

Original Research Article

Role of Ultrasonography in Evaluating the Causes of Obstructive Jaundice

Dr Chandra Prakash Ahirwar¹, Dr Abhijit Patil², Dr Kshitij Sharma³

¹Assistant professor, ²Associate professor, Dept. of radio-diagnosis, Gandhi Medical College and Hamidia Hospital, Bhopal, Madhya Pradesh, India

³Third year resident, Gandhi Medical College and Hamidia Hospital, Bhopal, Madhya Pradesh, India

*Corresponding author

Dr Chandra Prakash Ahirwar

Email: drchandraprakashradiologist@gmail.com

Abstract: To observe the role of ultrasonography in evaluation of causes of obstructive jaundice. A total of 100 patients were enrolled in this cross-sectional study done in Department of Radio-diagnosis, Gandhi Medical College, Bhopal. Ultrasonography was able to detect the presence of biliary obstruction in 100% of cases. Liver function tests were altered in all the patients with alkaline phosphatase raise out of proportion to the AST/ALT. The highest incidence of biliary obstruction was found in 61-70 years' age group with mean (\pm SD) age of the patient was 62.7 ± 12.64 years. Sensitivity, specificity and accuracy of ultrasonography in detecting the various causes of obstructive jaundice was 84.15%, 98.86% and 97% respectively. Accuracy and specificity for ultrasonography is high in detecting the causes of biliary obstruction with a slightly low sensitivity. Considering these attributes, ultrasonography can be used as a very effective screening modality in cases of obstructive jaundice.

Keywords: Ultrasonography, Obstructive jaundice, Biliary obstruction

INTRODUCTION

The main goals of any imaging procedure in clinically suspected cases of obstructive jaundice are to confirm the presence of obstruction, its location, extent, probable cause, and to provide a sufficiently accurate overview of the biliary tree that will help the surgeon to determine the approach to each individual case [1, 2]. Obstructive jaundice can be caused by a plethora of conditions. These include benign as well as benign and malignant conditions. Obstructive jaundice can be caused by the obstruction of the bile duct as with gall and CBD stones, strictures, malignancy, such as cholangiocarcinoma (in which the jaundice is persistent and progressive), periampullary carcinoma, carcinoma gall bladder and carcinoma head of pancreas, Castlemann disease, Caroli's syndrome and metastatic liver tumor [3].

USG is fairly accurate to detect dilated and non-dilated bile ducts. USG allows dynamic and real time evaluation of the biliary tree. Diagnostic procedures using ultrasound are painless, harmless, relatively inexpensive, easily available and free of ionizing radiation [4].

Gross intrahepatic dilatation is easy to detect sonographically and result in the "too many tubes" sign, created by the increased number of radiolucent channels in the liver, or the "parallel channel sign", formed by dilated intrahepatic ducts running anterior and parallel to the portal vein tributaries [5].

The normal diameter of CHD measures 4-5 mm or less on sonograms. The CBD measures 4-6 mm normally, with a 6-7 mm diameter considered equivocal. A diameter of more than 8 mm is indicative of ductal dilatation [6].

Our institution has a fair influx of patients suffering from obstructive jaundice with the patients constituting a fair number of hospital admissions. Ultrasonography is the primary modality used in the initial evaluation of obstructive jaundice. As this modality is fairly easily available, and constitutes the prima facie radiological investigation for the condition, this study is designed to evaluate the diagnostic role and accuracy of Ultrasonography in clinically suspected cases of obstructive jaundice.

MATERIALS AND METHODS

This study was carried out in the Department of Radiodiagnosis and Imaging, Gandhi Medical College, Bhopal from January 2014 to December 2015. 100 clinically suspected cases of obstructive jaundice were included in the study by simple random sampling. The presumptive diagnosis was based on combination of clinical and laboratory parameters including itching, weight loss, icterus, upper abdominal mass, raised serum values of liver enzymes with alkaline phosphatase raised out of proportion to AST/ALT.

Prior to the commencement of the study the research protocol was approved by ethical review committee and scientific research committee of Gandhi Medical College, Bhopal. The aim of this study along with details of procedure, involved risk and benefits were explained to the patients and informed consent was taken. Data collection was done according to the afore-structured preformat.

PATIENT POSITIONING AND PROBE ORIENTATION

The scan was done after 6 hours fast so that gall bladder is not contracted. An initial survey of gall bladder, biliary tree, liver, pancreas and duodenum was done with the patient mainly in supine and left lateral decubitus positions. Organs were visualized in longitudinal and transverse planes in midline, parasagittal, midclavicular, mid-axillary and intercostal views.

During scanning, size of intrahepatic and extra hepatic biliary tree, maximum transverse diameter of main pancreatic duct, maximum transverse diameter of

common duct, lumen and size of gall bladder, presence of choledocholithiasis or cholelithiasis/ size if present, presence of any mass lesion/ maximum antero-posterior and transverse diameter if present, presence of lymphadenopathy, (periportal, peripancreatic, pre and para aortic, retroperitoneal), presence of narrowing/strictures of biliary tree, presence of focal dilatation of intra and/or extra-hepatic bile ducts, presence of ascites. The findings were correlated with histopathological reports.

STATISTICAL ANALYSIS

Statistical analysis was done by computer software devised as the statistical package for social sciences (SPSS). The results were summarized as tables and charts. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasonography as diagnostic modality were calculated. A p value of <0.05 was considered significant.

RESULTS

Female cases were 55(55%) and male were 45(45%). The highest incidence of biliary obstruction was found in 61-70 years' age with mean (\pm SD) age of the patient was 62.7 ± 12.64 years. The levels of serum alkaline phosphatase, aspartate aminotransferase and alanine aminotransferase were raised with alkaline phosphatase raised out of proportion to the other two.

Figure 1, shows the ultrasonographic features of dilated biliary tree. Figure 2, shows the age wise distribution of causes of obstructive jaundice. Figure 3, shows the relative frequency of involvement of various organs.



Fig-1: Grossly dilated common duct and intrahepatic biliary radicles due to presence of large obstructing common duct stone.

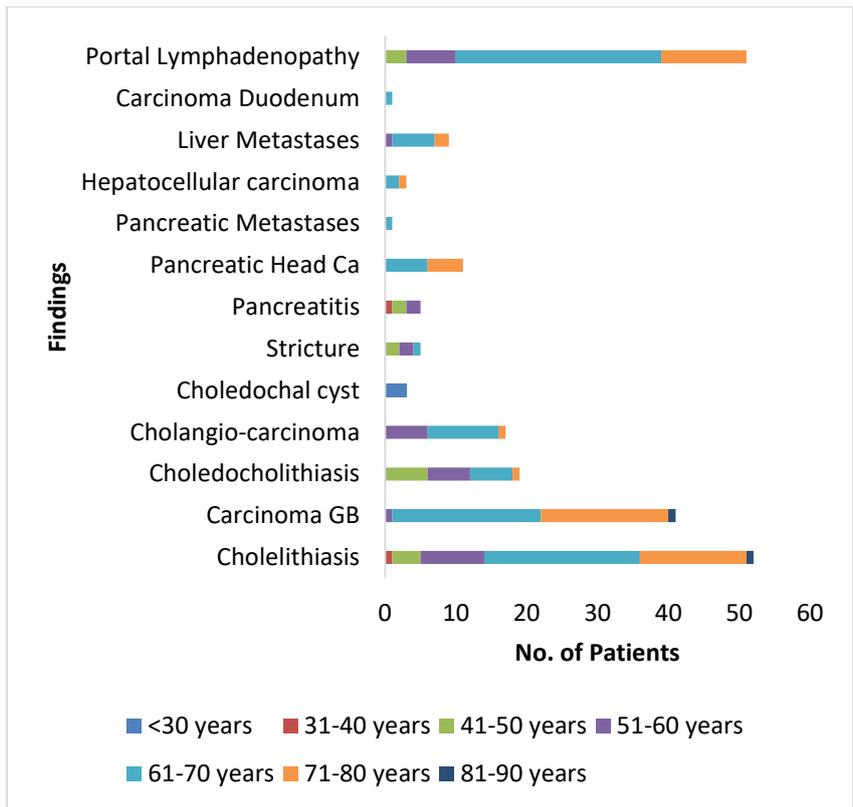


Fig-2: Age wise distribution of findings in patients

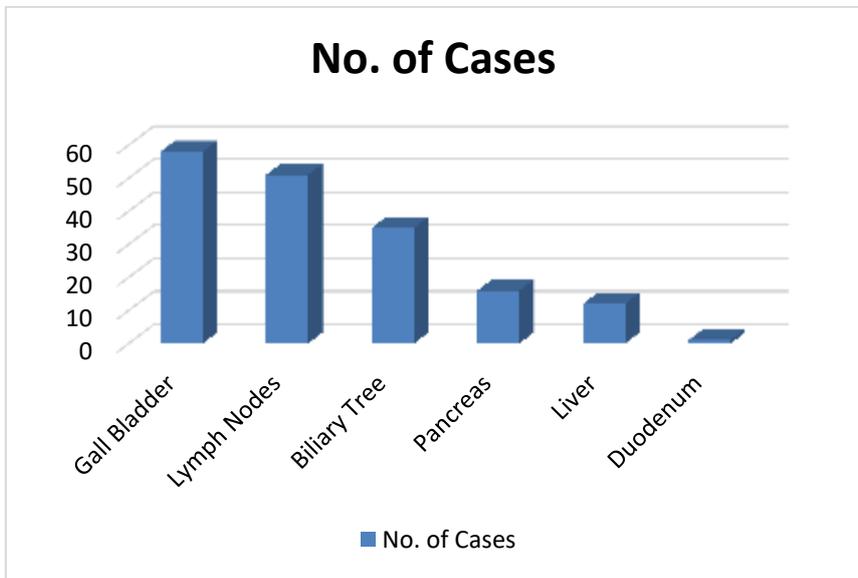


Fig-3: Frequency of involvement of various organ in the patients.

As shown in table 1, malignancy was the cause of obstructive jaundice in 80% of cases as compared to benign etiology in 20% of cases. Carcinoma of gall bladder was the leading cause of obstructive jaundice.

Overall, ultrasonography was 100% sensitive in detecting biliary obstruction. However, the sensitivity decreased for delineating the cause and level of obstruction.

As shown in table 2, sensitivity of ultrasonography was in range of 80-90% in for most of the causes of obstructive jaundice except for choledocholithiasis in which case it was 68.42%. Positive predictive value of ultrasonography was above 90% for most diagnosis except for cholangiocarcinoma in which it was low. Diagnostic accuracy of ultrasonography was above 90% for all the findings. Sensitivity of ultrasonography was 94.23% for

cholelithiasis which was a common associated finding seen in the cases of obstructive jaundice.

The present study findings indicate that ultrasonography is an effective screening as well as diagnostic modality for most of causes of obstructive jaundice.

DISCUSSION

In previous studies, the mean age of presentation of biliary obstruction was 48.42 ± 1.6 years, Naffisaadedin *et al.*[4]and 48.14 ± 12.55, Upadhyay V *et al.* [7] as compared to 62.7 ± 12.64 in our study, which was considerably lower. An increased preponderance of involvement of elderly population is seen. The maximum number of patients 45(45%) were seen in 61-70 years’ age group.

No significant difference was seen in prevalence of obstructive jaundice in males and females. However, female preponderance was seen in the cases of carcinoma of gall bladder. This observation may be attributed to the fact that incidence of cholelithiasis was higher in females.

Malignancy was cause of obstructive jaundice in 80% of cases. Most common as well as most common malignant cause of obstructive jaundice was carcinoma of gall bladder 41/100(41%), followed by cholangiocarcinoma 17/100(17%) cases. The most common benign cause was choledocholithiasis causing obstruction in 7/100(7%) of cases, followed by benign biliary strictures (5%). K. Siddique *et al.* [8], in their study found that Commonest malignancy was Carcinoma (Ca) of the head of pancreas (30%) followed by Ca gall bladder (13.33%) and cholangiocarcinoma (11.66%).

Naffisa Adedin [4] *et al.* reported carcinoma gall bladder as the most common etiology of obstructive jaundice.

Serum alkaline phosphatase, aspartate aminotransferase and alanine aminotransferase were raised in 100% of study subjects with serum alkaline phosphatase raised out of proportion to the other two. In obstructive jaundice, serum alkaline phosphatase is usually more than three times the upper limit of normal (40-125 U/l) [9].

Table-1: Distribution of cases according to the cause of obstructive jaundice

Causes of obstructive jaundice	No. of Patients	% of Patients
1.Carcinoma GB	41	41
2.Cholangio-Carcinoma	17	17
3.Pancreatic Head Ca	11	11
4.Choledocho-lithiasis	7	7
5.Stricture	5	5
6.Pancreatitis	4	4
7.Hepatocellular Carcinoma	3	3
8.Metastases	3	3
9.Choledochal Cyst	3	3
10.Lymphadenopathy Portal	3	3
11.Pancreatic Metastases	1	1
12.Carcinoma Duodenum	1	1
13.Mirizzi syndrome	1	1

Table-2: Diagnostic value of Ultrasonography in evaluating findings in cases of obstructive jaundice

USG	Cholelithiasis	Carcinoma GB	Choledocho-lithiasis	Cholangio-Carcinoma	Choledochal Cyst	Stricture	Pancreatitis	Pancreatic Head Ca	Hepatocellular Carcinoma	Liver Metastases	Portal Lymphadenopathy
Sensitivity	94.23	82.9	68.42	82.4	100.0	100.0	100.0	81.8	0.667	88.9	91.84
Specificity	97.92	98.3	98.77	91.6	100.0	100.0	100.0	98.9	100	97.8	98.04
PPV	98.0	97.1	92.86	66.7	100.0	100.0	100.0	90.0	100	80.0	97.83
NPV	94.0	89.2	93.02	96.2	100.0	100.0	100.0	97.8	99.0	98.9	92.59
Accuracy	96.0	92.0	93.0	90.0	100.0	100.0	100.0	97.0	99.0	97.0	95.0
p value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Kappa	0.92	0.74	0.7	0.676	1.0	1.0	1.0	0.84	0.795	0.826	0.9

In the present study, sensitivity, specificity, PPV, NPV and accuracy of ultrasonography for detection of choledocholithiasis were 68.42%, 98.77%, 92.86%, 93.02% and 93% respectively. Amandeep Singh *et al.* [10] in their study found the diagnostic accuracy, sensitivity and specificity of USG for choledocholithiasis was 96%, 93.3% and 97.14% respectively. Naffisaadedin *et al.* [4] in their study found that the sensitivity, specificity, accuracy, PPV and NPV of USG for evaluation of choledocholithiasis were 62.5 %, 100%, 94.7%, 100%, 94.2% respectively. In another study, ultrasonography correctly identified ductal stones as cause of obstruction in 71% of cases.¹¹ Ultrasonography could not detect choledocholithiasis in some cases due to poor visualisation of distal common bile duct owing to bowel gas and obesity.

41% of the cases were diagnosed with carcinoma of gall bladder. Sensitivity, specificity, PPV, NPV and accuracy of USG for detection of carcinoma gall bladder were 82.9%, 98.3%, 97.1%, 89.2%, 92% respectively with a p value < 0.001. Naffisaadedin *et al.* [4] in their study found that the sensitivity, specificity, accuracy, PPV and NPV of USG for evaluation of CA GB were 95 %, 94.6%, 93%, 90.5%, 97.2% respectively. Khalili and Wilson [12] in their study estimated the sensitivity of USG in diagnosis of Gall Bladder malignancy to be 94%. Yeh [13] observed the accuracy of ultrasonography in the diagnosis of gall bladder carcinoma to be 84.6%. The present study showed a similar accuracy with alower sensitivity.

37/41(90.2%) cases of carcinoma gall bladder were present in gall bladder neck region with variable involvement of cystic duct and confluence of cystic duct and common hepatic duct resulting in dilated intrahepatic biliary ductules. Rest originated from other regions of gall bladder. Neck lesions present with obstruction in early stages while rest of GB carcinomas cause obstruction in advanced stages.

Loss of fat planes with infiltration into the liver parenchyma was present in 31/41 (75.6%) cases. S. Pradhan *et al.* [14] in their study found presence of liver infiltration in 74% of cases of carcinoma of gall bladder. 17/41 (41.4%) of cases had lesion size of < 3cm, 22/41 (53.6%) of cases had a lesion size of 3-5 cm and 2/41 (4.8%) of cases had a lesion size of >5cm. 21/41 (51.2%) cases were heterogeneous, 11/41(26.8%) isoechoic, 8/41(19.5%) hypoechoic and 1/41(2.4%) of cases was echogenic with wall calcifications on USG.

Sensitivity, specificity, PPV, NPV and accuracy of USG for detection of cholangiocarcinoma were 82.4%, 91.6%, 66.7%, 96.2%, 90% respectively with a p value < 0.001. Amandeep Singh *et al.* [10] in their study found the diagnostic accuracy, sensitivity, specificity and NPV of USG for cholangiocarcinoma was 96%, 66.67%, 100%, 95.65% respectively. L E

Hann *et al.* [15] found in their study that ductal masses were revealed by sonography in 87%.

11/17(64.7%) cases of cholangiocarcinoma were extrahepatic, 5/17(29.4%) cases were hilar, 1/17(5.9%) cases were intrahepatic variety. 15/17(88.2%) cases were <3cm in size, 1/17(5.9%) cases were 3-5 cm in size and 1/17(5.9%) were >5cm in size. 9/17(52.9%) of cases were hypoechoic, 7/17(41.2%) of cases were isoechoic and 1/17(5.9%) of cases were heterogeneous on USG. L E Hann *et al.* [15] found in their study that masses were isoechoic in 65%, hypoechoic in seven 21%, and hyperechoic in five 15%.

Sensitivity, specificity, PPV, NPV and accuracy of USG for detection of carcinoma head of pancreas were 81.80%, 98.9%, 90%, 97.8%, 97% respectively with a p value < 0.001. Naffisaadedin *et al.* [4] in their study found that the sensitivity, specificity, accuracy, PPV and NPV of USG for evaluation of CA Pancreas were 80.0 %, 97.6%, 93%, 92.3%, 93.2% respectively. Thomas MJ *et al.* [16] in their study found that USG was 97% sensitive with 100% PPV, accuracy of USG was 80.0%. Hessel *et al.* [17] found that USG has a sensitivity of 69% and specificity of 82%.

4/11(36.4%) cases were <3cm in size, 7/11(63.6%) cases were 3-5 cm in size. 7/11(63.6%) of cases were hypoechoic, 3/11(27.3%) of cases were heterogeneous and 1/17(9.1%) of cases were cystic on USG.

100% of patients had dilated CBD and pancreatic duct with 10/11(90.9%) cases showing loss of peripancreatic fat planes and displacement of surrounding vasculature. 8/11(72.7%) of cases had associated regional lymphadenopathy and ascites. 1 case had presence of liver metastases

Sensitivity, specificity, PPV, NPV and accuracy of USG for detection of cholelithiasis were 94.23%, 97.92%, 98%, 94%, 96% respectively. Weltman DI *et al.* [18] reported the accuracy of USG for detection of cholelithiasis to be 94%.

Sensitivity, specific, PPV, NPV and accuracy of USG for detection of metastases were 88.90%, 97.8%, 80.0%, 98.9%, 97% respectively with a p value < 0.001.

Sensitivity, specific, PPV, NPV and accuracy of USG for detection of choledochal cyst, biliary stricture, hepatocellular carcinoma and pancreatitis as a cause of obstructive jaundice were 100%, 100%, 100%, 100%, 100% respectively. All the cases were Modified Todani Type I choledochal cyst. However, not much about the statistical significance can be said due to the limited number of cases.

In 3 cases portal lymphadenopathy was causative factor of obstructive jaundice by causing extrinsic compression of CBD. 2/3 cases had CA stomach as primary and 1/3 cases had NHL as primary. USG was able to diagnose correctly all these 3 cases. In 46 cases portal lymphadenopathy was present as secondary finding.

1 case of mirizzi syndrome was seen which was diagnosed correctly on USG. 1 case of duodenal carcinoma was seen which was diagnosed as periampullary carcinoma on USG.

The overall sensitivity, specificity, PPV, NPV, accuracy of USG for detecting various causes of obstruction was 84.15%, 98.86%, 91.39%, 97.74% and 97% respectively with a p value of <0.0001. Satish K. Bhargava *et al.* [19], in their study found that USG could pick up the presence of biliary obstruction in almost all cases (100%). Accurate detection of the level was possible in 98% of cases and to a much lesser extent the cause of obstruction in 75% of cases. Naffisaadedin *et al.* [4] in their study found that sensitivity, accuracy and PPV for USG to detect the cause of biliary obstruction were 68.4%, 68.4% and 100% respectively.

CONCLUSIONS

Malignancy was the cause of obstructive jaundice in 80% of cases as compared to benign causes in 20% of cases. The most common cause of obstructive jaundice was carcinoma of gall bladder. The most common benign cause of obstructive jaundice was choledocholithiasis. The most common associated finding seen in cases of obstructive jaundice was cholelithiasis followed by lymphadenopathy.

The highest incidence of biliary obstruction was found in 61-70 years' age with mean (\pm SD) age of the patient was 62.7 ± 12.64 years of age with a range of 7 to 81 years of age. Female preponderance was seen in cases of cholelithiasis and carcinoma of gall bladder.

Liver function tests were altered in all with alkaline phosphatase raise out of proportion to the AST/ALT.

The overall sensitivity, specificity, PPV, NPV, accuracy of USG for detecting various causes of obstruction was 84.15%, 98.86%, 91.39%, 97.74% and 97% respectively with a p value of <0.0001 and kappa agreement of 0.859.

With the above statistical evaluation and in accordance with the findings of previous studies it can be safely said that ultrasonography is an excellent screening modality of choice in clinically suspected

cases of obstructive jaundice and provides good quality diagnostic information.

ABBREVIATIONS

ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
CA	Carcinoma
CBD	Common Bile Duct
CD-USG	Color Doppler Ultrasonography
CECT	Contrast Enhanced Computed Tomography
CHD	Common Hepatic Duct
CT	Computed Tomography
CTA	Computed tomography Angiography
ERCP	Endoscopic Retrograde Cholangio-Pancreatography
GB	Gall Bladder
GGT	Gamma Glutamyl Transferase
IHBR	Intrahepatic Biliary Radicles
IHBD	Intrahepatic Biliary Ductules
LHD	Left Hepatic Duct
MRA	Magnetic Resonance Angiography
MRCP	Magnetic Resonance Cholangio-Pancreatography
MRI	Magnetic Resonance Imaging
NPV	Negative Predictive Value
PTC	Percutaneous Transhepatic Cholangiography
PPV	Positive Predictive Value
RAD	Right Anterior Duct
RHD	Right Hepatic Duct
RPD	Right Posterior Duct
SD	Standard Deviation
USG	Ultrasonography

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