Comparative Assessment of Imaging Modalities in Biliary Obstruction

Rahman AKMS[1], Alam SZ[2], Hossain MD[3], Khan HA[4], Rahman F[5], Montaha SS[6]

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Abstract

Introduction: Complete assessment of biliary obstruction requires the use of various imaging modalities to confirm the presence, level and cause of obstruction which can help in treatment planning. Commonly used procedures include Ultrasonography (USG), Computed Tomography (CT) and Magnetic Resonance Cholangiopancreatography (MRCP).

Objective: To determine the accuracy, sensitivity and specificity and to compare the diagnostic accuracy of USG, CT scan and MRCP in assessing the level and cause of obstruction in patients with obstructive jaundice.

Materials and Methods: This cross sectional descriptive study in 50 patients who presented in the department of Radiology and Imaging, Combined Military Hospital (CMH), Dhaka with symptoms and signs of obstructive jaundice above the age 20 years was carried out during the period from 01 October 2012 to 30 April 2013. The accuracy, sensitivity and specificity of each modality in assessing the level and cause of obstruction were determined.

Results: MRCP detected level of obstruction in 100%, CT scan in 95.8% and USG in 90% cases. For detection of cause of obstruction, MRCP had the highest sensitivity (96.2%); followed by CT scan (88.4%) and USG (62.5%). The diagnostic accuracy for detection of cause of obstruction was the highest for MRCP (93.1%); followed by CT scan (89.8%) and USG (66%).

Conclusion: MRCP has highest diagnostic accuracy and sensitivity by detecting the level and cause of obstruction most accurately.

Key-words: Biliary obstruction, Ultrasonography (USG), Computed Tomography (CT), Magnetic Resonance Cholangiopancreatography (MRCP).

Introduction

Evaluation of obstructive jaundice is a common clinical problem[1] and it is a medical emergency[2,3]. Complete assessment of biliary obstruction requires the use of various imaging modalities to confirm the presence, level and cause of obstruction and to aid in treatment planning. Current available technologies include Ultrasonography (USG), Computed Tomography (CT), Magnetic Resonance Cholangiopancreatography (MRCP)[1]. Choledocholithiasis and pancreaticobiliary malignancies (periampullary carcinoma of head of pancreas, ampullary carcinoma, cholangiocarcinoma) are the most common causes of extrahepatic obstruction. Less common causes include biliary parasites; benign stricture of CBD; chronic pancreatitis; benign bile duct tumours (papilloma, adenoma, fibroma, lipoma), intrahepatic masses (hepatocellular carcinoma, large hydatid cyst or abscess of liver) when nearby porta hepatis and compress biliary tree; gallbladder carcinoma extending to porta hepatis; enlarged lymphnode at porta hepatis and sclerosing cholangitis of the extrahepatic bile ducts[1,4]. Rapid advances in diagnostic imaging are presenting a steadily increasing variety of imaging choices to referring clinicians[5]. Without a clear and rational strategy, the inappropriate use of imaging may lead to the duplication of investigations with resultant increased costs, delayed diagnosis and possibly unwanted morbidity[6]. There is little consensus in the literature as to which imaging modality is the most appropriate for a given clinical situation[1]. We should select cost effective, available and appropriate modality for differential diagnosis of biliary obstruction.

The purpose of this study was to determine the accuracy, sensitivity and specificity of USG, CT scan and MRCP in assessing the level and cause of obstruction in patients with obstructive jaundice and to compare the diagnostic accuracy of these modalities in assessing the level and cause of bile duct obstruction. This study will help our clinicians to reach to a proper diagnosis by choosing appropriate imaging modalities and thereby to plan management of cases of obstructive jaundice.

Materials and Methods

This descriptive cross-sectional study was conducted among 50 patients who presented in the Department of Radiology and Imaging in Combined Military Hospital (CMH), Dhaka with a clinical diagnosis of obstructive jaundice from 01 October 2012 to 30 April 2013. All admitted and outdoor patients attended in CMH, Dhaka with symptoms and signs of obstructive jaundice above the age 20 years and irrespective of sex, were included in this study and patients were evaluated by USG, CT and MRCP. Age below 20 years and non-obstructive jaundice patients were excluded from this study. Informed written consent was taken from the patient or

1. **Lt Col AKM Sharifur Rahman**, MBBS, FCPS, MCPS, Classified Specialist in Radiology & Imaging, CMH, Dhaka (*E-mail*: sharif961@gmail.com) 2. **Brig Gen Syed Zoherul Alam**, MBBS, FCPS, MCPS, Advisor Specialist & Head, Department of Radiology & Imaging, CMH, Dhaka 3. **Brig Gen Md Delwar Hossain**, MBBS, FCPS, Advisor Specialist in Medicine & Gastroenterologist, CMH, Dhaka 4. **Dr Husnea Ara Khan**, MBBS, FCPS, Junior Consultant in Pediatrics, National Institute of Neurosciences & Hospital, Dhaka 5. **Lt Col Farzana Rahman**, MBBS, FCPS, MCPS, Classified Specialist in Radiology and Imaging, CMH, Dhaka 6. **Dr Somaya Sidratul Montaha**, MBBS, MCPS, DGO, Assistant Professor in Gynecology & Obstetrics, ZH Sikdar Medical College, Dhaka.

attendant. Examinations were performed on Real time USG machine HI-vision Avius Japan, Spiral CT scan machine Siemens AG Germany and MRI machine Hitachi Japan.

Diagnosis were made by symptom analysis and USG, CT scan, MRCP findings. At least two imaging modalities were used in each patient. Having diagnosed a cholestatic picture, as the initial screening investigation, USG of abdomen was done in all 50 cases followed by any of the remaining two (depending on the clinical desirability and attending clinicians' preference). If initial USG revealed the pathology within the liver, gallbladder or pancreas particularly if the jaundice was due to malignancy; then CT scan was done to reveal the cause of obstruction and for staging of malignancy. MRCP was done in selected cases if an initial USG provided information about bile duct stricture or dilatation, pancreatic duct abnormalities, biliary and pancreatic duct stone. Patients underwent ERCP who needs therapeutic intervention to relieve biliary obstruction.

Patients underwent USG (n=50), CT scan (n=49), MRCP (n=29). The level and cause of obstruction were evaluated by each modality. USG, CT and MRCP findings were evaluated by direct ERCP findings. Biopsied sample at ERCP evaluated by operative and histologic or cytologic results; these were considered the standard of reference of the study. Diagnostic accuracy was calculated by comparing with the ERCP, operative and histopathological findings. The sensitivity in detection of cause of obstruction was also compared for each modality. The findings of the study expressed as frequency (%) presented in Tables and Graphs according to patient's age, sex and known medical conditions with the topographic findings on USG, CT, MRCP. Descriptive statistical analysis of data was performed using SPSS version 16.0.

Results

Out of 50 patients highest incidence of obstructive jaundice was in the 5th to 7th decade of life. The mean age of presentation was 57.1±12.7 years with range 25 to 84 years. Forty (80%) were male and 10 (20%) were female. All the patients presented with jaundice and clay colored stool/high colored urine. Next frequent symptom was upper abdominal pain (52%). Cholangiocarcinoma 17 (34%) was the commonest cause of obstrucive jaundice (Table-I). Obstructive jaundice patients' MRCP detected level of obstruction in 100% cases. CT scan detected level of obstruction in 95.8% cases and USG in 90% cases (Figure-1). USG could detect causes of obstruction in 100% cases of carcinoma of head of pancreas and biliary ascariasis. CT scan could detect causes of obstruction in 100% cases of carcinoma of head of pancreas, foreign body in CBD and MRCP could detect causes of obstruction in 100% cases of cholangiocarcinoma, carcinoma of head of pancreas, benign stricture and choledocholithiasis (Table-II). Table-III shows the comparison of detection of cause of obstructive jaundice. It was revealed that causes detected by MRCP in most of the cases (93.1%) followed by CT scan in 77.6% cases and USG in 46% cases. Percentage of detection among different imaging modalities were statistically significant (p<0.001). For detection of cause of obstruction, MRCP had the highest sensitivity (96.2%); followed by CT scan (88.4%) and USG (62.5%). The overall diagnostic accuracy for detection of cause of obstruction was the highest for MRCP (93.1%); followed by CT scan (89.8%) and USG (66%) (Figure-2).

Table-I: Demographic characteristics of the patients (n = 50)

Demographic characteristics		Frequency	Percentage
Age group (years)	21 – 30	01	02
	31 – 40	02	04
	41 – 50	13	26
	51 – 60	14	28
	61 – 70	13	26
	71 – 80	04	08
	81- 90	03	06
	Mean ±SD =57.1±12.7; Range 25-84		
Sex	Male	40	80
	Female	10	20
Symptoms/ Sign	Jaundice	50	100
	Itching	21	42
	Upper abdominal pain	26	52
	Nausea / vomiting	23	46
	Fever	18	36
	Anorexia	19	38
	Weakness	11	22
	Weight loss	3	6
	Distension of abdomen	2	4
	Clay colored stool / high colored urine	50	100
Cause of obstructive jaundice	Cholangiocarcinoma	17	34
	Periampullary carcinoma	09	18
	Carcinoma of head of pancreas	05	10
	Benign stricture	04	08
	Choledocholithiasis	13	26
	Biliary ascariasis	01	02
	Foreign body in CBD	01	02

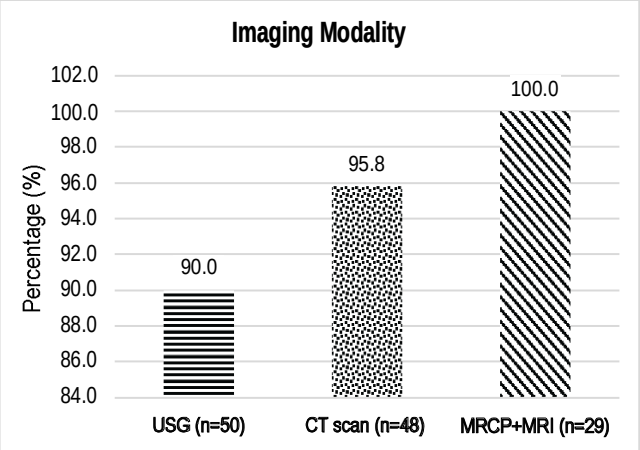

Figure-1: Comparison of detection of level of obstruction by imaging modalities (n=50)

Table-II: USG, CT scan and MRCP findings in Obstructive Jaundice (n=50)

Disease/ finding	Final diagnostic case	USG done	Positive USG finding n(%)
Cholangiocarcinoma	17	17	7(41.2)
Periampullary carcinoma	9	9	4(44.4)
Carcinoma of head of pancreas	5	5	5 (100)
Benign stricture	4	4	0(0)
Choledocholithiasis	13	13	6(46.2)
Biliary ascariasis	1	1	1(100)
Foreign body in CBD	1	1	0(0)
Total	50	50	23(46)
Disease/ finding	**Final diagnostic case**	**CT scan done**	**Positive CT scan finding n(%)**
CT scan findings			
Cholangiocarcinoma	17	17	16(94.1)
Periampullary carcinoma	9	09	05(55.6)
Carcinoma of head of pancreas	5	05	05(100)
Benign stricture	4	04	0(0)
Choledocholithiasis	13	13	11(84.6)
Biliary ascariasis	1	-	-
Foreign body in CBD	1	01	01(100)
Total	50	49	38(77.6)
MRCP ± MRI findings	**Final diagnostic case**	**MRCP done**	**Positive MRCP finding**
Cholangiocarcinoma	17	17	17(100)
Periampullary carcinoma	09	05	03(60)
Carcinoma of head of pancreas	05	01	01(100)
Benignstricture	04	04	04(100)
Choledocholithiasis	13	02	02(100)
Biliary ascariasis	01	-	-
Foreign body in CBD	01	-	-
Total	50	29	27(93.1)

Table-III: Comparison of detection of cause in obstructive jaundice by different imaging modalities.

Imaging modalities	n	Cause of obstructive jaundice		p-value
		Detected No. (%)	Not detected No. (%)	
USG	50	23(46%)	27(54%)	<0.001
CT scan	49	38(77.6%)	11(22.4%)	
MRCP±MRI	29	27(93.1%)	2(6.9%)	

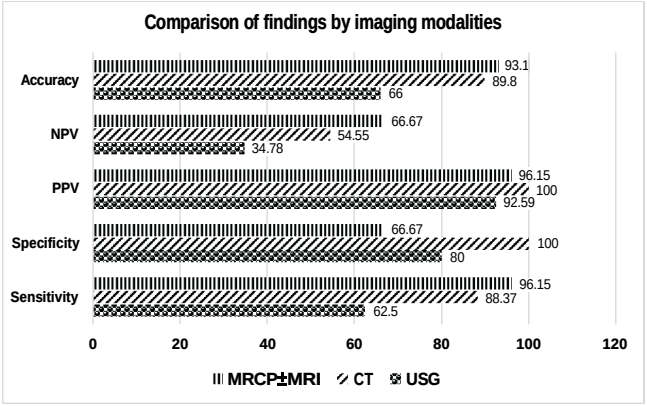

Figure-2: Comparison of findings by imaging modalities (n=50)

Figure-3: A. USG, B. CT of HBS, C. MRCP of three different patients of cholangiocarcinoma show dilated intrahepatic and extrahepatic biliary channels suggesting distal biliary obstruction.

Discussion

In this study, the highest incidence of obstructive jaundice was in the 5th to 7th decade of life. The mean age of presentation was 57.1±12.7 (range 25-84 years). The study of Verma et al[7] on 110 patients with obstructive jaundice reported that the mean age was 50.4 years (range 3–85 years). These results are similar to present study. In this study, 40 (80%) were male and 10 (20%) were female. Verma et al[7] also showed male preponderance which is comparable to present study. In this study, all the patients presented with jaundice and clay colored stool/ high colored urine. Next frequent symptom was upper abdominal pain (52%); followed by nausea/ vomiting (46%), itching (42%), anorexia (38%), fever (36%), weakness (22%), weight loss (6%) and distention of abdomen (4%). Verma et al[7] showed that, presenting symptoms and signs were jaundice (100%), clay coloured stool (65.2%), pain in the abdomen (the right hypochondrium) (87%). These findings are similar to the present study. During the period of this study, cholangiocarcinoma showed the highest incidence 17 (34%). Next frequent was choledocholithiasis 13 (26%); followed by periampullary carcinoma 9 (18%), carcinoma of head of pancreas 5 (10%), benign stricture 4 (8%), biliary ascariasis 1 (2%) and foreign body (bullet) in CBD 1 (2%) case. Verma et al[7] reported that carcinoma of the head of pancreas was the commonest aetiology (33.6%); followed by choledocholithiasis (29%), carcinoma of gall bladder (18.2%), periampullary carcinoma (5.5%), cholangiocarcinoma (3.6%), CBD stricture (2.7%), acute pancreatitis (2.7%) and choledochal cyst (2.7%) and HCC (1.8%) which is similar to the present study regarding the aetiology of obstructive jaundice but shows variation in some cases in comparing the incidence of various etiologies possibly related to regional dietary and social factors.

In this study, USG detected level of obstruction in 90% cases. Upadhyaya et al[8] showed that USG was able to identify the level in 83.5% cases. The results are comparable to the present study. Less discrimination of USG to detect level of obstruction may also be contributed by operator's skillness and lower resolution of the machine. In this study, USG could detect causes of obstruction in 100% cases of carcinoma of head of pancreas and biliary ascariasis, 46.2% cases of choledocholithiasis, 44.4% cases of periampullary carcinoma, 41.2% cases of cholangiocarcinoma. USG could not detect cause of obstruction in cases of benign stricture and foreign body in CBD. The findings in present study are broadly in agreement with Tse et al[1] study done at various other centers which reported that USG exhibited poor test performance at detecting CBD stones with sensitivities in the range 25-58%, ampullary carcinoma 5% and pancreatobiliary malignancies 67-81% cases. These data demonstrate that the major limitation of USG is in its inability to reliably diagnose the level and cause of obstruction. In this study, CT scan detected level of obstruction in 95.8% cases. Upadhyaya et al[8] showed that CT was able to detect the level of obstruction in 85.7% of the cases. As compared to present study which shows improvement in determination of level by faster CT scanner with improved resolution. In this study, CT scan could detect causes of obstruction in carcinoma of head of pancreas and foreign body (bullet) in CBD in 100% cases, cholangiocarcinoma in 94.1%, choledocholithiasis in 84.6%, periampullary carcinoma in 55.6% cases. CT scan could not detect cause of obstruction in cases of benign stricture. This finding is comparable to Tse et al[1] study which showed that CT could detect CBD stones in 87%, pancreatic cancer in 91% and periampullary tumour in 22-29% cases.

In this study, MRCP detected level of obstruction in 100% cases. Upadhyaya et al[8] reported that MRCP was able to detect the level of obstruction in 95.5% cases. The results are similar to present study which shows better result. In this study, MRCP and MRI could detect causes of obstruction in cholangiocarcinoma, carcinoma of head of pancreas, benign stricture and choledocholithiasis in 100% cases and periampullary carcinoma 60% cases. Upadhyaya et al[8] reported that MRCP was able to correctly diagnose all cases of benign CBD stricture, cholangiocarcinoma and periampullary carcinoma. It is in agreement with present study except periampullary carcinoma in which MRCP missed 2 cases out of 5 cases possibly because of interference of intraluminal gas. In this study, for detection of cause of obstruction, MRCP had the highest sensitivity (96.2%); followed by CT scan (88.4%) and USG (62.5%). The overall diagnostic accuracy for detection of cause of obstruction was the highest for MRCP (93.1%); followed by CT scan (89.8%), and USG (66%). Verma et al[7] showed that, regarding etiology of the obstruction, the accuracy of ultrasound, CT scan and MRCP was 87.3%, 92.7% and 90%, respectively. The sensitivities of USG, CT and MRCP in the diagnosis of benign diseases were 85.3%, 84.6%, 92.3% respectively and for malignant diseases were 88.4%, 94.2%, 86% respectively. This result is comparable to present study in which the highest sensitivity and accuracy is observed in MRCP; followed by CT and USG. Upadhyaya et al[8] study done in India reported that MRCP had the highest accuracy (87.5%), followed by CT scan (85.7%) and USG (77%). This present study is similar to that result.

In this study, MRCP showed the best result in detecting the level and cause of biliary obstruction followed by CT scan. With the excellent diagnostic capabilities, MRCP has certainly carved a niche for itself in the non-invasive evaluation of the patient with obstructive jaundice. Our results not only confirm earlier studies concerning the value of MRCP in obstructive jaundice, but also allow for its evaluation in perspective of daily practice where ultrasound and CT are often part of radiological workup.

Conclusion

In this study, MRCP most accurately detected the level and cause of biliary obstruction. Ultrasound and CT scan have high diagnostic accuracy and sensitivity and MRCP has the highest diagnostic accuracy and sensitivity. There is increasing role for MRCP and CT scan following an initial USG in the assessment of patients with suspected biliary obstruction to select candidates for therapeutic ERCP or surgery.

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