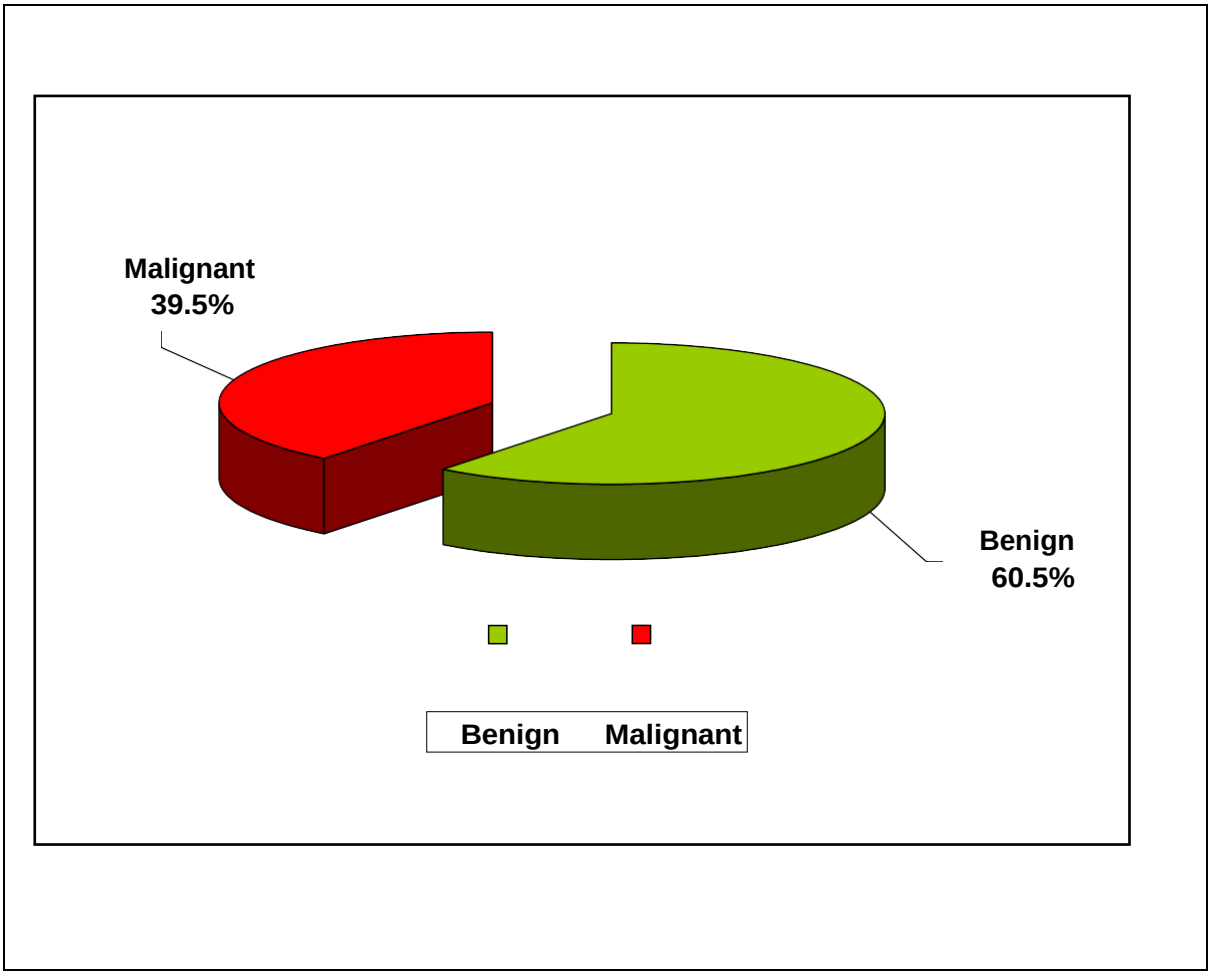

Figure 4: Distribution of type of obstructive jaundice of the patients

As per the USG findings "78.9% of the patients had obstructive jaundice which was significantly higher than that of no obstructive jaundice cases (21.1%) ($Z=8.17;p<0.0001$)."

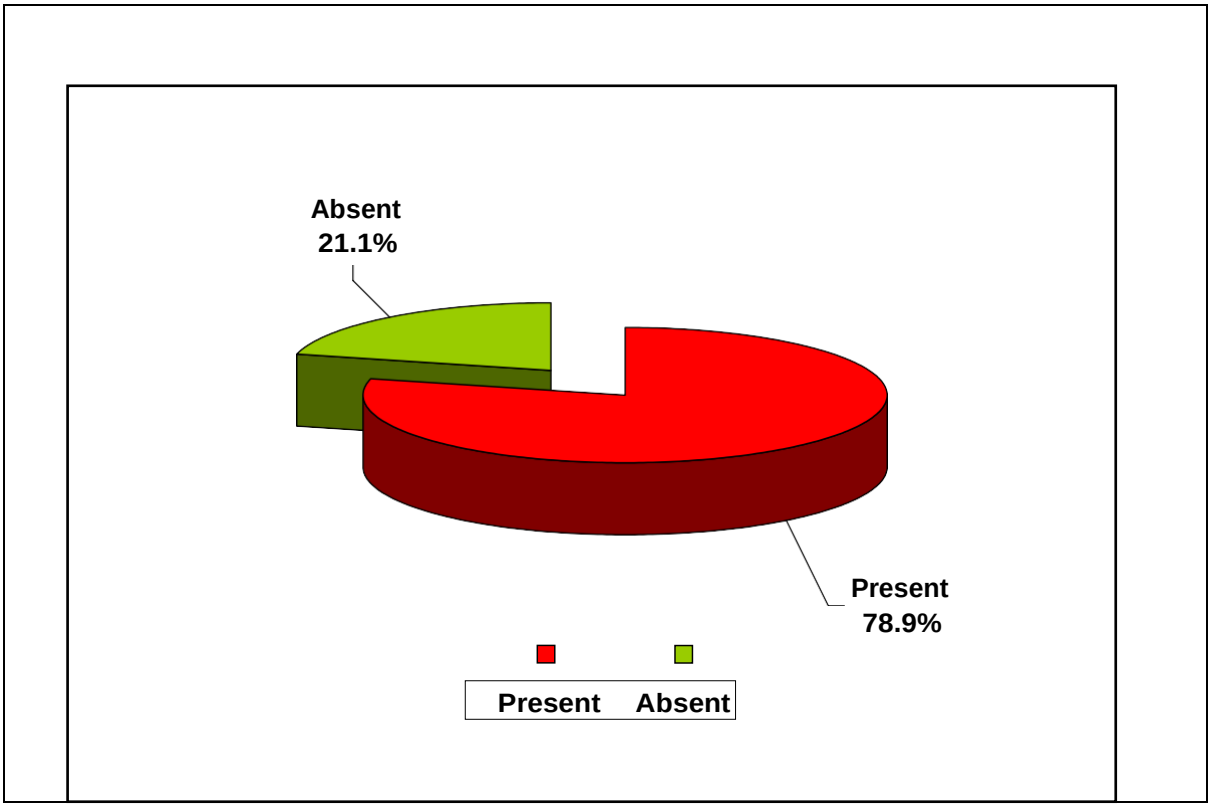

Figure 5: Distribution of USG Findingsof the patients

As per the MRCP findings "89.5% of the patients had obstructive jaundice which was significantly higher than that of no obstructive jaundice cases (10.5%) (Z=11.17;p<0.0001)."

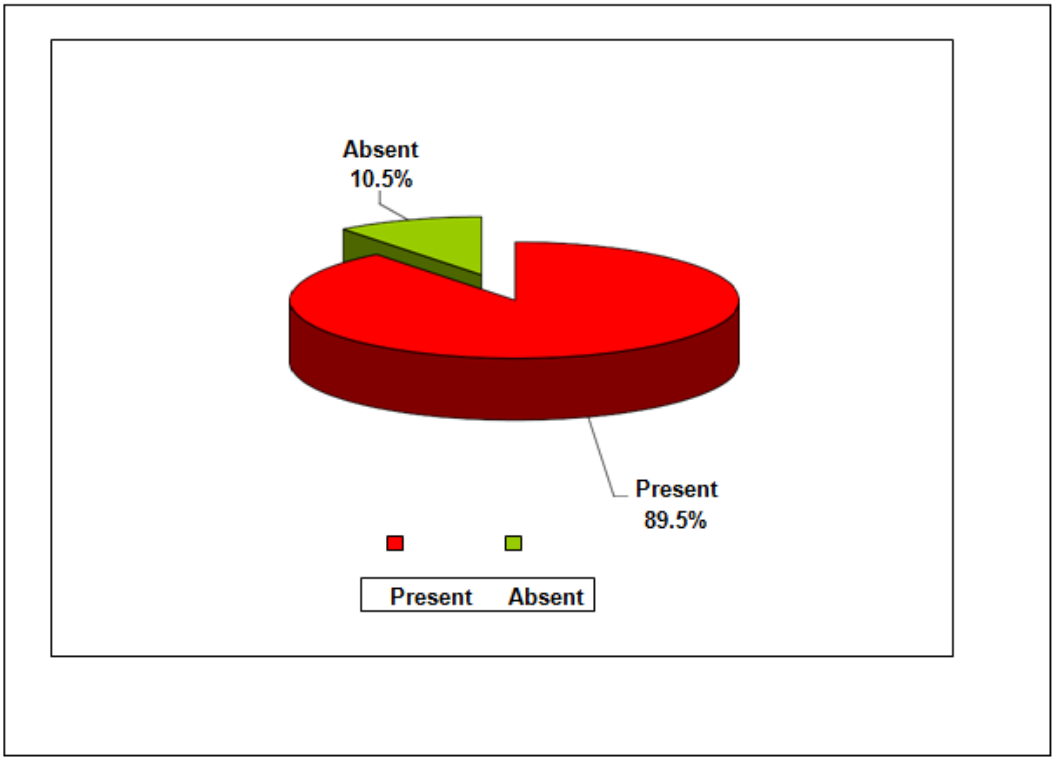

Figure 6: Distribution of MRCP Findings of the patients

Table-3: Distribution of status of CBD of the patients

Status of CBD	Number	%
Dilated	29	76.3%
Not dilated	9	23.7%
Total	38	100.0%

In 68.4% of the cases CBD were dilated which was significantly higher thanthat of not dilated cases (31.6%) (Z=5.20;p<0.001).

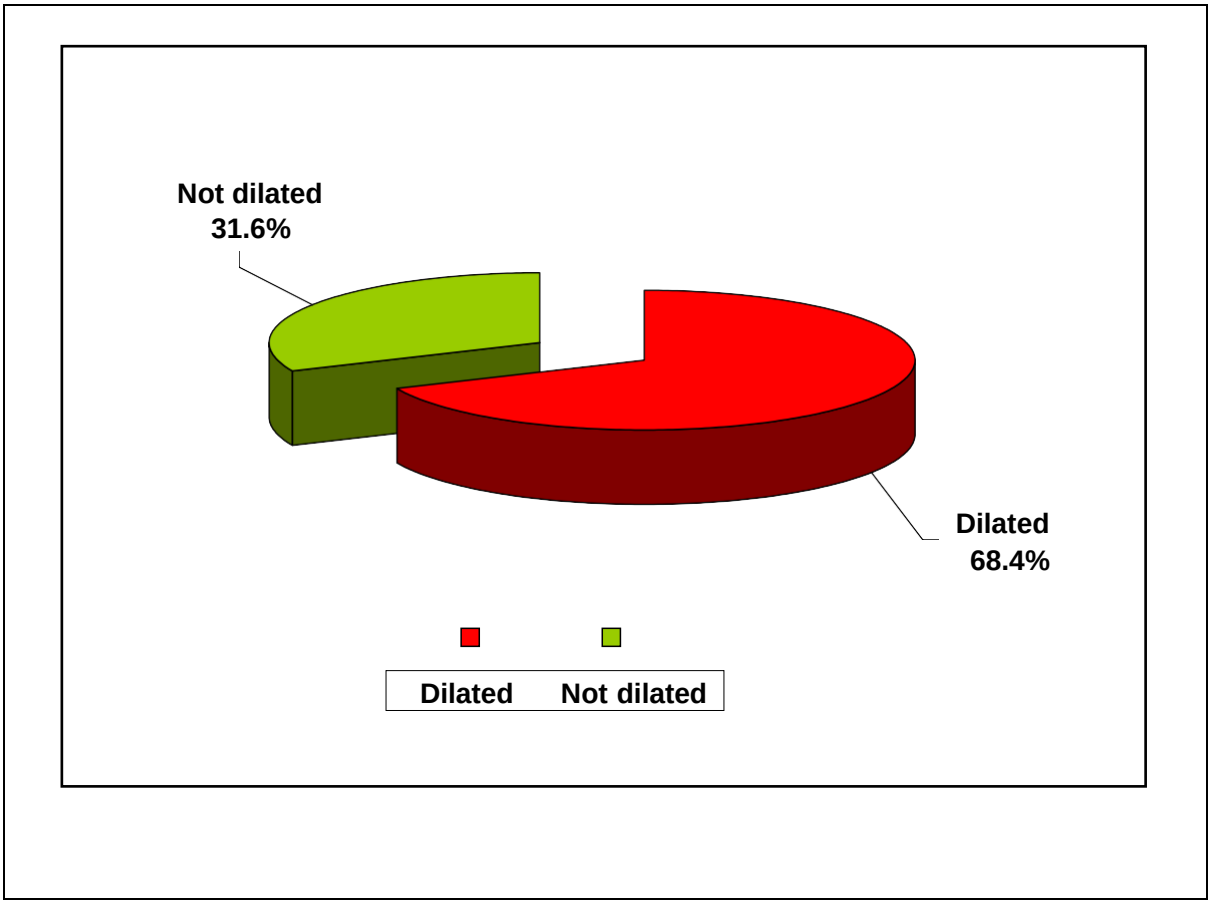

Figure 7: Distribution of IHBR status of the patients

Table-4: Distribution of status of pancreas of the patients

Status of pancreas	Number	%
Bulky	2	5.3%
Mass at head	3	7.9%
Atrophied	9	23.7%
Normal	24	63.2%
Total	38	100.0%

"55.3% of the cases were benign which was higher than that of the malignantcases (44.7%) which was not significant (Z=1.49;p>0.05)."

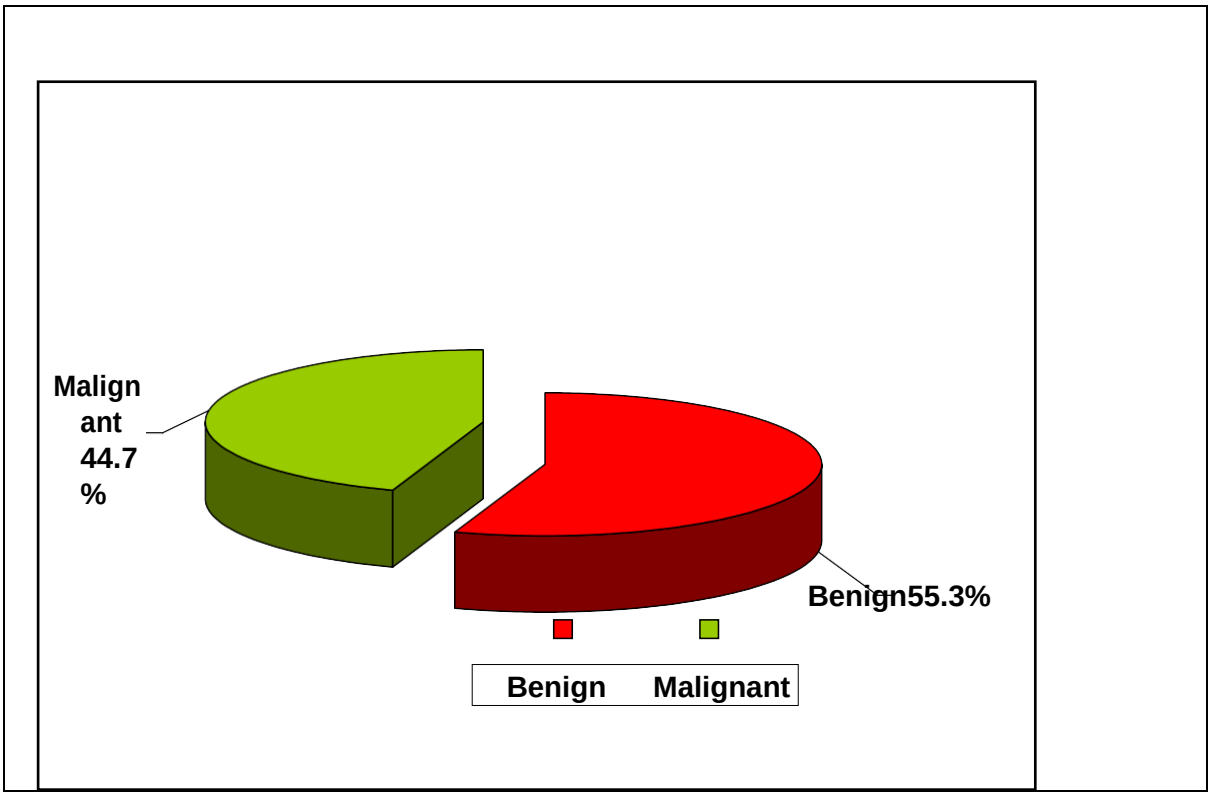

Figure 8: Distribution of FNAC/HPE/ERCPfindings of the patients

For Pancreatic carcinoma and Gall bladder calculi with common bile duct calculi the proportions of males were significantly higher than that of females (p<0.01).

"Since one of the cell frequencies was zero (X^2) test could not be applied. However, Fisher Exact test showed that both USG and MRCP findings showed significantly higher proportion of obstructive jaundice cases (p<0.0001). In 34(89.5%) [In 30(78.9%) cases both showed obstructive and in 4(10.5%) cases both showed non-obstructive] findings of USG and MRCP were matched with each other."

Table-5: Comparison of findings of USG with MRCP findings todiagnose obstructive jaundice

Comparison	Number	%
TP	30	78.9%
TN	4	10.5%
FN	4	10.5%
FP	0	0.0%
Total	38	100.0%

TP= correctly diagnosed by both. TN= not correctly diagnosed by bothFN= only diagnosed by MRCP

FP= only diagnosed by USG

Diagnostic Accuracy (i.e when both modalities gave same findings) = (TP+TN) / TOTAL CASES X 100 = 89.47%

Sensitivity of USG, among cases where MRCP was correctly able to diagnose = TP/ (TP+FN) x 100 = 88.24%

Specificity = TN/ (TN+FP) x 100 = 100.0%

Positive Predictive Value = TP/(TP+FP) x 100 =100.0% Negative Predictive Value = TN/(TN+FN) x 100 = 50.0%

Out of the 17 malignant cases as per HP findings 11(64.7%) were found to beobstructive by USG.

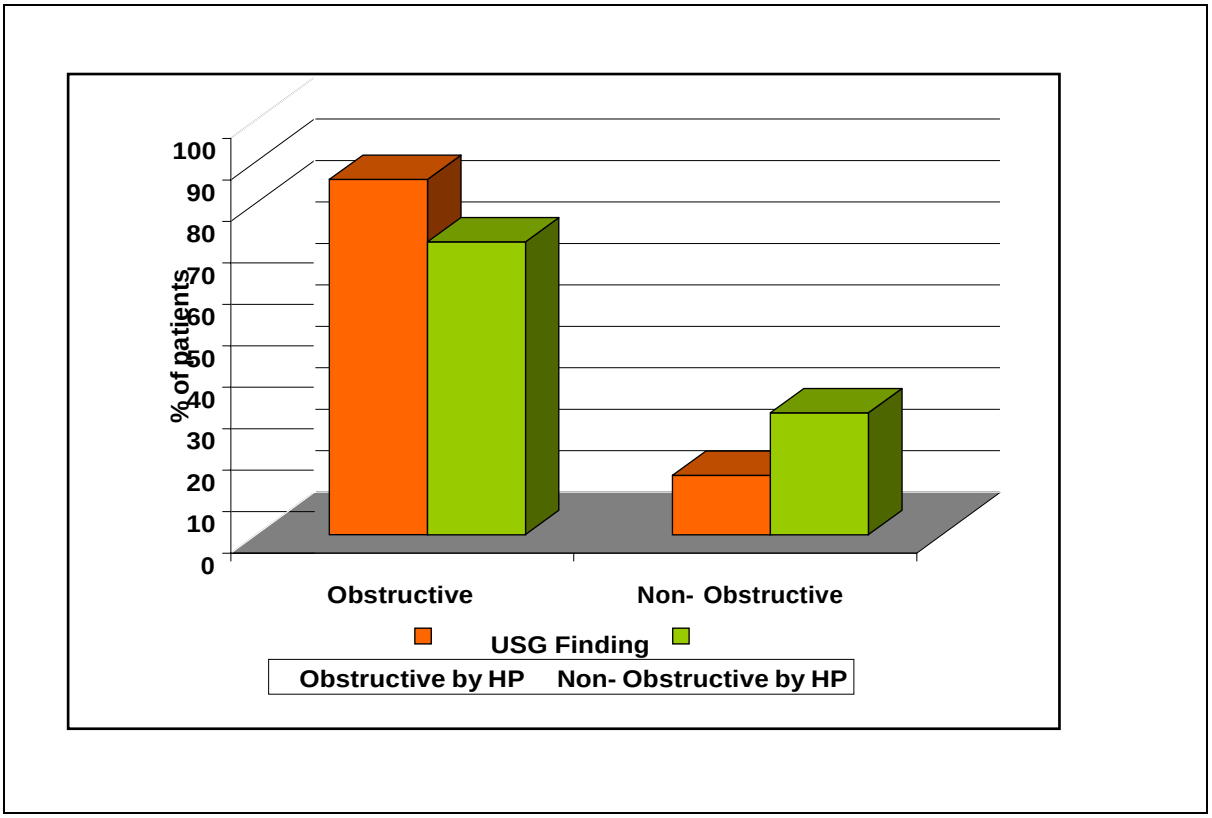

Figure 9 : " Association between findings of USG and HP findings todiagnose obstructive jaundice"

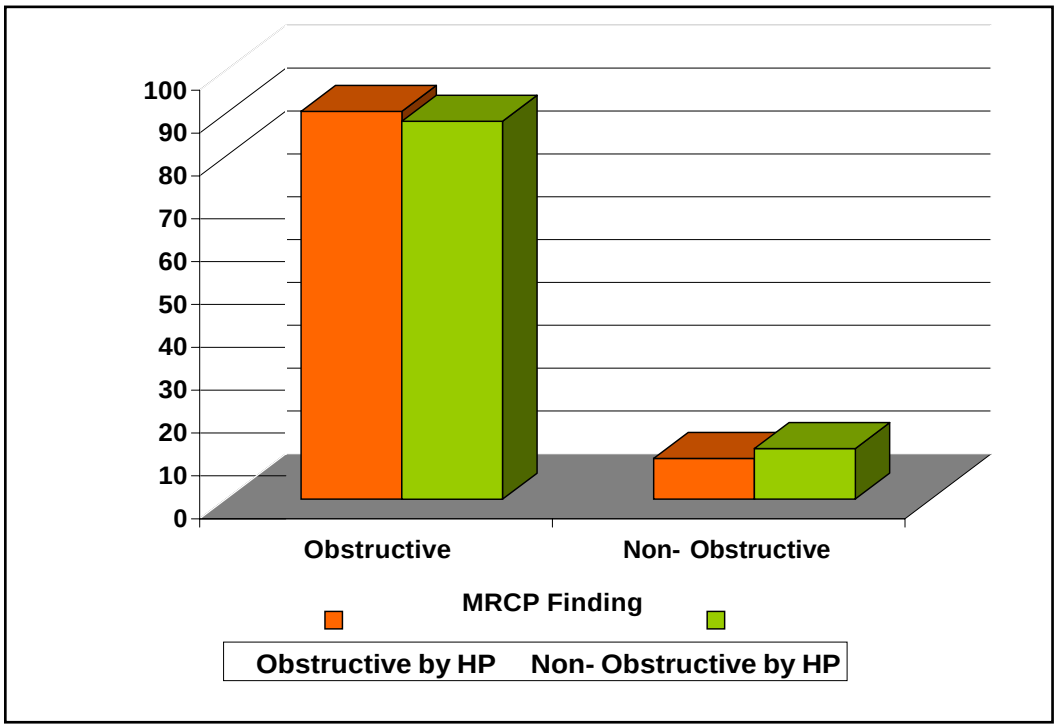

Figure 10: "Association between findings of MRCP and HP findings todiagnose obstructive jaundice"

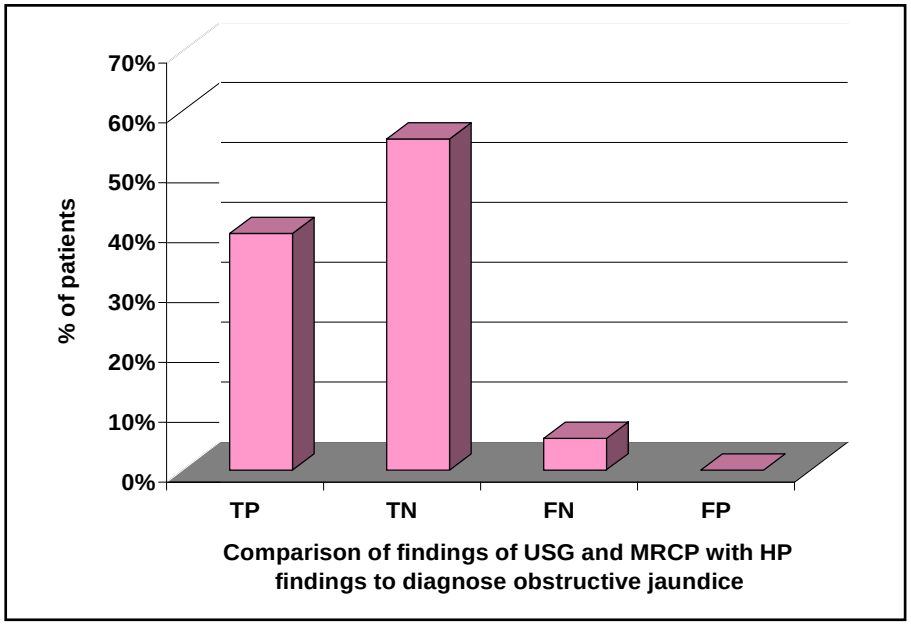

Figure 11: "Comparison of findings of USG and MRCP with HP findings todiagnose obstructive jaundice"

Discussion

Early diagnosis in cases of suspected biliary tree pathologies are very important for proper patient care and management. Appropriate work up for the correct diagnosis depends on the selection of proper imaging modality, so the advantages and pitfalls of the concerned modalities should be known.

With the advent of MR Cholangiopancreatography for diagnosis of biliary tree pathologies, invasive procedure like ERCP should not be performed for the sole purpose of diagnosis.

"The range of age of patients in our study was from 39 – 86 years, with mean age of presentation being 59.52 ± 11.22. Most patients were in age group of 50-69 which was significantly higher than other age groups."

Among the benign lesions, there were 8 (21.1 %) cases of choledochocolithiasis, 5 (13.2%) cases of gall bladder and common bile duct calculi, 4(10.5%) cases of cholelithiasis, 2(5.3%) cases of cystic duct calculi, 2(5.3%) cases of papillary stenosis, 1(2.6%) case of biliary cystadenoma and 1(2.6%) case of hepatic calculus causing obstructive jaundice.
Among the malignant lesions there were 9(23.7%) cases of cholangiocarcinoma, 5(13.2%) cases of pancreatic carcinoma and 1(2.6%) cases of gall bladder carcinoma.

"Most common level of obstruction was at supra-pancreatic level in 15 cases (39.4%), followed by periampullary region, in 14 cases (36.8%), which were significantly higher than other level of obstruction. On MRCP out of these 21 cases, 19(90.5%) cases were correctly diagnosed as having benign pathologies. Only in 2(9.5%) cases of papillary stenosis no mechanical obstruction were seen in biliary tree. Thus the diagnostic accuracy of both the imaging modalities combined was found to be 94.74%, sensitivity of 88.24%, specificity of 100%. Imaging modalities had positive predictive value of 100% and negative predictive valueof 91.3%."

In 13 cases of common bile duct calculus/ calculi, ultrasound detected calculi in 11 cases where as MRCP was able to detect all 13 cases precisely, thus sensitivity of ultrasound was 84.6 % and that of MRCP 100 %. In 10 cases of gall bladder calculus/ calculi, ultrasound and MRCP were both able to detect all the cases accurately.

However, "Shea et al reported sensitivity of approximate 88% and specificity of 80% on ultrasound in cases of gall bladder calculi [11]. Calvo MM et al found the sensitivity of MRCP to be in between 86% to100%in different studies, which is in concordance with our study." [12].

In the present study only had 1 case of cystic duct calculus was diagnosed by both modalities, USG and MRCP. The calculus however was not causing obstruction of common bile duct and the insertion of cystic duct was in middle of CBD. It was also associated with GB sludge.

Future Scope:

MRI guided interventions it can be soon possible in the coming times to use MRCP for diagnostic as well as therapeutic applications.

"Of the thirty-eight patients, one hundred and one patients had benign causes of obstructive jaundice while fifty two patients had malignant causes of obstructive jaundice. MRCP had an accuracy of 95.45% in detecting the cause of obstructive jaundice while USG had a accuracy of 81.63%. The performance of MRCP when compared to USG was statistically more significant ($p<0.05$)."

Advantages of MRCP in assessment of biliary tract pathologies:

- Patients are not exposed to ionizing radiations.
- The anatomy of biliary tree, associated variant in every individual and detailed information about the pathology is obtained, like:

-Status of gall bladder and common bile ducts.

-Gall bladder calculi and Cholecystitis.

-Calculus size.

-Gall Bladder mass lesion.

-Gall bladder wall thickness.

-Gall bladder wall surface

-Diameter and presence of calculi in common bile ducts.

-Exact anatomical location of Calculus in common bile ducts.

-Presence of stricture and if its benign or malignant.

IMAGES

Illustration number 1:

T2 haste cor thin slab section shows abrupt cut-off in suprapancreatic CBD. Awell-defined hypointense calculus is seen at CBD.

Illustration number 2: Cystic duct calculus

T2 haste cor thin slab sections showing filling defect in cystic duct (arrow) withGB sludge.

Illustration number 8:Hepatic calculus:

Illustration Number 3: Hepatic Calculus

T2 haste cor thin slab show hypointense filling defect in left hepatic duct(arrow).

Illustration number 4:

On MIP reconstructed images malignant stricture was seen in suprapancreatic CBD, which

on HPE proved to be cholangicarcinoma.

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