Original Article

Comparison of the Diagnostic Accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) with Ultrasound and Computed Tomography (CT) in Evaluation of Patients with Obstructive Jaundice

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Abstract

Background: *Obstructive jaundice patients need surgical intervention to overcome the biliary obstruction. For planning these complex interventions, the radiologist has to precisely assess the etiology, location, level, and extent of the disease.*

Aim: *To compare the diagnostic benefit of Magnetic Resonance Cholangiopancreatography (MRCP) with Ultrasound and Computed Tomography (CT) in the evaluation of patients with obstructive jaundice taking histologic tests and anatomical findings after surgical intervention as gold standard.*

Study Design: *This prospective study included 72 patients who were referred to DCIMCH radiology department with clinical features of biliary obstructive disease.*

Materials and Methods: All patients were evaluated by Ultrasonography followed by Computed tomography (CT) and Magnetic Resonance Cholangiopancreatography (MRCP). The results were read by radiologists blinded to other imaging findings. The characteristic histopathological diagnosis / surgical findings (as applicable) were considered as gold standard.

Results: *Diagnostic accuracy of MRCP (98%) in the diagnosis of benign and malignant diseases was relatively high (98% and 98%) as compared to CT (82.86% and 91.43% in benign and malignant respectively) and USG (88% and 88%). In the diagnosis of benign diseases, MRCP was 100% sensitive compared to ultrasound (80.77%), which was more sensitive than CT scan (54.55%).In the diagnosis of malignant diseases, MRCP was more sensitive (95.83%) as compared to CT scan (91.67%), which was more sensitive than ultrasonography (79.17%).*

Conclusion: *MRCP is the best imaging investigation in the pre-operative evaluation for obstructive jaundice patients.*

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MRCP (Magnetic Resonance Cholangio Pancreatography), CT (Computed Tomography, USG (Ultrasonography)

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Introduction

The biliary tract refers to the liver, gallbladder and bile ducts and how they work together to produce, store and secrete bile. Bile is secreted by the liver in small channels that join to form the common hepatic duct. Between meals, the secreted bile is stored in the gallbladder, where 80 to 90% of the water and electrolytes can be absorbed, leaving bile acids and cholesterol. During a meal, the smooth muscles of the wall of the gallbladder contract, causing the secretion of bile in the duodenum to eliminate waste stored in the bile and contribute to the absorption of fat and edible oils by solubilizing them with bile acids. Jaundice is caused by hyper bilirubinaemia that may be in conjugated or unconjugated form. Medical jaundice is when bilirubin level exceeds 34-35 ìmol / L or 2-3 mg /

dL.[1,2] Jaundice can be divided into two categories: obstructive (surgical) and non-obstructive (medical) jaundice.[3] Post hepatic jaundice is a type of jaundice whose cause lies in the biliary part of the hepatobiliary system. The main cause of post hepatic jaundice is extra hepatic biliary obstruction. Therefore, it is also known as obstructive jaundice.[1] Obstructive jaundice has high morbidity and mortality and is therefore a difficult condition for the surgeons.[4] After a series of biochemical liver function tests, radiological investigations are performed. Role of radiologist is not only confined to differentiate between obstructive or non-obstructive etiology but is to elaborate the exact anatomical site of obstruction, extent of the disease as well as the feasibility for interventional procedures. Only after accurate assessment of these factors, appropriate therapeutic option can be decided for further management.[5,6] US 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.[7] Traditional Computed Tomography (CT) scan is usually considered more accurate than US for helping determine the specific cause and level of obstruction.[8] Both ultrasound and CT scan are regarded as safe and non-invasive procedures in evaluating the status of the biliary tract. Ultrasound is used as an initial modality to confirm or exclude duct obstruction, which it does with at least 90% accuracy.[9] The range of application of CT has been partially restricted by MRCP.[7] MRCP techniques have greatly evolved, providing high Radiology Section resolution images of the biliary tree with short exam duration, while remaining non invasive without contrast medium injection.[10]

Aims and Objective

This study was aimed to compare the diagnostic accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) with Ultrasound and Computed Tomography (CT) in evaluation of patients with obstructive jaundice taking histopathology and operative anatomical findings as gold standard.

Materials and Methods

Type of study was prospective observational study. The study has been conducted on 72 patients after approval from the institutional ethic committee starting from January 2019 to December 2021 at Dhaka Central International Medical College, Dhaka. All patients with clinically diagnosed obstructive jaundice were included in the study. Patients with contraindications to MRI. non-obstructive (prehepatic/hepatic) cause of jaundice and refusal to be part of our study were excluded from this study. Written informed consent was taken from all the subjects. A composite assessment of the patient's history, findings on physical examination, laboratory investigations conventional biochemical liver function tests like total serum bilirubin, serum alkaline phosphatase, AST, ALT levels, CA 19-9, serum albumin and globulin were noted. Initial USG evaluation was followed by Contrast enhanced Computed Tomography and MRI/ MRCP. Transabdominal ultrasonography was done using curvilinear probe on GE Logiq-e machine followed by CECT on a 40 Slice Philips Brilliance machine. MRCP was done in all patients on Philips Achieva 1.5 Tesla MRI scanner. For MRCP, patients were asked to come with 8-12 hours fasting to promote gall bladder distension, reduce fluid secretions in stomach and duodenum and reduce peristalsis. Using heavily T2 weighted images (at longer echo time (TE) ranging from 600-1200 ms) we aim to suppress the background signal so that only bile in biliary tract can show bright signal. Three most important sequences included axial T2 weighted scan from liver to ampullary region followed by T2 weighted 3D FSE sequence acquired in coronal oblique plane using respiratory triggering by tying bellows over abdomen. After this breath hold HASTE sequence was acquired in coronal plane. Maximum intensity projection (MIP) and thick slab images were also used for interpretation. USG, CECT and MRCP scans were interpreted by radiologists blinded to other imaging findings. All patients undergone operative procedure (open surgery or ERCP). We used histopathological findings after biopsy and operative anatomical findings as the gold standard.

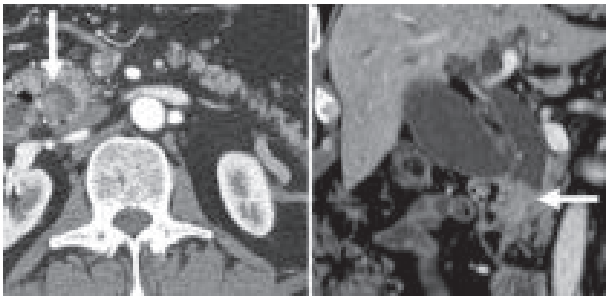

Figure 1: *CT image showing distal cholangiocarcinoma (Periampullary carcinoma)*

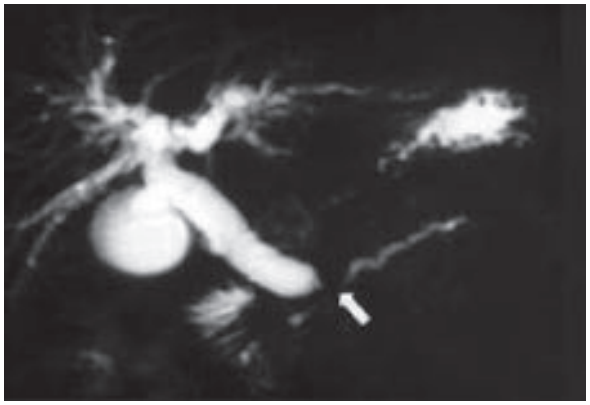

Figure 2: *MRCP showing carcinoma head of pancreas causing obstructive jaundice*

Results and Observations:

We included 72 patients in our study, 38 were male and 34 were female. They belonged to age group ranging from 3 years to 82 years. Benign cause was found in 32 cases (44%) and malignant cause was reported in 40 cases (56%). According to Table I, most frequent benign causes of obstructive jaundice were CBD stones and combined gall bladder and CBD stones. Benign strictures also contributed to 25% of benign causes. Cholangitis causing beaded blockade of biliary tract and anatomical variants were also encountered in this study.

Table I

Benign causes of obstructive jaundice

Benign cause	Number of case	Percentage
CBD calculi	8	25%
Gall stone with CBD stone	8	25%
Benign stricture	8	25%
Anatomic variant	6	19%
Cholangitis	2	6%
Total	32	100%

Among the malignant causes of obstructive jaundice, periampullary carcinoma (malignancy arising within 1 cm of ampulla of vater) were most commonly encountered.

Table II

Malignant causes of obstructive jaundice

Malignant causes	Number of cases	Percentage
Periampullary carcinoma	16	40%
Cholangiocarcinoma	8	20%
Carcinoma gall bladder	8	20%
Klatskin tumor	4	10%
Carcinoma head/ body of pancreas	2	5%
Lymphnode compression	2	5%
Total	40	100%

Our study revealed that common cause of obstructive jaundice is malignant in older age groups whereas in younger and middle age, benign causes were found to be relatively more common (Table III).

Correlation of the findings in ultrasound, CT and MRI/ MRCP was done taking histopathology or cholangiography as gold standard to evaluate the diagnostic accuracy of each of these modalities (Table 4, 5, 6).

Table III

Table showing distribution of Benign and Malignant Lesions with respect to age of patients

Age group	Benign cases		Malignant cases		Total cases
	Number	Percentage	Number	Percentage	
0-20	2	50%	2	50%	4
21 - 40	10	83%	2	17%	12
41 – 60	16	47%	18	53%	34
>60	4	18%	18	82%	22
Total	32		40		72

Table IV

Table showing diagnosis by Helical CT scan and Histopathological diagnosis

		Histopathological diagnosis			Significance
		Benign	Malignant		$X^2 = 24.89$
CT finding	Benign	28 (TP)	2 (FP)	30	df = 1
	Malignant	4 (FN)	38 (TN)	42	
		32	40	72	P<0.00000101

Table V

Table showing diagnosis by MRI/MRCP and Histopathological diagnosis

		Histopathological diagnosis			Significance
		Benign	Malignant		$X^2 = 28.36$
MRCP	Benign	31 (TP)	1 (FP)	32	df = 1
	Malignant	1 (FN)	39 (TN)	40	
		32	40	72	P< 0.00000101

Table VI

Table showing diagnosis by ultrasonography and Histopathological diagnosis

		Histopathological diagnosis			Significance
		Benign	Malignant		$X^2 = 7.106$
USG	Benign	25 (TP)	08 (FP)	40	df = 2
	Malignant	7 (FN)	32 (TN)	32	
		32	40	72	P< 0.028

Table VII

Table showing Comparison of diagnostic values of ultrasound, Helical CT and MRI/MRCP

	MRCP	CT scan	USG
Sensitivity	96.8%	87.5%	78%
Specificity	97.5%	95%	80%
Positive Predictive Value	96.87%	93.3%	75%
Negative Predictive Value	97.5%	90.5%	82%
Diagnostic Accuracy	97.4%	93.7%	77%

Our final comparison was done among all these 3 imaging modalities in terms of sensitivity, specificity, positive and negative predictive values and diagnostic accuracy (Table 7). Our study revealed that the diagnostic accuracy of MRCP is better than that of CT and USG which are 97.4%, 93.7% and 77 % respectively.

Discussion

The opinion is broadly shared that US is the first choice option in the diagnosis of choledocholithiasis. Our results for US diagnostic accuracy, sensitivity and specificity are in accordance with those reported in literature. Boraschi et al., reported a specificity of over 90%.[11] In the literature, a sensitivity range of 20 to 80% is often documented[12]; these considerable differences in sensitivity among various case series are partially attributable to the impossibility of approaching the distal CBD and ampullary region in obese patients and patients with abdominal meteorism, as well as to the variability of the US technique applied. The high sensitivity in our study presumably derives from the use of dosed compression, and to THI, which allowed for better study of the distal tract of the CBD. As described by Ortega et al.[13], harmonic imaging, by improving contrast resolution, stresses the difference between the anechoicity of the duct lumen and the surrounding soft tissues. Todua et al.[14], has mentioned that for choledocholithiasis, CT is similar to ultrasound, with a sensitivity range of 23% to 85% and specificity of 97%. Present study showed similar results. MRCP diagnostic accuracy, sensitivity and specificity are comparable to those reported in the literature (Calvo et al.,[12] Huassein et al.[15], Boraschi et al.[11] Varghese et al.[16] where sensitivity, specificity and diagnostic accuracy respectively range between 81-100%, 84-100% and 90-96%. Study conducted by Al-Obaidi et al.[17] showed higher sensitivity (100%), specificity (98.5%), accuracy (98.7%) of MRI/MRCP for cases with benign stricture as compared to sensitivity of USG (44.4%) which is consistent with present study. Andersson M et al.[18] concluded in their study that MRI with MRCP was more accurate than CT in differentiating between malignant and benign lesions in patients with suspected periampullary tumors. This is consistent with present study where MRCP showed 100 % accuracy in diagnosing cases with periampullary carcinoma. The overall sensitivity was 66.67%, specificity was 100% and accuracy was 96% for cases with cholangiocarcinoma on ultrasound with a negative predictive value of 95.65%. The finding of our study approximate with findings by Hann et al.[19] who reported that ultrasonography detected 87% of Klatskin tumor. Verma et al.[20] demonstrated the sensitivity and specificity

of 85.3% and 88.4% on ultrasound, 84.6% and 94.2% on CT, 92.3% and 86% on MRCP for detecting the benign etiology of obstruction. Ferrari FS et al.[21] demonstrated similar findings for benign lesions in their study. The diagnostic accuracy, sensitivity and specificity of USG was 78.62%,16.67% 97.29%, of CT it was 92.59%, 92.3%. 92.85% and of MRCP was 93.13%,90%,94% respectively. Similar results were found in present study in which the overall sensitivity was 78%, specificity was 80% and accuracy was 77% for ultrasound. The sensitivity for CT is inconsistent with the study conducted by Verma et al.[20] This discrepancy could be because of the small subject size in our study. However the specificity demonstrated in their study was 94.2%, which is consistent with present findings. Verma et al. demonstrated the sensitivity and specificity of 88.4% and 85.3% on ultrasound, 94.2% and 85% on CT, 86% and 92% respectively for detecting the malignant etiology of obstruction. Ferrari FS et al., [21] demonstrated the diagnostic accuracy, sensitivity and specificity of USG 93.13%, 61.12%, 98.23% and 92.59%, 90.9%, 93.75% of CT and 93.13%, 90%, 94% of MRCP respectively. Similar results were found in present study in which the overall sensitivity was 78%, 87% and 96.8%; specificity was 80%, 95% and 97.5% and accuracy was 77%, 93.7% and 97.4% for ultrasound, CT scan and MRCP.

Conclusion

Diagnostic accuracy of MRI/MRCP was found superior to ultrasonography and CT scan for diagnosis and assessment of obstructive jaundice. The accuracy of MRI/MRCP was significantly better for cases with benign etiology. Among the malignant causes, periampullary carcinoma was most common etiology. MRI/MRCP and contrast enhanced CT showed high diagnostic accuracy in such cases. Hence, MRCP is best and reliable imaging tool for obstructive jaundice patients.

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