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ORIGINAL ARTICLE

RADIOLOGICAL EVALUATION OF OBSTRUCTIVE JAUNDICE BY ULTRASOUND AND CT

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ABSTRACT: INTRODUCTION: The goals of any radiologic procedure in obstructive Jaundice are to confirm the presence of bile duct obstruction, its location, its extent & the probable cause. It should also attempt to obtain a map of the biliary tree that will help the surgeon to determine the best approach to each individual case. **OBJECTIVES:** 1. To evaluate the role of Ultrasound and CT in patients presenting with clinical features of obstructive jaundice. 2. To evaluate the causes of obstructive jaundice by Ultrasound and CT. **PATIENTS AND METHODS:** The study was carried with 45 patients from January 2006 to September 2007 who were attending the surgical and Gastroenterology Departments, Govt. General Hospital, Kurnool, which is an attached hospital to Kurnool Medical College, Kurnool. **OBSERVATIONS AND RESULTS:** In our study, there is female predominance with male: female ratio 1: 1.6.Majority of patients are in age group of 41-50 years. Jaundice was the commonest presentation in all patients followed by pruritis in 72% and pain abdomen in 67% of patients. Ultrasound identified the benign cause of biliary obstruction in 79.1% cases and the malignant cause in 61.9% cases. CT identified the benign cause of biliary obstruction in 91.6% of patients and the malignant cause in 80.9% cases.
KEYWORDS: Biliary tract obstruction, Jaundice, Ultrasound, Benign, Malignant.

INTRODUCTION: Evaluation of obstructive jaundice can be done by various imaging techniques like Ultrasound, CT, ERCP, PTC, MRCP. Among these Ultrasound, CT and MRCP are non-invasive whereas PTC, ERCP are invasive techniques. Ultrasound is the primary modality of investigation with accuracy of 80% or more for biliary diseases.(1) Due to its wide availability in most hospitals and treatment centers, it proved its benefit to the jaundiced patient. The application of CT is increasing in the evaluation of biliary system. It can be helpful in situations where the use of ultrasound is difficult. Eg: in the presence of obesity or postoperatively(2) It can also be used to elucidate findings which may not be clear on ultrasound examination. Reconstruction of data in coronal, sagittal and axial sections may provide more diagnostic information.

ULTRASOUND: Ultrasound has been always considered the first choice technique in the study of biliary obstructive disease, due to its accessibility, speed, ease of performance and low cost.(3,4) A potential difference in biliary sonography has been made due to the advent of Tissue Harmonic Imaging. Studies have shown that in patients in whom the most distal portion of the CBD was difficult to visualize, THI showed a longer length of the CBD with relative ease.(5)

COMPUTED TOMOGRAPHY: The accuracy of conventional CT in determining the presence and level of obstruction has been 81 to 94% and 88 to 92% respectively.**(6)** The dilated intrahepatic

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radicals are easily seen in CT because their attenuation co-efficient is lower than that of normal liver parenchyma. Intravenous iodinated contrast agents tend to increase the attenuation co-efficient of surrounding hepatic parenchyma.[7] The dilated common hepatic and bile duct can be identified as a round or slightly oval hypodense structures seen in the regions of hepatic hilus or pancreatic head.

AIMS AND OBJECTIVES OF THE STUDY:

1. To evaluate the role of Ultrasound and CT in patients presenting with clinical features of obstructive jaundice.
2. To evaluate the causes of obstructive jaundice by Ultrasound and CT.

Causes of Obstructive Jaundice: They can be divided into intrahepatic and extrahepatic.

Mechanical or Intrahepatic causes are most commonly hepatitis, cirrhosis and drugs like anabolic steroids and chlorpromazine.

Extra Hepatic Causes:

- They can be subdivided into intraductal and extraductal.
- Intraductal causes include neoplasms, stone disease, biliary stricture, parasites, primary sclerosing cholangitis, AIDS related cholangiopathy and biliary tuberculosis.
- Extraductal obstruction is caused by external compression of the biliary ducts, may be secondary to neoplasms, pancreatitis or cystic duct stones with subsequent gall bladder distention.
- Neoplasms are ampullary tumours, gall bladder carcinomas and cholangiocarcinomas.
- Metastatic tumours usually from gastrointestinal tract or breast and the secondary adenopathies in the porta hepatis that may be associated with these tumours can cause external bile duct compression.
- Of pancreatic tumours, 60% occur in the head of the pancreas and manifest early with obstructive jaundice.

COMMON CAUSES OF OBSTRUCTIVE JAUNDICE:

GALL STONES: Gall Stones are about twice as common in women as in men. Gall stones may be diagnosed on a plain X-ray or during ultrasound, CT or contrast procedures of the biliary tract. Patients with pancreatitis have co-existent stones in 1/3rd of cases and carcinoma of gall bladder is usually associated with stones.

CHOLEDOCHOLITHIASIS: Most CBD calculi form initially in the gall bladder and migrate through the cystic duct into CBD. The stones are identified as secondary calculi to distinguish them from primary CBD calculi, which form within the biliary tract.

Primary common duct stones are associated with biliary stasis and infection. The cause of the biliary stasis, which leads to the development of primary duct stones, may include biliary stricture, papillary stenosis or sphincter of oddi dysfunction.

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Clinical Presentation: Approximately 7% - 15% of patients undergoing cholecystectomy have CBD stones. Clinical features are biliary colic, jaundice, lightening of stools, and darkening of urine. Serum bilirubin, serum amino transferases, alkaline phosphatase are all increased. On ultrasound they are characteristically echogenic with posterior acoustic shadowing. On CT, CBD stones are seen as hyperdense structures. Usually only 20% duct stones are of homogenous high attenuation on CT[8] and ~ 50% of stones are of faint attenuation, slightly greater than the surrounding bile and often similar to that of the adjacent soft tissues of the pancreas. Hence, detection of these stones is difficult. MRCP provides excellent anatomical detail and has a sensitivity and specificity of 95% and 89% in detecting choledocholithiasis.[9] Endoscopic cholangiography is the gold standard for diagnosing CBD calculi preoperatively.

CHOLEDOCHAL CYST: Most common congenital lesion of bile ducts. It is the segmental aneurysmal dilatation of common bile duct without involvement of gall bladder or cystic duct.

Diagnosis: On ultrasound fusiform cyst beneath the porta hepatis separate from the gall bladder can be seen. There will be abrupt change of caliber at the junction of dilated segment to normal ducts. Intrahepatic biliary dilatation may be present.

CARCINOMA OF GALL BLADDER: It is an aggressive malignancy that occurs predominantly in the elderly.

90% of gall bladder cancers are adenocarcinomas. Hepatic involvement with gall bladder cancer can occur by direct invasion through the gall bladder bed, angiolymphatic, portal tract invasion or distant hematogenous spread.

A heterogenous mass replacing the gall bladder lumen or irregular gall bladder wall are common sonographic features.

CT scan usually demonstrates a mass replacing gall bladder or extending into adjacent organs.

Cholangiographic finding of gall bladder cancer is a long stricture of common hepatic duct.

Angiography, spiral CT or MR imaging may identify the encasement of portal vein or hepatic artery.

AMPULLARY CARCINOMA: Adenocarcinoma of the ampulla of vater is an important diagnosis to make and to distinguish from cholangiocarcinoma and pancreatic cancer. Most commonly it presents in 6^{th} to 7^{th} decade. It is associated with Familial Adenomatous Polyposis syndromes, colon cancer.

Diagnosis: Diagnosis is usually suspected by CT or Ultrasonography demonstrating a uniformly dilated intra and extra hepatic bile duct with either no mass lesion or suspicion of duodenal mass. The principal means of making diagnosis is by ERCP.[10]

CARCINOMA OF HEAD OF PANCREAS: Approximately 70% of adenocarcinomas arise in head, neck or uncinate process, with the remainder arising in the body or tail.

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Diagnosis: On ultrasound, the tumour has a lower reflectivity than adjacent pancreatic tissue. On CT the mass may not be visible on a preliminary unenhanced image but, because the tumour is less vascular than the surrounding normal pancreatic parenchyma, it will be seen as a poorly enhancing focal area within the densely enhancing normal pancreatic tissue on dynamic contrast enhanced CT. CT can also reveal hepatic and nodal metastasis, local extension into peripancreatic fat or surrounding organs, ascitis and vascular encasement or invasion.

In ERCP when small ampullary distal bile duct or duodenal lesion a suspected, an ERCP can often provide the histopathological diagnosis. Conversely an ERCP may provide a clear 'cutoff' of both distal bile duct and proximal pancreatic duct highly suggestive of pancreatic adenocarcinoma, the classic double duct sign.

MRCP is relatively new and non-invasive imaging technique to evaluate bile and pancreatic ducts.

CHOLANGIOCARCINOMA: It is an uncommon tumour, which may occur anywhere along the intrahepatic or extrahepatic biliary tree. These tumours are located most commonly at hepatic duct bifurcation. Less commonly they originate in the distal CBD or in the intrahepatic bile ducts.

Intrahepatic cholangiocarcinoma are easily visualized on CT scans, however perihilar and distal tumours are often difficult to visualize on ultrasound or CT scan. A hilar cholangiocarcinoma gives a picture of dilated intrahepatic biliary tree and a normal or collapsed gall bladder and extra hepatic biliary tree. Distal tumours lead to dilatation of the gall bladder and both the intrahepatic and extrahepatic biliary tree.

Klatskins Tumour: It is intrahepatic central cholangiocarcinoma. The tumour is at the confluence of hepatic ducts. On ultrasound, it is seen as iso to hyperechoic central porta hepatis mass or focal irregularity of ducts. There may be segmental dilatation with nonunion of right & left ducts at porta hepatis with normal caliber of extra hepatic ducts. Pressure effect or encasement or invasion or obliteration of portal vein & hepatic artery can be seen

PATIENTS AND METHODS: The study was carried with 45 patients from January 2006 to September 2007 who were attending the surgical and Gastroenterology Departments, Govt. General Hospital, Kurnool, which is an attached hospital to Kurnool Medical College, Kurnool.

All the patients with strong suspicion of obstructive jaundice were evaluated clinically & biochemically before sending them to radiology department. Detailed imaging was done in all patients with ultrasound & CT. Ultrasound evaluation was followed by CT scan of the upper abdomen.

ULTRASOUND: Transabdominal Sonography was carried out with ESOATE MEGAS GPX Ultrasound machine using 3.5 & 5 MHZ curvilinear transducer.

Scanning in transverse, oblique & sagittal planes were carried out and the probable cause of biliary obstruction was evaluated.

CT SCAN: In all 45 patients CT scan of the abdomen was carried out with TOSHIBA ASTEION sub second (0.75sec) spiral CT scanner capable of 50 sec. continuous spiral run.

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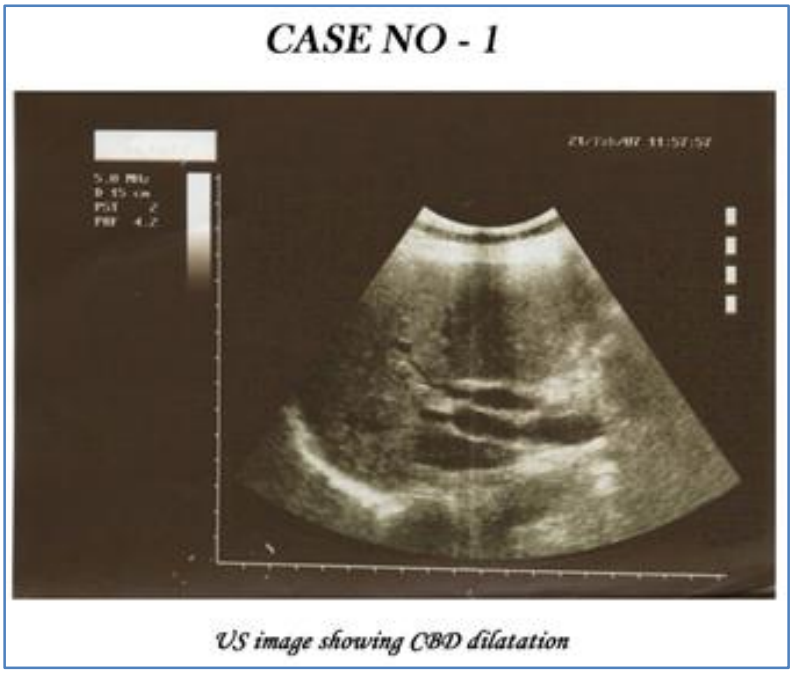
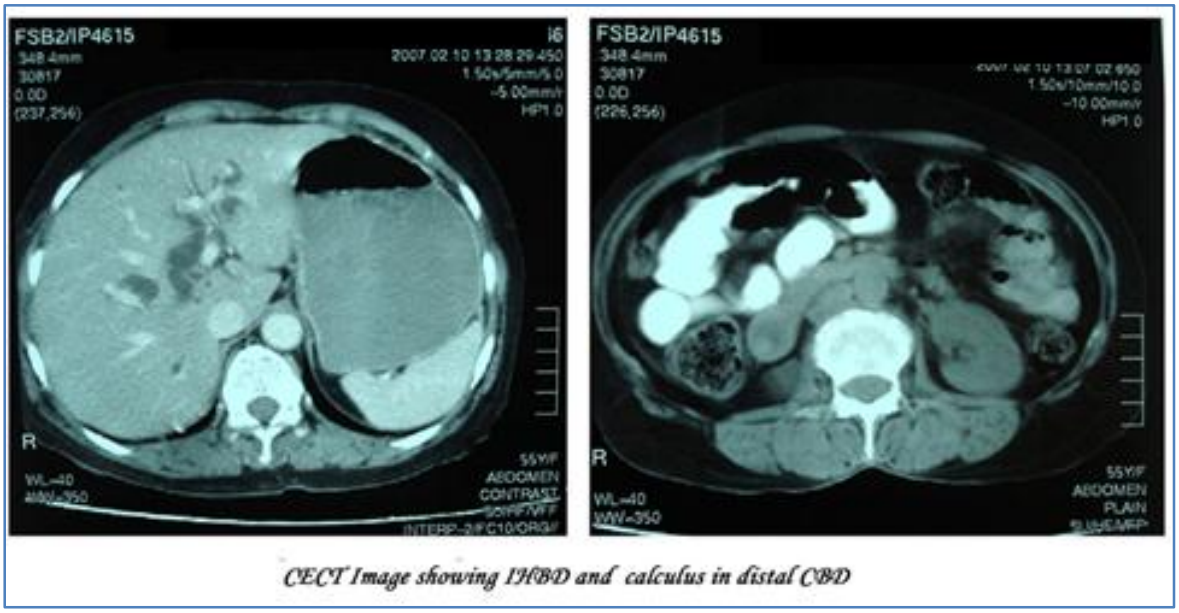
Pre and post IV contrast images along with oral contrast were taken in the axial planes. Evaluation of the cause of obstruction was carried out as in Ultrasound. Thin sections of 3 mm were taken in the region of interest. Evaluation of any liver metastasis and lymphadenopathy, ascites were also part of CT assessments.



US image showing CBD dilatation



CECT Image showing IHBD and calculus in distal CBD

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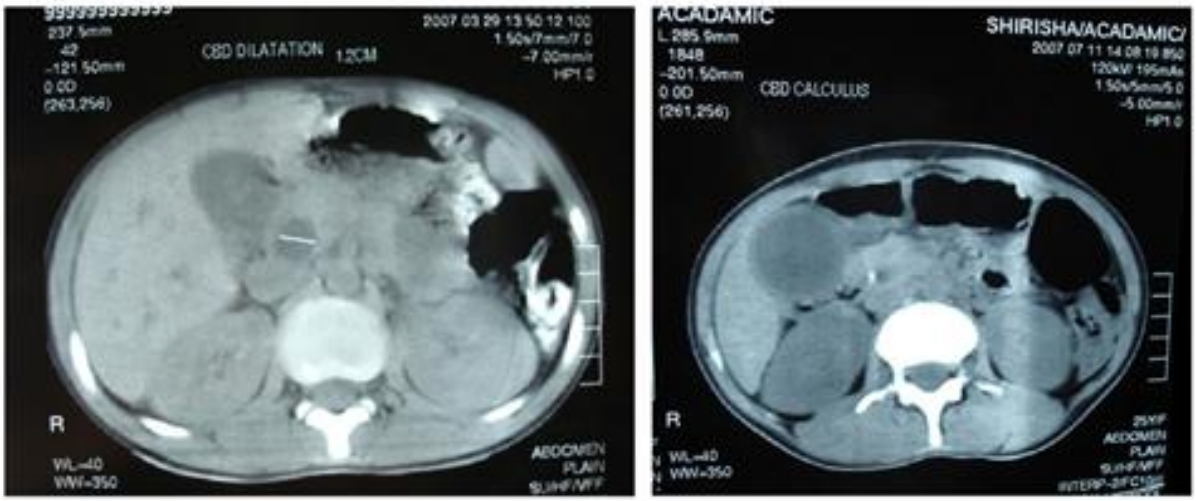
CASE NO - 2

US image showing CBD calculus



CECT Image showing IHBD and calculus in distal CBD

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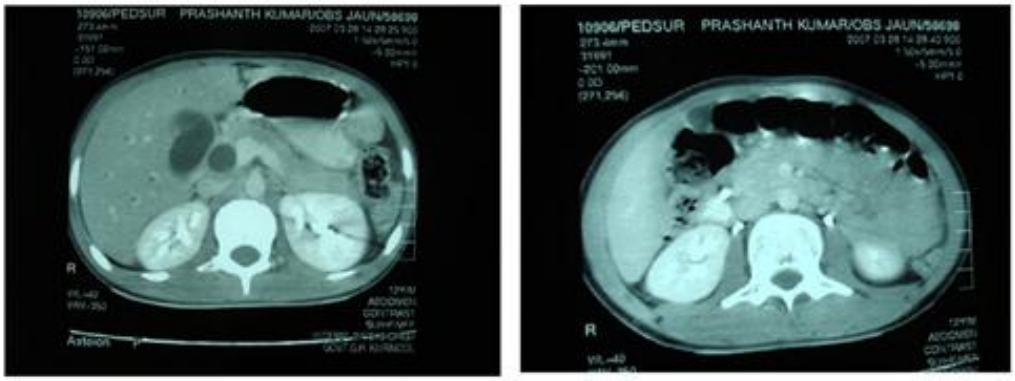
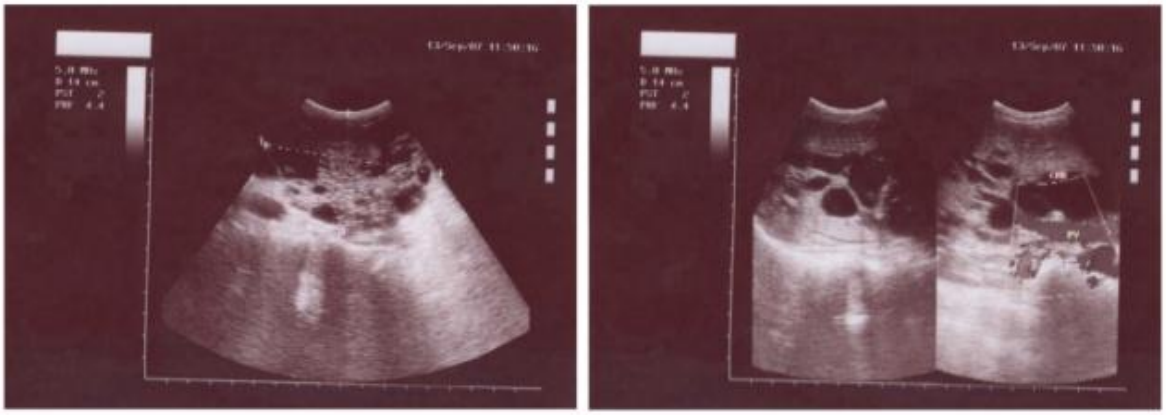
CASE NO - 3

US image showing IHBD and CBD dilatation with calculus



CECT image showing CBD dilatation and calculus in distal CBD

CASE NO - 4



US image showing Mucinous cystadenocarcinoma of pancreas with IHBD and CBD dilatation

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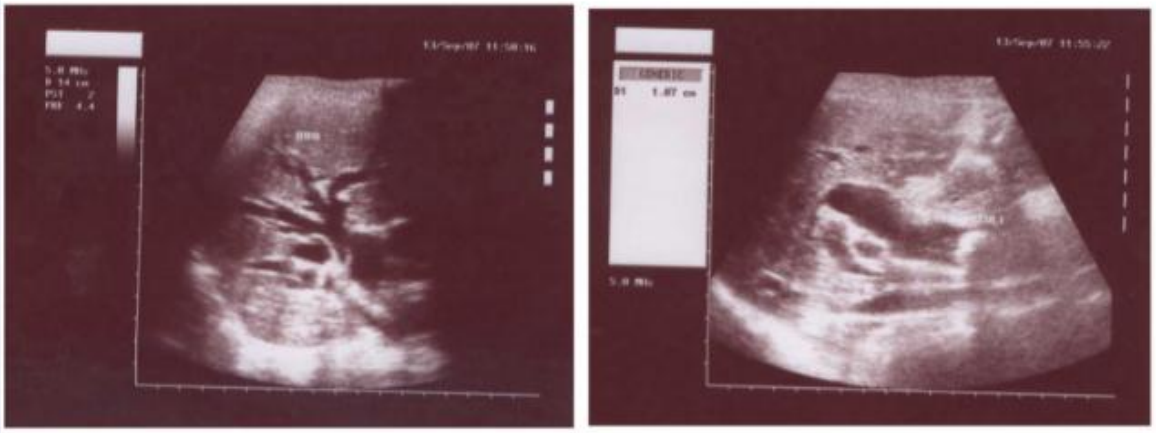
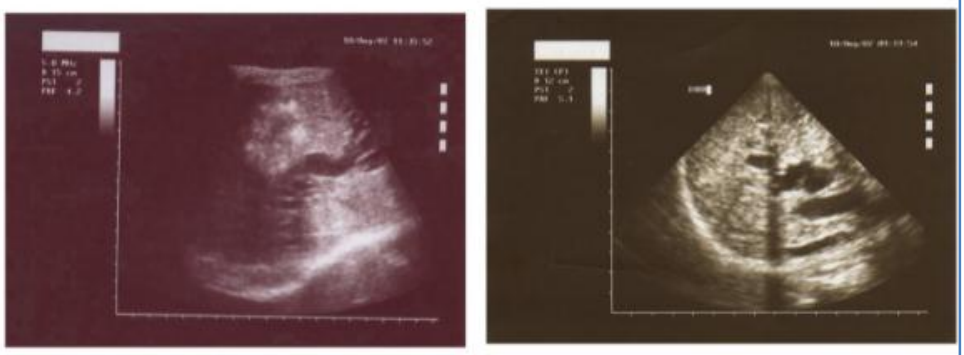
CASE NO - 5



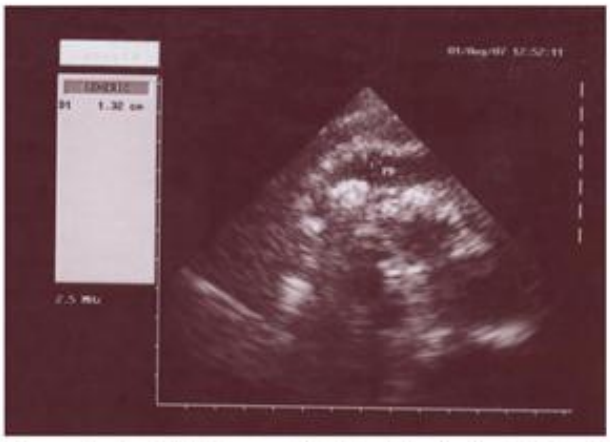
US image showing IHBD and CBD calculus

CASE NO - 6



US image showing Gallbladder carcinoma with IHBD

CASE NO - 7



US image showing dilated pancreatic duct with calculi within the duct in a case of chronic pancreatitis

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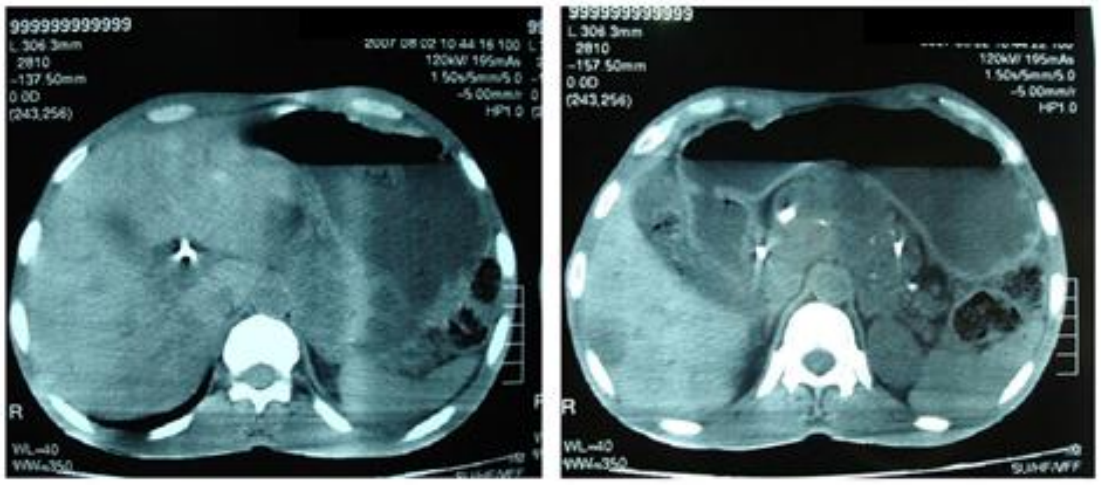
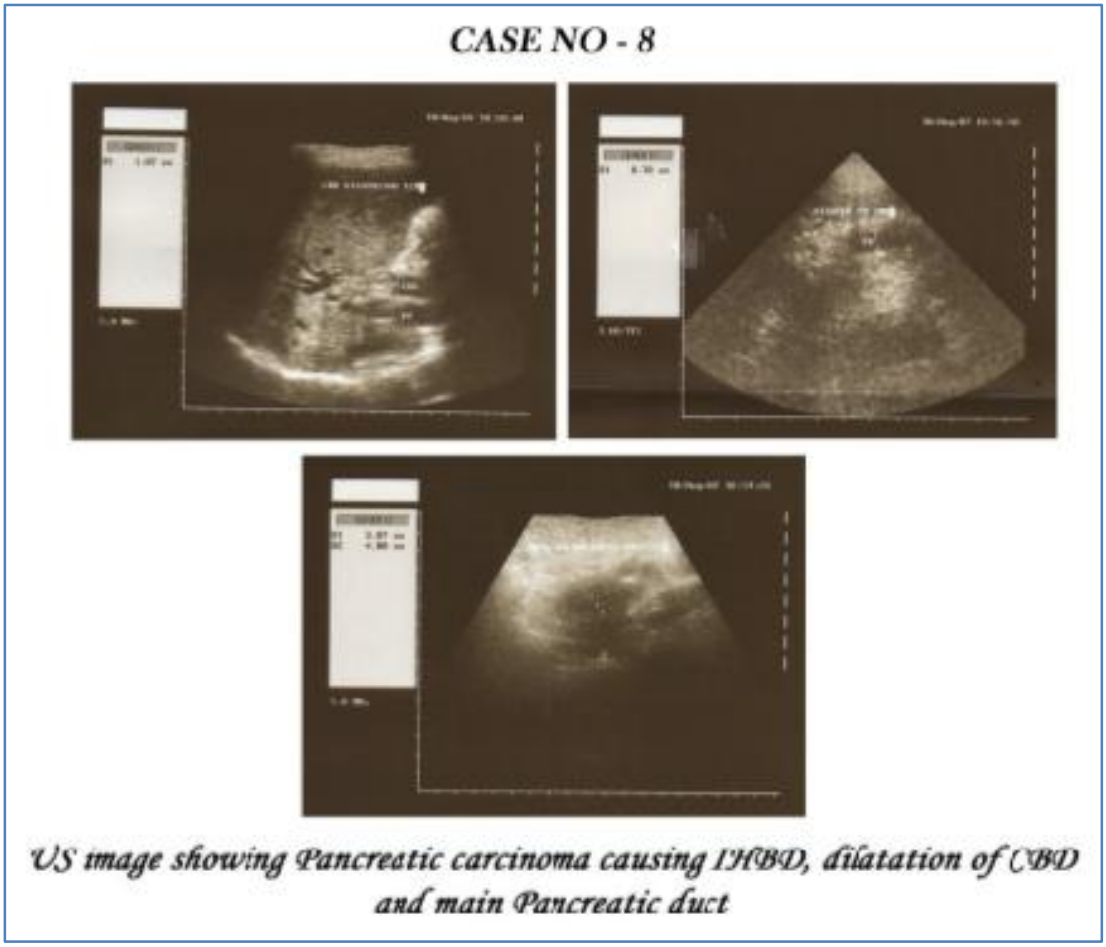


NECT image showing calculus in CBD and calculi within the pancreatic duct in a case of chronic pancreatitis



US image showing Pancreatic carcinoma causing IHBD, dilatation of CBD and main Pancreatic duct

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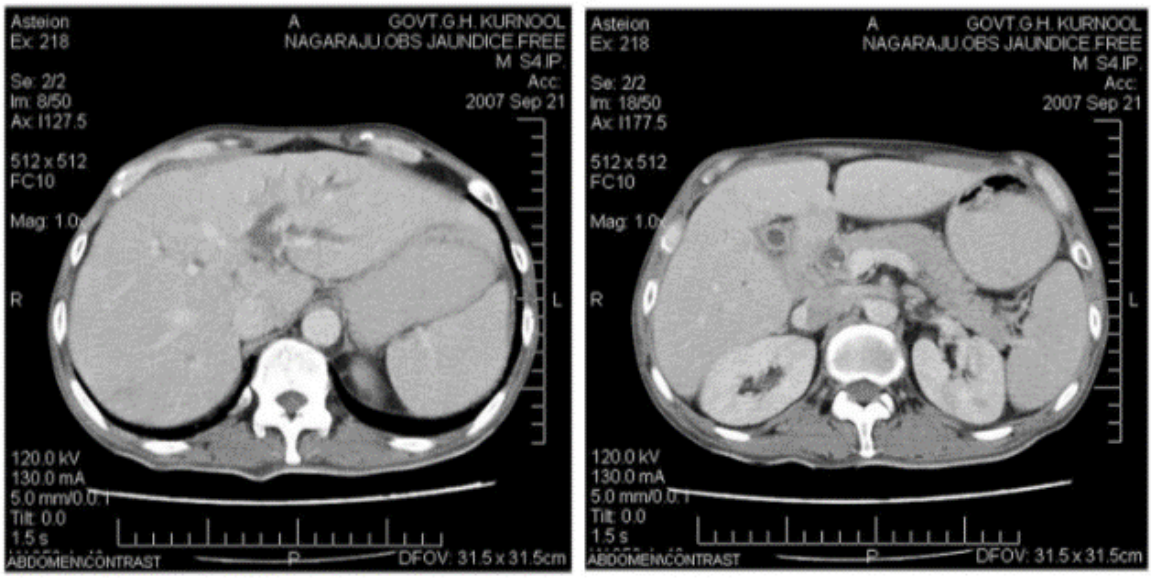
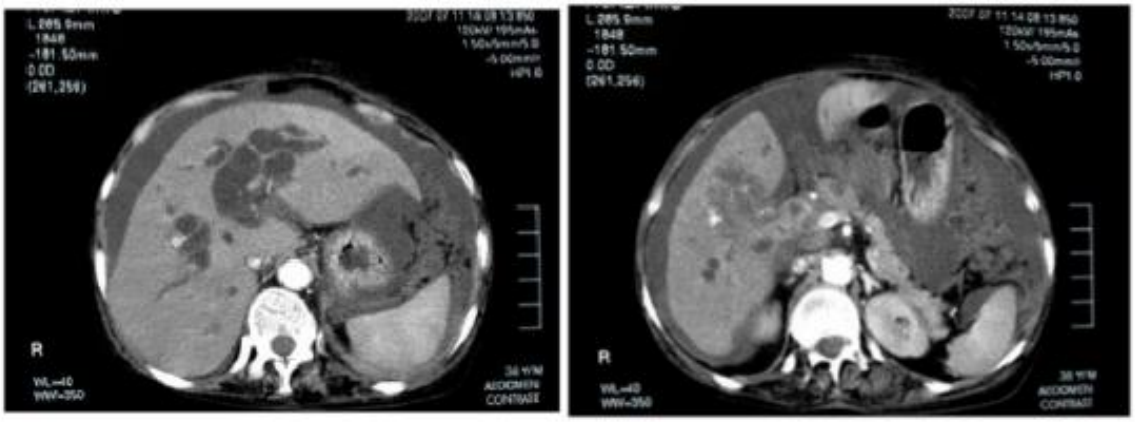
CASE NO - 9



CECT image showing IHBD and calculus in distal CBD

CASE NO -10



CECT image showing IHBD and CBD dilatation in a case of periampullary carcinoma

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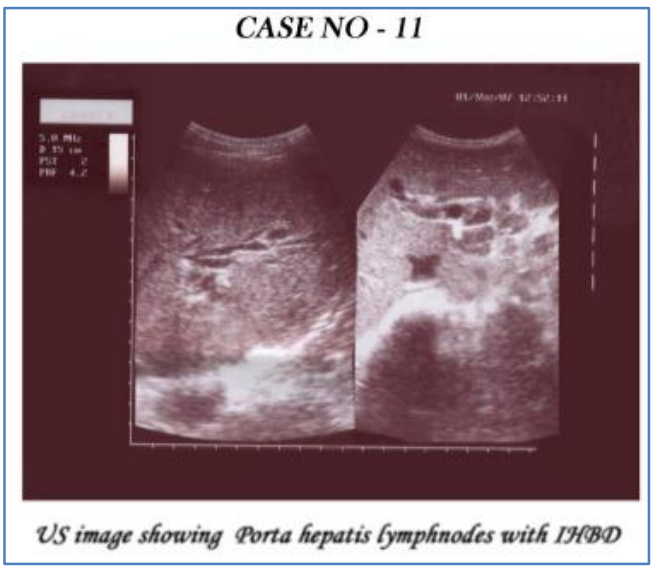
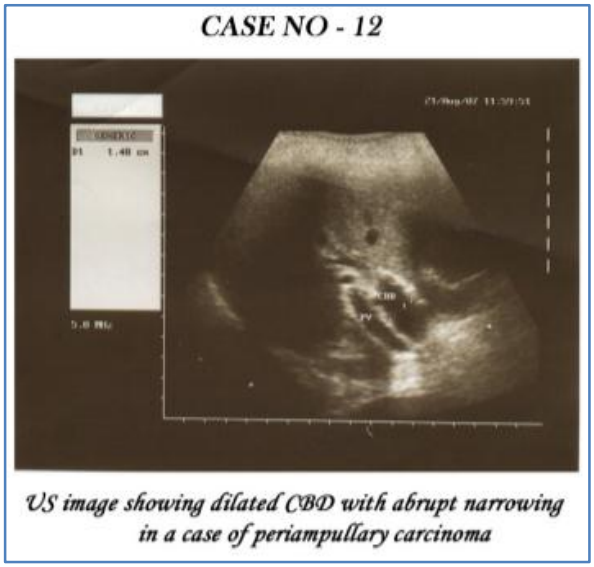


CASE NO - 11

US image showing Porta hepatis lymphnodes with IHBD



CASE NO - 12

US image showing dilated CBD with abrupt narrowing in a case of periampullary carcinoma

OBSERVATIONS AND RESULTS: In the present study, 45 patients of obstructive jaundice were studied attending the surgical and gastroenterology departments of Govt. General Hospital, Kurnool, which is an attached hospital to Kurnool Medical College, Kurnool from January 2006 to September 2007.

The study group included 45 patients with age range from 11-70 years. Majority of patients were in 41 – 50 years group. The youngest patient being 11 years old and oldest patient 70 years old. Among 45 patients, 17 patients were males and 28 patients were females with male: female ratio 1: 1.6.

SEX	N0. OF CASES	PERCENTAGE
Males	17	38%
Females	28	62%
Total	45	100%

TABLE 1: SEX DISTRIBUTION OF PATIENTS STUDIED

AGE (In Years)	NUMBER	PERCENTAGE
0-10	0	0
11-20	2	4%
21-30	5	11%
31-40	8	18%
41-50	18	40%
51-60	10	22.2%
61-70	2	4.4%
Total	**45**	**100%**

TABLE 2: AGE DISTRIBUTION OF PATIENTS STUDIED

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CLINICAL PRESENTATION	NO.OF PATIENTS	PERCENTAGE
Jaundice	45	100%
Pruritis	32	72%
Pain abdomen	30	67%
Anorexia	20	45%
RUQ mass	12	27%
Fever	6	12%

TABLE 3: INCIDENCE OF CLINICAL PRESENTATION IN PATIENTS WITH OBSTRUCTIVE JAUNDICE

LIVER FUNCTION TESTS	NO.OF CASES	PERCENTAGE
Total Bilirubin	45	100%
Direct Bilirubin	45	100%
ALT	16	35.5%
Alkaline Phosphatase	25	55%

TABLE 4: LIVER FUNCTION TESTS IN OBSTRUCTIVE JAUNDICE

Sl. NO.	DIAGNOSIS	NO.OF CASES	PERCENTAGE
1.	Choledocholithiasis	19	42.2%
2.	Ampullary Carcinoma	10	22.2%
3.	Carcinoma of pancreatic head	4	8.9%
4	Choledochal cyst	4	8.9%
5	Carcinoma of Gall Bladder	3	6.7%
6	CholangioCarcinoma	2	4.4%
7	Chronic pancreatitis	1	2.2%
8	Porta hepatis lymphnodes Secondary to lymphoma	1	2.2%
9	Hepato cellular carcinoma	1	2.2%

TABLE 5: INCIDENCE OF INDIVIDUAL CAUSES OF OBSTRUCTIVE JAUNDICE

SL. NO.	DIAGNOSIS	NO.OF CASES	PERCENTAGE
1.	Choledocholithiasis	19	79.16%
2.	Choledochal cyst	4	16.6%
3.	Chronic pancreatitis	1	4%

TABLE 6: INCIDENCE OF BENIGN CAUSES OF OBSTRUCTIVE JAUNDICE

SL. NO.	DIAGNOSIS	NO. OF CASES	PERCENTAGE
1.	Periampullary Carcinoma	10	47.6%
2.	Carcinoma of Pancreatic head	4	19%

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3.	Carcinoma Gall bladder	3	14.2%
4.	Cholongiocarcinoma	2	9.5%
5.	Portahepatis lymphnodes Secondary to lymphoma	1	4.8%
6	Hepatocellular carcinoma	1	4.8%

TABLE 7: INCIDENCE OF MALIGNANT CAUSES OF OBSTRUCTIVE JAUNDICE

CAUSE	NO. OF CASES	NO.OF CASES CORRECTLY IDENTIFIED	PERCENTAGE
BENIGN	24	19	79.16%
MALIGNANT	**21**	**14**	**66.7%**

TABLE 8: INCIDENCE OF BENIGN AND MALIGNANT CAUSES OF OBSTRUCTIVE JAUNDICE EVALUATED BY US

CAUSE	NO. OF CASES	NO. OF CASES CORRECTLY IDENTIFIED	PERCENTAGE
BENIGN	24	22	91.66%
MALIGNANT	21	17	80.9%

TABLE 9: INCIDENCE OF BENIGN AND MALIGNANT CAUSES OF OBSTRUCTIVE JAUNDICE EVALUATED BY CT

DIAGNOSIS	NO. OF CASES	US	CT
Choledocholithiasis	19	15	17
Choledochal cyst	4	3	4
Chronic pancreatitis	1	1	1

TABLE 10: CORRELATION OF US & CT IN IDENTIFICATION OF BENIGN CAUSES OF OBSTRUCTIVE JAUNDICE

SL. NO	DIAGNOSIS	NO. OF CASES	US	CT
1.	Periampullary Carcinoma	10	5	7
2.	Carcinoma pancreatic head	4	3	4
3.	Carcinoma Gall bladder	3	3	3
4	Cholongiocarcinoma	2	0	1
5.	Porta hepatis lymphnodes secondary to lymphoma	1	1	1
6.	Hepatocellular Carcinoma	1	1	1

TABLE 11: CORRELATION OF US & CT IN IDENTIFICATION OF MALIGNANT CAUSES OF OBSTRUCTIVE JAUNDICE

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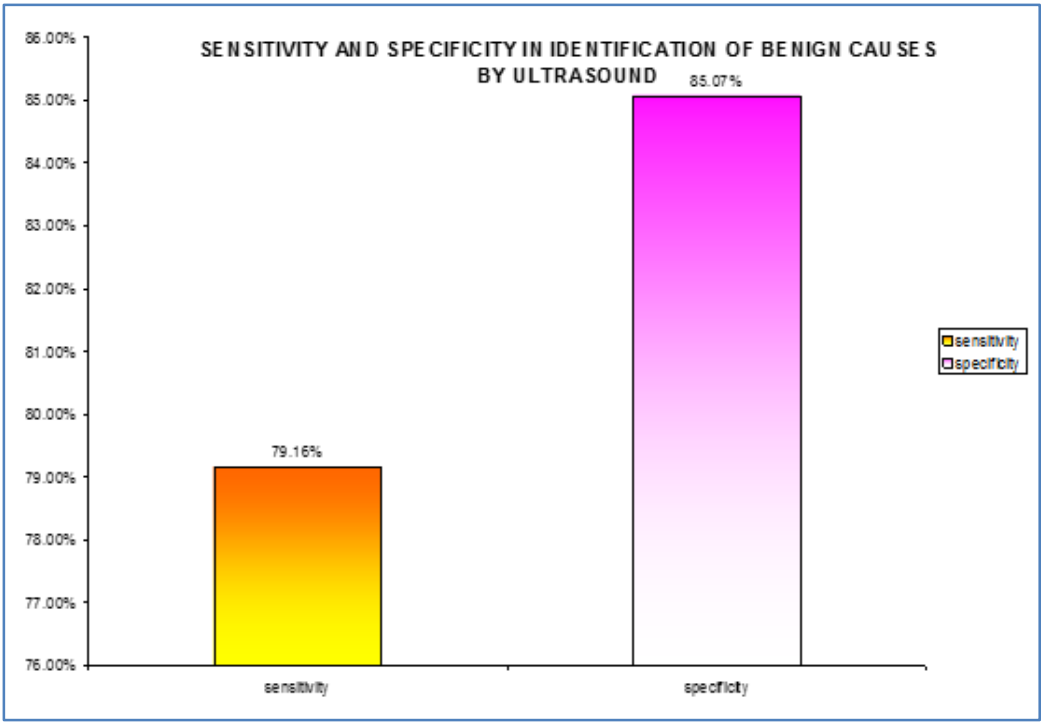

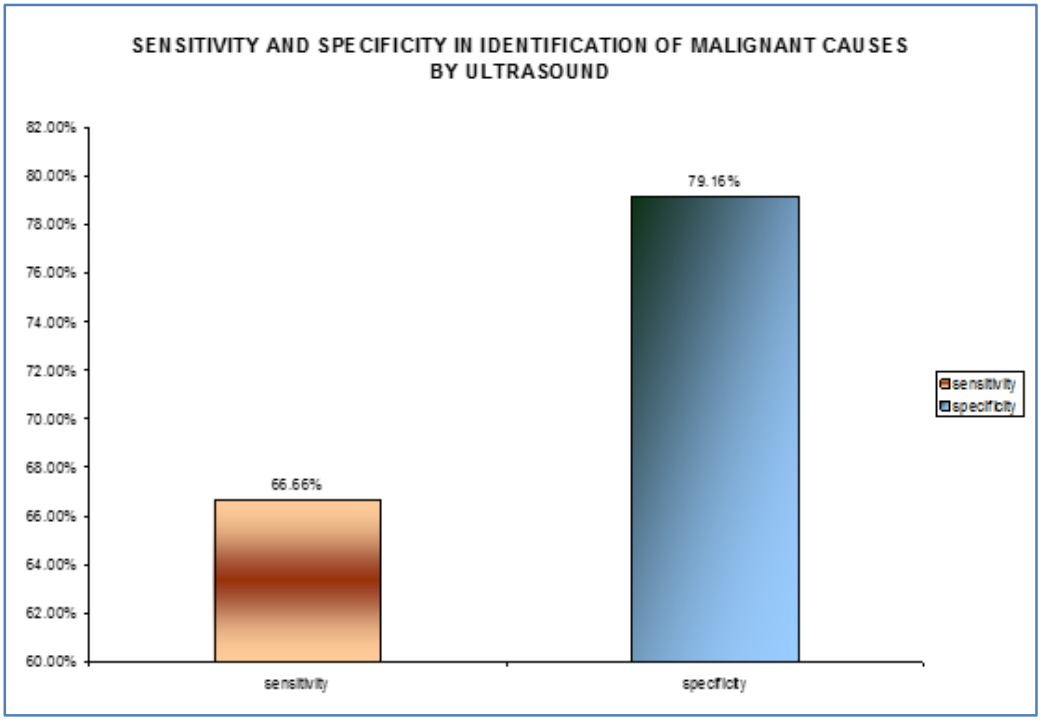

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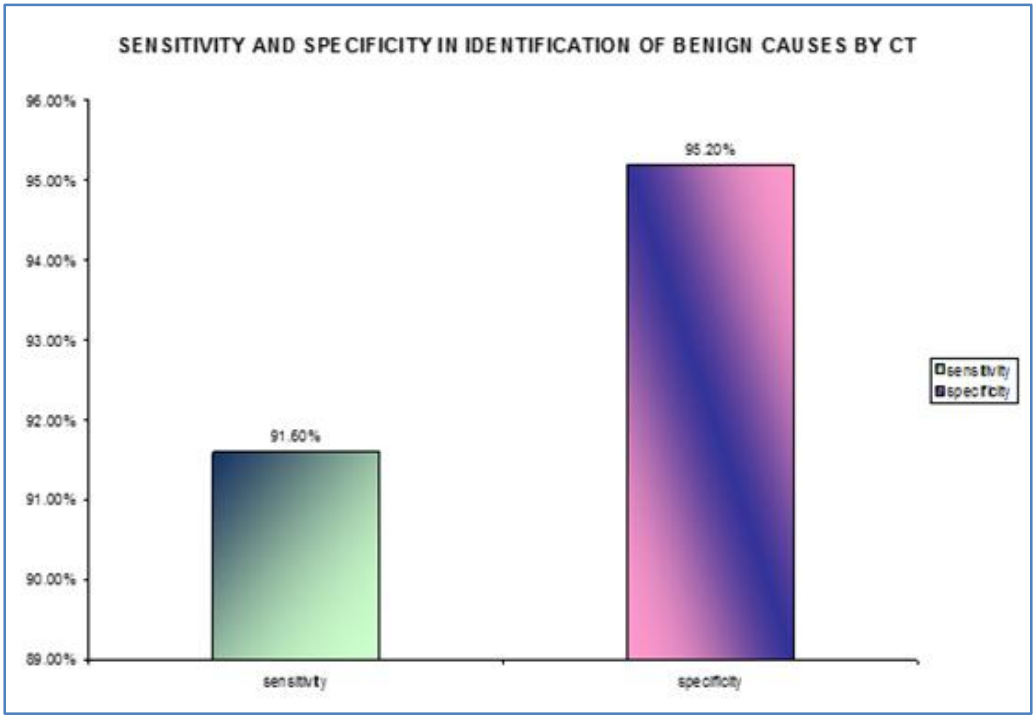

DISCUSSION: Gray scale Ultrasonography & CT are both accurate non-invasive imaging methods in differentiating obstructive and non-obstructive biliary disease. Transabdominal ultrasonography has remained the initial imaging modality of choice in the evaluation of suspected biliary obstruction as it is non-invasive, inexpensive and readily available**(11)** CT is superior to ultrasound in evaluating the cause of obstruction.(12) Although ultrasound is well suited to visualize the common hepatic duct and proximal CBD, one of its major limitations is assessment of the distal CBD and pancreas, which are often obscured by overlying bowel gas in about 30-50% of the patients.(13,14) The application of CT is increasing in the evaluation of biliary system. It can be helpful in situations where the use of ultrasound is difficult. Eg: in the presence of obesity or postoperatively.

In the present study, radiological evaluation of obstructive jaundice of 45 patients was performed with US & CT to evaluate the cause of obstruction. Of these 45 patients, 17 patients were males: females were 28 making male: female ratio: 1: 1.6.

Majority of patients were in the age group of 41-50 years. Jaundice was the most common presenting symptom is 98% of patients. It is followed by pruritis present in 72% of patients pain abdomen present in 67% and anorexia in 45% patients, Right Upper Quadrant mass noted in 27% and fever in 13% of patients.

Total bilirubin and direct bilirubin was raised in all cases. Alkaline phosphatase was raised in 25 cases and serum alanine amino transferase (ALT) (SGPT) raised in 16 cases.

Choledocholithiasis is the most common cause of obstructive jaundice noted in 9 patients and 4 patients had Carcinoma of pancreatic head and 4 patients had choledochal cyst and carcinoma gallbladder in 3 patients, cholongio carcinoma noted in 2 patients. Chronic pancreatitis

causing obstructive jaundice noted in 1 patient. Porta hepatis lymphnodes secondary to lymphoma causing extrinsic compression over common bile duct was seen in 1 patient. Hepatocellular carcinoma seen in 1 patient.

Of 45 patients, the cause of obstruction in 24 patients was benign and the cause of obstruction in 21 patients was malignant. Among the benign causes, choledocholithiasis was the most common cause noted in 19 patients. Among the malignant causes, peri ampullary carcinoma was noted in 10 causes.

Out of 24 patients with benign causes of biliary obstruction, Ultrasound identified 19 causes whereas CT identified 22 causes. Ultrasound detected 15 patients with choledocholithiasis whereas CT detected 17 patients. Ultrasound was able to detect all the cases of proximal CBD stones but detected distal CBD stones in only 6 patients due to inadequate visualization of distal CBD because of overlying bowel gas and extreme obesity. In the study of Pedrosa et al,[(2)] CT correctly identified 14 out of 17 common duct calculi. Baron et al identified CBD stones in 83% by CT. Jeffrey et al correctly identified stones in 90% of patients by CT. They found CT is especially useful for evaluation of distal bile duct and ampulla, areas poorly imaged by sonography.

Ultrasound detected 5 patients of periampullary carcinoma out of 10 patients whereas CT detected 7 patients. Ricardo Robledo et al conducted a retro spective study of 8 patients with obstructive jaundice by ultrasound. All of them had ampullary carcinoma and the study showed identification of ampullary tumors in 75% of cases by ultrasound.

Ultrasound identified 3 cases of carcinoma of pancreatic head and CT identified 4 cases of carcinoma of pancreatic head. Richard L. Baron et al, in his study showed identification of 10 cases of pancreatic carcinoma by CT and 8 cases by Ultrasound out of 12 cases. Joan p.campbell et al did Ultrasonographic analaysis in evaluation of pancreatic neoplasams in 51 patients. 50 out of 51 pancreatic mass were identified at the time of initial evaluation by ultrasound. 32 masses were in pancreatic head, periampullary region or neck, 10 in the tail, 3 in the body. 27 patients had pancreatic duct dilatation at Ultrasound.

Ultrasound and CT identified 3 cases of carcinoma of gallbladder. Shelly Nan weiner et al, in his study showed Ultra sound and CT were found to be complimentary in the detection of carcinoma of gallbladder, especially when there was abdominal gas or anterior reverberations in the gallbladder that prevented a complete sonogarphic evaluation.

In the present study, Ultrasound was able to detect the benign causes of biliary obstruction in 79% cases where as CT was able to detect the benign causes in 91.6% of cases. Ultrasound was able to detect the malignant causes of obstruction in 61.9% cases where as CT was able to detect the malignant causes in 80.9% cases.

Sensitivity and Specificity of Ultrasound in identification of benign causes were 79.16% and 85.7% and of CT were 91.1% and 95.2%. Sensitivity and Specificity of Ultrasound in identification of malignant causes were 66.7%, and 79.1% and of CT were 80.9%, and 87.5%.

CONCLUSIONS:

1. CT is superior to Ultrasound in determining the cause of biliary obstruction and eliminates the need for invasive procedures.

2. In recent years, the improved spatial resolution and contrast sensitivity available with current CT scanners has increased their capability for evaluating the biliary system, although it requires the use of IV contrast and exposes the patient to ionizing radiation.
3. CT superior to Ultrasound in detecting the stones in distal CBD, and periampullary growth where Ultrasound cannot adequately visualize the distal CBD due to overlying bowel gas or obesity.
4. Although CT is superior to Ultrasound in evaluating obstructive Jaundice, ultrasound should be the initial screening procedure because of its ready availability, its cost effectiveness, no requirement of contrast material and lack of ionizing radiation.
5. Ultrasound is more sensitive for gall stones, but as the stones pass down to common bile duct, CT is more sensitive in detecting them.

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