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Original Article

Comparative Study of Abdominal Ultrasonography and Computed Tomography in Evaluation of Biliary Tract Obstruction

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Abstract

Introduction: Jaundice may be obstructive (surgical) or nonobstructive (medical). The aim of radiological investigations in obstructive jaundice is to provide the diagnostic information including the level and cause of obstruction. Improvement in resolution of ultrasonography (USG) and greater experience with this technique has yielded consistently better success rate of late.

Materials and Methods: A total of 50 patients suspected of biliary tract obstruction were examined first by real time USG with convex (2.5-5 MHz) transducer, then computed tomography (CT) scan (plain/contrast enhanced). Incidence, etiology, level of obstruction, and level of dilatation was studied. Similarly, the causes were grouped as malignant and benign. Diagnosis was confirmed either at surgery or histopathologically.

Results: A total of 50 patients were included in the study. The incidence of biliary tract obstructive disease was more in female. Tumors comprised the largest group of cases 29(58%). Common hepatic duct and proximal common bile duct (CBD) was dilated on USG in 92% cases and in CT scan 100% cases. On USG and CT scan distal CBD was found to be dilated in 50% and 84% cases respectively. USG was found sensitive in 100% and specific in 86.2% cases while CT scan was sensitive in 100% and specific in 93.1% in benign lesion as a cause of obstruction while among malignant lesion as a cause of obstruction USG was found 86.2% sensitive and 100% specific and CT scan was 93.1% sensitive and 100% specific.

Conclusion: USG is considered the first choice option in the diagnostic imaging of obstructive biliary disease. CT scan is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies.

Keywords: Biliary obstruction, Computed tomography, Ultrasound

INTRODUCTION

Obstructive jaundice is one of the most frequent and grave form of hepatobiliary disease. It can pose problems in diagnosis and management, particularly intrahepatic cholestasis.[1] Despite the technical advances, the operative modes of management of obstructive jaundice were associated with very high morbidity and mortality. Yet, during the last decade significant advances have been made in our understanding with regard to the pathogenesis, diagnosis, staging and the efficacy of management of obstructive biliary tract diseases.[2] Correct choices among therapeutic options usually rest on a precise assessment of etiology, location, level and extent of disease.[3]

Hence, it is mandatory to determine preoperatively the existence, the nature and site of obstruction because an ill chosen therapeutic approach can be dangerous.

Detailed information for diagnosis of biliary obstruction is usually obtained by the combined use of ultrasonography (USG), computed tomography (CT), endoscopic retrograde cholangiopancreatography (ERCP), and percutaneous transhepatic cholangiography. Magnetic resonance cholangiopancreatography (MRCP) and cholangio CT (CCT) have been recently added.

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USG is 95% accurate to detect dilated and nondilated bile ducts, if the serum bilirubin exceeds 170 μmol/L (10 mg/dl).[4] False negative are seen if the obstruction is of short duration or intermittent. Diagnostic procedures using ultrasound are painless, harmless, relatively inexpensive, and available and there is no ionizing radiation. However, it has some limitations in the diagnosis of some causes of biliary obstruction. The larger main right and left hepatic ducts can be identified in USG as tubular structures running anterior and parallel to the right and left branches of the portal vein, and measures up to 2 mm in diameter in the nondilated systems.[5] The diameter of the normal common duct at the porta hepatis should be <5 mm,[6] increasing slightly (<6 mm) as the duct runs caudally in the free edge of the lesser omentum and within the head of the pancreas.[7]

CT is another imaging modality to evaluate obstructive jaundice. The overall accuracy of CT for diagnosing biliary obstruction has been reported at 85-97%,[4] sensitivity 96% and specificity 91%.[8] Diagnosis of extrahepatic bile duct dilatation is based on the caliber of the common hepatic duct (CHD) and common bile duct (CBD). On CT, a CBD with diameter ≤7 mm should be considered normal, between 7 mm and 10 mm equivocal and >10 mm dilated.

Studies conducted by Rigauts *et al*. suggested that USG correctly defined the cause of biliary obstruction in 71% of patients with ductal stone.[9] Mitchell and Clark conducted studies which showed that sensitivity and accuracy of USG to detect choledocholithiasis was 18% and 19% respectively, whereas sensitivity and accuracy of CT were 87% and 84%, respectively.[10]

In evaluation of carcinoma pancreas, Lindsell showed that USG was 97% sensitive with 100% positive predictive value (PPV).[11] Accuracy of USG was 80% and that of the CT scan was 93% was shown by studies conducted by Thomas *et al.*[12]

In evaluation of the gall bladder (GB) mass Khalili and Wilson showed sensitivity of USG was 94%.[13] Yeh in 1979 observed the accuracy of USG in the diagnosis of GB carcinomas to be 84.6%.[14]

Regarding validity of CT as a diagnostic modality in the evaluation of GB mass, Kumaran *et al.* found accuracy of 93%,[15] Yoshimitsu *et al.* found sensitivity 80% and accuracy 86% in detecting GB mass.[16]

Although ultrasound continues to remain the preliminary investigation modality for detecting the presence or absence of surgical obstructive jaundice, its inability to answer the true extent and cause of obstructive jaundice necessitates the use of another imaging modality such as contrast enhanced CT and MRCP which scores over ultrasound in the diagnostic accuracy.[17] The study aims at evaluating the role of abdominal USG and CT scan in diagnosis of biliary tract obstruction and to compare the diagnostic accuracy of USG and CT scan in terms of operative findings.

MATERIALS AND METHODS

The material for the study consisted of patients with history suggestive of obstructive biliary tract diseases admitted to surgery ward of M.K.C.G Medical College Hospital from August 2014 to July 2016 for evaluation and treatment. After admission detailed clinical history was obtained from each case as per the pro forma (Annexure I). After that, they were subjected to ultrasound after an overnight fast (6-8 h) followed by CT scan (plain and with intravenous [IV] contrast followed by surgery in appropriate cases.

Inclusion Criteria

Patients with evidence of biliary tract obstruction with special emphasis on upper abdominal pain, itching, jaundice, upper abdominal mass, and weight loss.

Exclusion Criteria

- Patients unfit for surgery
- Patients unwilling for any investigation such as USG and CT.
- Drop out cases
- Patients who are unwilling to undergo operation.

Methods

Before the commencement of the study the objectives of the study along with its procedure, risks and benefits of this study will be explained to the patients and then informed consent taken.

Each patient will be enrolled in a single-institution prospective trial under the approval of the institution ethics committee.

During reviewing of the clinical history, special emphasis given to upper abdominal pain, itching, jaundice, upper abdominal mass, tenderness, condition of surrounding structures.

Then patients will be subjected to routine investigations using appropriate hematological and biochemical parameters to reach at a clinical diagnosis of biliary tract obstruction.

Each patient will be subjected to abdominal USG and plain/contrast CT of abdomen to evaluate the biliary tract for any obstructive lesion.

Method of USG Study

- Machine used: SHIMADZU 450 XL located in the department of radiodiagnosis in M.K.C.G Medical College, Berhampur. Probe frequency: 2.5-5 MHz
- Preparation of the patients: Imaging is usually performed following a 4-h fast, allowing the GB to fill and reducing obscuring upper abdominal gas. Since the liver is adjacent to stomach and small bowels, the gas within may interfere with the image. Hence, it is preferable to avoid scanning immediately after a meal. Carbonated fluid should be avoided by the patient during 2 h before the examination.
- Positioning of the patients and probe orientation: An initial survey of the biliary tree and GB with the patient in supine position and also in left lateral decubitus will be done. During scanning, the size of intrahepatic biliary tree, extrahepatic biliary tree, main pancreatic duct and GB, lumen of the GB and CBD, pancreas, all will be searched for presence of any mass lesion, calculus or any other pathology. Periampullary region assessment will be done. Lymphadenopathy, ascitis, ascaris, etc., will also be looked for.

Method of CT Scanning

A. Machine used: SIEMENS SOMATOM ESPRIT located in the Department of Radio Diagnosis in M.K.C.G Medical College, Berhampur.
Camera KODAK EKTASCAN 160 LASER IMAGER and KODAK 14” × 17” films are used for prints. Noncontrast/contrast-enhanced scans will be done.

B. Noncontrast CT scan technique: The patients will be positioned in supine position in the CT table with head properly positioned in the head rest. CT will be performed in the transverse axis in 5 mm slice from top of the diaphragm to the iliac crests.

C. Contrast-enhanced. CT scan technique: After noncontrast CT, 20 ml of water soluble iodinated contrast is mixed with 750-l000 ml of water and patients will be advised to drink 200-250 ml in every 15 min. Then patients will be again brought back to CT table and 40-50 ml of 76% nonionic contrast (iohexol) will be administered IV as bolus.

Scanning will be repeated and enhancement pattern of the lesion will be studied.

Lateral projection CT and sagittal reconstruction will be done if required to better appreciate the three dimensional anatomy of the lesion and the status of the adjacent structures.

Procedure

For CCT, a multislice CT unit was used. An AP scout was obtained with the patient in supine position, following oral administration of contrast for opacization of stomach and bowels; subsequently, a scan was achieved with one breath-hold and no contrast medium of the upper abdomen (from the diaphragm cupola to the iliac crests) for the localization of the biliary tract (Table 1). Scan duration was 12 s. Once the biliary tract had been identified, 40-50 ml of 76% nonionic contrast (iohexol) was administered IV, followed by administration of saline solution; after 60 s in one breath-hold a high quality scan was obtained from the diaphragm cupola to the inferior margin of the pancreatic head (Table 2). The data set were transferred to an Advantage 4.0 workstation where multi-planar reconstructions and maximum intensity projection reformats could be constructed in a few minutes.

USG findings include:

- Visualization of stone(s)
- Echogenic rounded focus
- Size ranges between 2 and >20 mm
- Shadowing may be more difficult to elicit than with gallstones within the GB
- Dilated bile duct
    - >6 mm + 1 mm per decade above 60 years of age
    - >10 mm postcholecystectomy.
- Dilated intrahepatic biliary tree
- Intrahepatic duct >2-3 mm centrally. Any hyperechoic lesion in hepatobiliary system. Any hyperechoic lesion in head of pancreas.

CT findings include:
Any tubular structure in the porta hepatis and/or the head of pancreas that did not enhance and was larger than 10 mm in diameter represented a dilated segment of the extrahepatic biliary system.

Pre-operative Preparation of Patients

Before operating the patients of biliary obstruction, pre-operative preparation is very essential. It includes routine pre-operative preparation along with specific preparation for patients with biliary tract operation.

Routine pre-operative preparation:

- Complete blood count
- Electrocardiogram
- Fasting blood sugar/postprandial blood sugar/random blood sugar
- Urine routine and microscopic tests
- Marking the site/side of operation
- Informed consent
- Special investigation:
    - Investigations for obstructive jaundice
    - Serum bilirubin. Normal value is <1.0 mg%.

Both direct and indirect bilirubin are assessed

- Serum albumin, globulin and A:G ratio. Normal serum albumin is more than 3.5 g%. Prothrombin time. Normal value is 12-16 s.

Pre-operative Preparation of Patient with Obstructive Jaundice

- Injection vitamin K IM 10 mg for 5 days
- Fresh frozen plasma - Often requires 6 bottles or more adequate hydration is most important 5/10% dextrose blood transfusion in case of anemia
- Oral neomycin, lactulose mannitol 100-200 ml BD IV to prevent hepatorenal syndrome
- Repeated monitoring by doing prothrombin time, electrolytes antibiotics like third generation cephalosporins
- Calcium supplements as calcium chloride IV
- Correction of coagulopathy, prevention of renal failure, infection, hepatic encephalopathy, and electrolyte imbalance (correction of hypoglycemia and dilutional hyponatremia due to water retention).

On the Day of Surgery

- Minimum 8 h of fasting
- Ryle's tube and catheterization
- Prophylactic administration of antibiotics
- Shaving, toileting, and consent.

Surgery

Surgical approach to be decided according to the diagnosed etiology and pathology to be confirmed by operative/histopathological findings.

RESULTS

A total of 50 patients satisfying the inclusion criteria were included in the study. A descriptive comparative analysis of imaging findings in each modality was compared, and results were derived. Mean age was found to be 48.18 years. The majority of cases were found in 51-60 years age group and age group range was 1-90 years and incidence of biliary tract obstructive disease was more in female (60% cases) as compared to male (40%) (Graph 1). Predominant symptoms in the study group were jaundice in 46 patients (92%) and pain abdomen in 40 patients (80%).

In present study group tumors comprised the largest group of cases 29 (58%) followed by choledocholithiasis 14 (28%) cases and benign biliary stricture 4 (8%) cases (Table 3).

On USG, intrahepatic biliary radicles (IHBR) were found to be dilated in all except one patient, i.e., 98% while it was 100% on CT scan (Table 4). Excessive bowel gasses hindered evaluation of the hepatobiliary system in one patient.

Table 1: CCT: First scan protocol

Parameters KV/mAs/time per rotation (s)	140/160/0.8
Detector collimation (mm)	5
Slice thickness (mm)	5
Data reconstruction interval (mm)	2
Table speed (mm per rotation)/pitch	15/3

Table 2: CCT: Second scan protocol (contrast agent injection)

KV/mAs/time per rotation (s)	140/350/0.8
Detector collimation (mm)	2.5
Slice thickness (mm)	2.5
Data reconstruction interval (mm)	1
Table speed (mm per rotation)/Pitch	7.5/6
IV contrast volume and type	150 cc
Injection rate	3 cc/s
Scan delay (s)	60

CCT: Cholangio computed tomography, IV: Intravenous

Table 3: Distribution of cases according to final diagnosis and their comparative evaluation of USG and CT scan

Cause of obstruction	USG	CT scan	Final diagnosis (Surg/HP)
Cholangiocarcinoma	7	8	9
Benign biliary stricture	3	5	4
Choledochal cyst	3	3	3
GB mass	10	10	10
Periampullary carcinoma	2	2	3
Choledocholithiasis	19	15	14
Carcinoma head of pancreas	6	7	7

GB: Gall bladder, CT: Computed tomography, USG: Ultrasonography, HP: Histopathological

Table 4: Distribution of cases on the basis of level of dilatation of biliary tree

Biliary tree dilatation	USG	CT scan
IHBR	49	50
CHD	46	50
Proximal CBD	46	50
Distal CBD	40	42

CHD: Common hepatic duct, CBD: Common bile duct, IHBR: Intrahepatic biliary radicles, CT: Computed tomography, USG: Ultrasonography

Table 5: Distribution of cases on the basis of level of obstruction of biliary tree

Level of obstruction	USG	CT scan
Hilar and intrahepatic	25	25
Suprapancreatic	12	12
Infrapancreatic	13	13

CT: Computed tomography, USG: Ultrasonography

CHD and proximal CBD was dilated on USG in 92% cases and in CT scan 100% cases. On USG and CT scan distal CBD was found to be dilated in 50% and 84% cases respectively (Table 5). In our study, most common level

Table 6: Diagnostic performance of USG

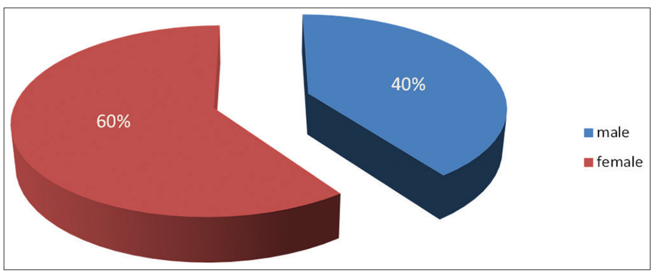
Cause of obstruction	Diagnostic performance of USG (%)		
	Sensitivity	Specificity	PPV
Cholangiocarcinoma	77	100	100
Benign biliary stricture	75	100	100
Choledochal cyst	100	100	100
GB mass	100	100	100
Periampullary carcinoma	66	100	100
Choledocholithiasis	100	86	73
Carcinoma head of pancreas	85.7	100	100

GB: Gall bladder, USG: Ultrasonography, PPV: Positive predictive value

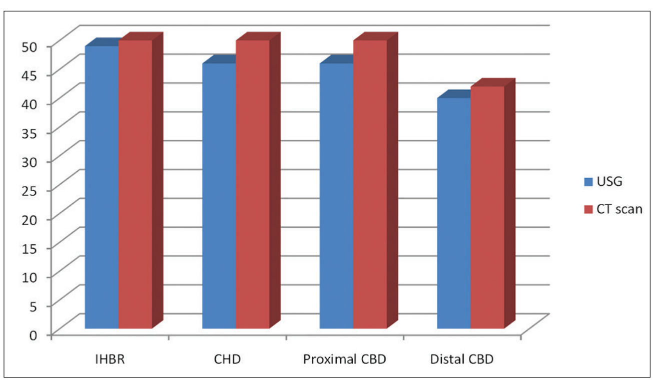
Table 7: Diagnostic performance of CT

Cause of obstruction	Diagnostic performance of CT (%)		
	Sensitivity	Specificity	PPV
Cholangiocarcinoma	100	97.6	88.8
Benign biliary stricture	100	97.8	80
Choledochal cyst	100	100	100
GB mass	100	100	100
Periampullary carcinoma	66	100	100
Choledocholithiasis	100	97.2	93.3
Carcinoma head of pancreas	100	100	100

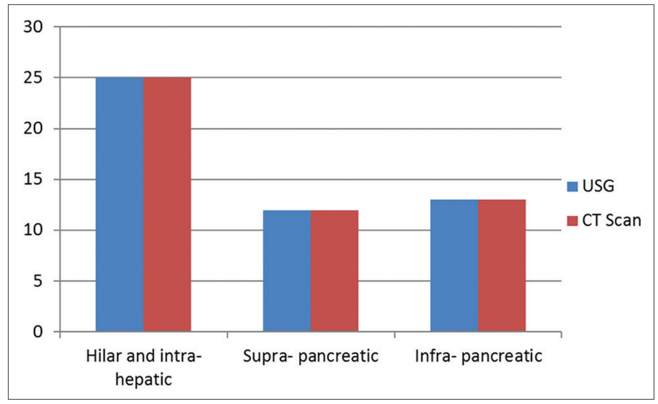
PPV: Positive predictive value, CT: Computed tomography



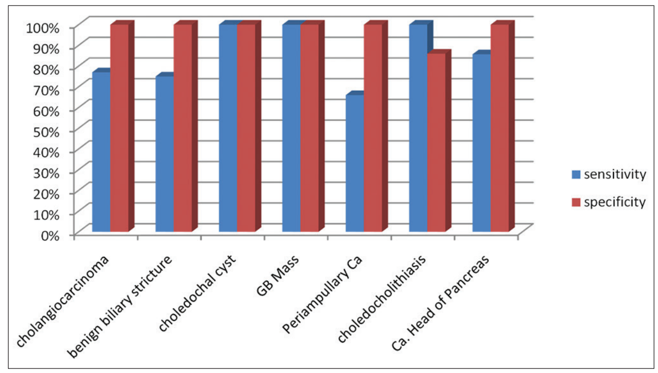
Graph 1: Sex distribution of cases of biliary tract obstruction



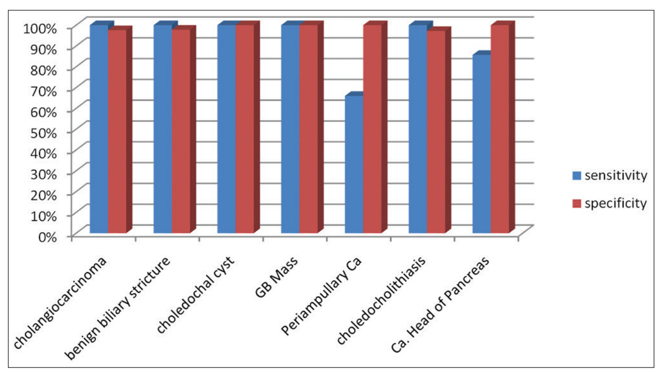
Graph 2: Distribution of cases on the basis of level of biliary tree dilatation



Graph 3: Distribution of cases on the basis of level of obstruction of biliary tree



Graph 4: Sensitivity and specificity of ultrasonography in biliary tract obstruction



Graph 5: Sensitivity and specificity of computed tomography scan in biliary tract obstruction

of obstruction detected by both modalities was Hilar and intrahepatic CBD. The level of obstruction was diagnosed accurately both by CT scan and USG.

Of a total of 21 benign cases, 25 cases were detected by USG and 23 cases were detected by CT scan while, among total 29 malignant cases, USG detected 25 cases and CT scan detected 27.

The most common benign cause of obstructive jaundice was choledocholithiasis (14) followed by benign biliary stricture in 4 cases, and choledochal cysts were 3 cases.

USG missed 1 case of benign biliary strictures, and 5 cases of distal CBD stone, while CT scan falsely detected 1 case of benign biliary stricture and CBD stone each.

The most common malignant cause of obstructive jaundice was infiltrating GB mass (10), followed by cholangiocarcinoma in 09/50 cases, and pancreatic carcinoma in 7/50 cases. In our study, USG missed 1 case of pancreatic head mass and 1 case of periampullary carcinoma.

Two cases of distal CBD mass could not be detected on ultrasound, with a diagnostic accuracy of USG (90%) as compared to 98% in CT scan. CT scan missed 1 cases of periampullary carcinoma and not able to detect 1 case of cholangiocarcinoma.

In present study, on USG 2 case of distal CBD mass were falsely reported as distal CBD stone because evaluation of distal CBD was not possible due to overlying bowel gases, while CT scan falsely reported 1 case of distal CBD stricture as distal CBD mass.

USG was found sensitive in 100% and specific in 86.2% cases while CT scan was sensitive in 100% and specific in 93.1% in benign lesion as a cause of obstruction while among malignant lesion as a cause of obstruction USG was found 86.2% sensitive and 100% specific and CT scan was 93.1% sensitive and 100% specific.

Overall 10 cases were falsely diagnosed by USG while only 4 cases were falsely diagnosed by CT scan among all 50 cases.

In cholangiocarcinoma, USG is able to detect 7 out of 9 cases with 2 false-negative cases whereas CT scan detected both 2 out of 3 cases with 1 false-negative cases. USG diagnosed 3 out of 4 cases with 1 false-negative case in case of biliary stricture whereas CT scan diagnosed 5 cases out of confirmed 4 cases of biliary stricture with 1 false-positive case. USG and CT scan both detected choledochal cyst and GB mass equally. In periampullary carcinoma, USG and CT scan detected both 2 out of 3 cases with one false negative case. In case of choledocolithiasis, USG detected 19 cases out of 14 confirmed cases with 5 false positive cases whereas CT scan detected 15 cases with 1 false positive case. Carcinoma head of pancreas detected 6 out of 7 cases whereas CT scan diagnosed all the 7 cases (Table 3).

IHBR were visualized in 100% cases on CT scan as compared to sonography (98%). Dilatation of the IHBR found in all 50 cases by CT scan as compared to 49 cases on sonography. On CT scan, CHD and proximal CBD dilatation was detected in all the 50 cases whereas USG could only detect 46 cases out of 50. In distal CBD, USG could only detect only 40 cases out of 50 and 42 cases were detected in CT scan (Table 4 and Graph 2).

Out of 50 cases, 25cases of obstruction at the hilar and intrahepatic level is detected by USG and CT scan each. 12 cases each was detected by USG and CT scan for obstruction at suprapancreatic level and 13 cases each of obstruction at infrapancreatic level was detected each by USG and CT scan (Table 5 and Graph 3).

Sensitivity of USG is 100% in detecting cases of choledochal cyst, GB mass, choledocholithisis, Carcinoma head of pancreas, whereas sensitivity is 77% for cholangiocarcinoma, 75% for benign biliary stricture, 66% for periampullary carcinoma.

Specificity of USG is 100% in cases of cholangiocarcinoma, benign biliary stricture, choledochal cyst, GB mass, periampullary carcinoma, carcinoma head of pancreas, whereas specificity in cases of choledocholithiasis is 86%.

Positive predictive value (PPV) is 100% in all the cases except in cases of choledocholithiasis where PPV is 73% (Table 6 and Graph 4).

Sensitivity of CT scan is 100% in detecting cases of choledochal cyst, GB mass, choledocholithisis, carcinoma head of pancreas and benign biliary stricture, whereas sensitivity is 66% for periampullary carcinoma.

Specificity of CT scan is 100% in cases of, choledochal cyst, GB mass, periampullary carcinoma, carcinoma head of pancreas whereas specificity in cases of choledocholithiasis is 97.2%, 97.6% in cholangiocarcinoma and 97.8% in benign biliary stricture cases.

PPV is 100% in cases of choledochal cyst, GB mass periampullary carcinoma, carcinoma head of pancreas and PPV in cholangiocarcinoma is 88.8%, benign biliary stricture cases showed PPV of 80% and in cases of choledocholithiasis PPV is 93.3% (Table 7 and Graph 5).

DISCUSSION

Obstructive jaundice can be caused by the obstruction of the bile duct with gall stones, strictures, malignancy, etc. Obstructive jaundice is common amongst females and choledocholithiasis are the commonest benign cause.[18] In my study, IHBR were visualized in 100% cases on CT scan as compared to sonography (98%). Dilatation of the IHBR found in all 50 cases by CT scan as compared to 49 cases on sonography and there was a declining trend observed in the ability of sonography to visualize the biliary tree as we moved distally (Table 4). Visualization of the proximal ducts was possible in 91.6% cases and dropped to 63.3% for distal CBD. Decreasing the diagnostic performance of sonography was because of difficulty in visualizing the distal CBD and the pancreatic region mainly due to interference by bowel gasses. Similar observations were also made by Vicary *et al*.[19]

who opined that limitation in the sonographic evaluation of the distal biliary tree and pancreas was due to bowel gasses besides the operator's experience. CT scan was better in showing the distal biliary tree. The distal CBD was visualized in 42/50 patients (84%) as against 40/50 (80%) patients by sonography. In eight cases, nonvisualization of the distal CBD on CT scan was caused by complete cut-off at the level of hilum due to malignant masses. Both ultrasound and CT scan seem to have sensitivity and specificity of nearly 100% for detecting the presence of a biliary obstruction. Mitchell and Clark conducted studies which showed that sensitivity and accuracy of USG to detect choledocholithiasis was 18% and 19%, respectively, whereas sensitivity and accuracy of CT were 87% and 84%, respectively.[10] According to my study most common site of obstruction was hilar and intrahepatic (50%) was comparable to Kumar *et al*.[18] who found a variable range of accuracy ranging from 27% to 95% for detecting the level of obstruction by ultrasound. The extent of the lesion could be determined in 100% of patients by CT scan as compared to only 66% by sonography.

CT scan showed good accuracy and an optimal capability of evaluating tumor extent as reported by Nafisa *et al*.,[7] who reported an accuracy of 100% in the assessment of their extent. Our finding is also in concurrence with the study conducted by Nafisa *et al*. Pasanen *et al*.[20] in a prospective study comparing USG, CT scan with ERCP found that when the obstruction was benign and extrahepatic ERCP was the most accurate, but when it was malignant CT was comparable. Intrahepatic disease was best diagnosed by US and CT.

Choledocholithiasis comprised maximum number of cases (n = 14 [28%]) in our study (Table 3). The second most common cause of obstruction was infiltrative GB mass 10/50 (20%) cases. In my study, cholangiocarcinoma comprised third common cause (n = 9 [18%]) of obstruction.

In my study, USG was found sensitive in 100% and specific in 86.2% cases while CT scan was sensitive in 100% and specific in 93.1% in benign lesion as a cause of obstruction while among malignant lesion as a cause of obstruction USG was found 86.2% sensitive and 100% specific and CT scan was 93.1% sensitive and 100% specific PPV: 93.7% and the diagnostic accuracy of 96%. Singh *et al*.[21] in a prospective study of comparative assessment of imaging modalities in biliary diseases found that USG had the accuracy of 88% for assessing the benign and malignant cause. In the diagnosis of benign diseases ultrasound (80.77%), which was more sensitive than CT scan (54.55%). In the diagnosis of malignant diseases as compared to CT scan (91.67%), which was more sensitive than USG (79.17%). Our results are comparable to Ghimire *et al*.[22] who found sensitivity: 67%, specificity: 91%, PPV: 71%, and negative predictive value: 73%, for ultrasound in the detection of benign lesions.

In my study, ultrasound was found to have sensitivity: 100%, specificity: 86%, PPV: 73% and diagnostic accuracy of 96% for choledocholithiasis while CT scan with sensitivity 100%, specificity: 97.2%, PPV: 93.3% and the diagnostic accuracy of 98%. Ferrari *et al*.[23] in their study showed the diagnostic accuracy of 80.15%, with a sensitivity of 71.08% and a specificity of 95.83%. Five false positive cases on USG were due to hindering of distal CBD evaluation by bowel gas shadow and obese body habitus. Pasanen *et al*. found that the sensitivity of ultrasound for choledocholithiasis varies widely from 20% to 80% with a high specificity of approximately 98%. Stones were diagnosed in 19 cases giving a sensitivity of 24.6%.

In my study for stricture ultrasound detected 3 out of 4 cases of post-operative stricture with diagnostic accuracy: 98% sensitivity: 75% and specificity: 100% while CT scan detected 5/4 cases of biliary strictures with sensitivity, specificity and diagnostic accuracy of 100%, 97.8%, and 98%, respectively. In contrast to our study, Pandit and Panthi[24] in their study found accuracy of ultrasound in detection of benign stricture was 31%. The high specificity was attributable to the capability of USG to detect true negatives in benign stenosis, thus showing the cause of the obstruction by calculi or malignant stenosis. The low sensitivity figures are to be related to intrinsic limitations of the methodology, which, though showing the indirect signs of stenosis, did not allow optimal visualization of the distal CBD and the ampullary region, which is where benign stenosis are often localized. Both USG and CT scan detected all the three cases of the choledocal cyst and gave information of involvement confidently similar findings were discussed by Kim *et al*. in their study.

CONCLUSION

USG is considered the first choice option in the diagnostic imaging of obstructive biliary disease. However, owing to its low sensitivity in most of the benign stenosis and distal CBD disease, where the clinical and laboratory suspicion is strong and unsupported by ultrasound and/or in the presence of conditions affecting ultrasound performance, and for a thorough staging evaluation of malignancy, CT scan is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies. CT scan is more sensitive and more likely to detect choledocholithiasis, CBD strictures and malignant pathologies as compared to USG. Sensitivity, specificity, and accuracy of CT scan for choledochal cyst are same as in USG. However, the potential applications of CT scan in the detection of obstructive biliary pathologies are limited by the expanse and availability of technology due to its high cost and lack of expertise available in operating the machine.

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ANNEXURE I

Case study no.____________

PROFORMA:

Name and address: ______ Age: ______ Sex: _________
Inpatient no: ____________
Unit: ____________
DOA: ____________
Duration of hospital stay: ____________
Date of discharge: ____________
Chief complaints and present illness:
- A. Pain
  - (a) Site and mode of onset
  - (b) Character
  - (c) Duration
  - (d) Radiation
  - (e) Relieving and exaggerating factor.
- B. Vomiting: Frequency/character
- C. Bowels: Regular/irregular blood and mucus
- D. Yellowish discoloration of urine
- E. Yellowish discoloration of eyes
- F. Itching
- G. Presence of upper abdominal mass

Past history:
Drug history:
Addiction history:
Family history:
General examination:
Pulse____________:
BP____________:
Respiration rate____________:
Temperature____________:
Palor____________:
Icterus____________:____________
Cyanosis____________:
Clubbing____________:
Lymphadenopathy____________:
Edema
Local examination:
Abdomen
Inspection:
1. Skin and subcutaneous tissue
2. Umbilicus
3. Contour of abdomen
4. Movements
5. Swelling

Palpation:
1. Tenderness
2. Muscular Rigidity
3. Distension
4. Lump (if any)
5. Palpation of the abdominal organs
   - Stomach
   - Liver
   - Spleen
   - Gallbladder
   - Kidney
   - Pancreas
   - Colon
6. Palpation of the hernia sites

Percussion:
1. Shifting dullness
2. Fluid thrill
3. Obliteration of liver dullness

Auscultation:
1. Rectal examination:
2. Vaginal examination:
3. Systemic Examination:
   - (a) Central Nervous system____________:
   - (b) Cardiovascular system____________:
     - Heart sounds
     - Murmurs
     - Any added sounds
   - (c) Respiratory system:
     - Breath sounds
     - Crepitations
     - Rhonchi
     - Any added sounds
   - (d) Musculoskeletal system:
4. Laboratory Investigations:
5. Hematological
   - (a) Hb%__
   - (b) RBC Count __
   - (c) Reticulocyte count
   - (d) Haematocrit
   - (e) Mean corpuscular volume (MCV)

(f) Mean corpuscular hemoglobin (MCH)
(g) Mean corpuscular hemoglobin concentration (MCHC)
(h) DC
- Neutrophils
- Basophils
- Eosinophils
- Lymphocytes
- Monocytes

(i) TLC
(j) PCV
(k) Haptoglobin
(l) Peripheral blood smears

Biochemical
(a) Liver function test:
- Serum bilirubin
- Serum albumin
- Total protein
- AST
- ALT
- GGT
- ALP

(b) Kidney function test:
- Serum urea
- Serum creatinine

(a) FBS ____________PPBS_______ RBS_______

Coagulation Profile:
(i) BT ____mins______secs
(ii) CT ____mins___secs
(iii) PT.____________

aPTT __________
INR ___________

Stool examination:
Occult blood : Positive/negative
Colour :___________

Urine examination:
(a) Physical examination
- Volume
- Colour
- Appearance
- Reaction
- Odour
- Specific gravity

(b) Chemical examination
- Protein
- Glucose
- Ketone bodies
- Bile salts
- Bile pigments
- Urine urobilinogen

(c) Microscopic examination
- Pus cells
- Epithelial cells
- Casts
- Crystals
- Bacteria
- Yeast cells
- Parasites

Imaging Investigations:
(a) USG of Abdomen
- Liver
- Gallbladder
- Pancreas
- Spleen
- Right kidney
- Left kidney
- Urinary bladder
- Prostate
- Uterus
- Ovaries
- Ascitis
- Lymph node status
- Other findings (if any)

b) Plain/contrast enhanced CT scan of abdomen
- Liver
- Gallbladder
- Pancreas
- Spleen
- Right kidney
- Left kidney
- Right ureter
- Left ureter
- Urinary bladder
- Prostate
- Uterus
- Ovaries
- Lymph node status
- Other findings (if any)

Upper Gastro-intestinal endoscopy :
Lower Castro-intestinal endoscopy :
Diagnosis :
Operative procedure :
Operative findings :
Histopathological report :