Role of MRCP to determine the etiological spectrum, level and degree of biliary obstruction in obstructive jaundice

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Abstract

Context: Obstructive jaundice as a result of hepatocellular disease many a times is indistinguishable from jaundice due to extrahepatic biliary obstruction based on just clinical and biochemical examinations. It is one of the most frequent and grave form of hepatobiliary disease which may lead to complications like ascending cholangitis, malabsorption and hepatorenal syndrome, thus demanding urgent surgical intervention. Thus not only early diagnosis but also accurate identification of level and cause of obstruction is crucial in managing these patients. Aims: The aim of this study is to evaluate the role of MRCP in the determination of the etiological spectrum, to evaluate level and degree of biliary obstruction in cases of obstructive jaundice, and to correlate MRCP findings with surgical/histopathology/ERCP findings where possible. Methods and Material: It is an observational study done after the Institutional Ethics Committee (I.E.C.)- 2 approval. (IEC no: IEC/HMPCMCE/122/Faculty/8/186/20) Outdoor and indoor patients referred to radiodiagnosis department of Shree Krishna Hospital, Karamsad, for MRCP with clinical and laboratory parameters suspecting obstructive jaundice were included in the study. Patients less than 10 years of age, those with contraindications to MRI and patients with clinico-laboratory evidence of perihepatic/hepatic jaundice were excluded. Methodology: A total of 50 patients were included after taking an informed consent from each patient. Demographic data, clinical details were recorded and collated along with MRI findings. Descriptive statistics was used to explore MRI findings and findings were correlated with surgical/histopathology/ERCP findings whichever applicable. The MRI scan was performed with 5 mm thick axial T1W, T2W and STIR, 5 mm thick coronal T1W, T2W and STIR TRUFIS, Thin coronal T2 FS, Thick coronal T2 FS, T2W coronal respiratory trigger sequences, 3-5 mm thick T2 weighted Haste and 3D sequence. Statistical Analysis Used: Analysis was performed using STATA (14.2). Descriptive statistics was used of study population. Sensitivity and specificity value was used to compare the modality and individually calculated for various causative factors of jaundice. Results: Of the 50 patients, 9 had CBD stones, it is observed that MRCP has sensitivity and specificity of 100% and 100%, respectively, in detecting Bile duct stones, whereas sensitivity and specificity of ERCP was 87.5% each. About 11 patients had CBD strictures, which were seen as narrowing of CBD with upstream dilatation. It was observed in our study that the sensitivity of MRCP was 93% and specificity was 95% in detecting CBD strictures while ERCP had 100% sensitivity and specificity. About 12 patients had CBD tumor for sensitivity and specificity of MRCP and ERCP was 100%. Out of 50 patients, 36% had gall bladder stones in whom MRCP sensitivity and specificity was 88.89% and 100% and was found to comparable with ERCP. Only three patients in our study had ampullary carcinoma out of which the sensitivity and specificity came 100% for MRCP. One patient, in whom MRCP and HPE detected ampullary carcinoma, ERCP detected no ampullary carcinoma thus favoring MRCP. However, owing to inadequate study population results are inconclusive. There is significant difference between MRCP and ERCP accuracy...
Introduction

Obstructive jaundice is a common problem in medical and surgical gastroenterological practice.\(^1\) It could be because of a variety of causes. The surgical jaundice can be caused by the obstruction of the bile duct as with gallstones,\(^2\) strictures, malignancy,\(^2,3\) such as cholangiocarcinoma, periampullary carcinoma, carcinoma gall bladder and carcinoma head of pancreas.\(^3,4\) Various rare causes like the Castleman disease; Caroli’s syndrome and metastatic liver tumor have also been reported.

The symptoms of obstructive jaundice include jaundice with or without pain, dark urine, pruritis, pale stools, weight loss and anorexia. It is one of the most frequent and grave form of hepatobiliary disease which may lead to complications like ascending cholangitis, malabsorption and hepatorenal syndrome, thus demanding urgent surgical intervention. Thus, not only early diagnosis but accurate identification of level and cause of obstruction is crucial in managing these patients.

Obstructive jaundice as a result of hepatocellular disease many a times is indistinguishable from jaundice due to extrahepatic biliary obstruction based on just clinical and biochemical examinations.\(^5\) The wide spectrum of different therapeutic options for patients with surgical jaundice makes important for the imaging radiologist to accurately assess the cause, location, level and extent of disease providing a road map to the treating surgeon.

Recent technical imaging advances have highly aided in the diagnosis of biliary tract disease. A wide array of diagnostic procedures including the invasive procedures like endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography (PTC), endoscopic ultrasound (EUS) as well as noninvasive investigations like ultrasonography (USG), multidetector CT (MDCT) and magnetic resonance imaging (MRI). Magnetic Resonance Cholangiography (MRCP) have been utilized for evaluating the biliary tract in suspected obstructive jaundice. It is important for the referring clinicians to understand the role of each imaging modality and the inherent limitations and advantages associated in diagnosing the etiological factors causing obstructive jaundice.

While ERCP and PTC are considered invasive techniques having unique advantage of getting a tissue diagnosis along with therapeutic intervention at the same time but is limited by the fact that it cannot provide extra luminal information. Moreover, ERCP has a failure rate of 3–10% and is also associated with life-threatening complications like pancreatitis, gastrointestinal (GI) tract perforation, bleeding, cholangitis, sepsis, etc.\(^6\)

Ultrasoundography (USG) is considered as the first-line investigation in imaging obstructive jaundice as it is not only non-invasive but also cost effective and widely available; however, its sensitivity and specificity ranges from 55 to 95% and 71 to 96%, respectively; thus, it can be used in the initial screening to further guide patients for MDCT, MRCP or ERCP in appropriate setting for accurate diagnosis.\(^7,8\)

**Keywords:** Ampullary malignancy, choledocholithiasis, ERCP, MRCP, obstructive jaundice, stricture

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**Figure 1:** Thick slab image of 52-year-old male of showing upstream dilatation of CBD and dilatation of pancreatic duct in ampullary carcinoma

**Figure 2:** Thick slab image of 35-year-old male of showing choledochal cyst type IVa with changes of obstructive biliopathy as upstream dilatation of CBD, CHD, RHD, LHD and IHBR.
MDCT with its recent advances of post-processing reconstruction techniques (Multiplanar Reconstruction (MPR) and Minimal Intensity Projection (MinIP) constitutes a fast and alternative noninvasive imaging technique improved diagnostic accuracy in detection of biliary calculi and for differentiating benign from malignant lesions. Moreover, the combined use of MPR and MinIP techniques significantly improves the visualization of the biliary ducts and their site of confluence compared with those obtained by axial CT.\[9\] It is thus an excellent alternative for a non-invasive one-stop-shop imaging of the hepato-biliary tree especially in those cases where MRI/MRCP has its limitations.\[5\]

MRCP though is considered the most reliable non-invasive technique, it has certain disadvantages. It is an expensive imaging technique utilizing prolonged examination time. It is also not widely available as a resource compared to MDCT. Patients with pacemakers and ferromagnetic implants, as well as claustrophobia cannot be imaged with MRI/MRCP. It is also susceptible to artifacts and requires adequate patient cooperation to successfully complete the study.\[9-11\]

In the recent era MRCP is considered an important noninvasive imaging modality for preoperative evaluation of patients with obstructive jaundice. It can replace the more invasive ERCP and PTC which were considered as first-line investigations in the past.\[8\] With technical advances MRCP has proved to be a reliable noninvasive imaging technique in imaging the biliary tract in obstructive jaundice as well as help the surgeons in accurate therapeutic planning.\[12\]

MRCP consists of heavily T2 weighted sequences highlighting static fluid which would be present in dilated pancreatic and biliary ducts. Due to availability of the ultrafast sequences and the newer 3D sequences, the images after post-processing resemble direct cholangiogram as seen by ERCP or percutaneous transhepatic cholangiopancreatography.\[13\]

We intend to evaluate the role of MRCP in determining the etiological spectrum, the level and degree of biliary obstruction in cases of obstructive jaundice. Moreover, we also wish to compare and correlate MRCP findings with surgical/histopathology/ERCP findings wherever possible.

### Materials and Methods

The present study is an observational study which was conducted after the approval of Institutional Ethics Committee (I.E.C.)-2. (IEC no: IEC/HMPCMCE/122/Faculty/8/186/20)

Outdoor and indoor patients referred to radiodiagnosis department of Shree Krishna Hospital, Karamsad, for MRCP with clinical and laboratory parameters suggesting obstructive jaundice were included in the study. Patients less than 10 years of age, those with contraindications to MRI and patients with clinico-laboratory evidence of perihepatic/hepatic jaundice were excluded.
Methodology

A total of 50 patients were included after taking an informed consent from each patient. Demographic data, clinical details were recorded and collated along with MRI findings. Descriptive statistics was used to explore MRI findings and findings were correlated with surgical/histopathology/ERCP findings whichever applicable.

The MRI scan was performed with 5 mm thick axial T1W, T2W and STIR, 5 mm thick coronal T1W, T2W and STIR TRUFIS, Thin coronal T2 FS, Thick coronal T2 FS, T2W coronal respiratory trigger sequences, 3-5 mm thick T2 weighted Haste and 3D sequence.

Result

The study included 50 patients (27 males and 23 females) with age ranging from 10 to 90 years. It was observed that biliary ductal obstruction was more common in males.

Of the 50 patients 18% had CBD stones, 22% had CBD strictures, 24% had CBD tumors, 4% had ampullary stones and 6% had ampullary tumor.

MRCP had a sensitivity and specificity of 87.5% in detecting bile duct stones, whereas sensitivity and specificity of ERCP was 100%.

In the present study, out of 50, 12 patients had CBD tumors in which both the sensitivity and specificity was 100%. Only three patients were found to have ampullary carcinoma for which MRCP sensitivity and specificity was 100% [Figure 1]. One patient, in whom MRCP and HPE detected ampullary carcinoma, ERCP failed to diagnose the same. There is significant difference between MRCP and ERCP in evaluating the extent of disease and accuracy rate for ampullary carcinoma.

There were 78% patients who were shown to have biliary duct dilatation both on ERCP and MRCP. Thus both MRCP and ERCP had 100% sensitivity and specificity in detecting biliary duct dilatation.

Out of 50 patients, 36% had gall bladder stones in whom MRCP sensitivity and specificity was found to be 88.89% and 100% which was comparable with ERCP.

Pancreatic dilatation was detected in four patients and there were two patients who were detected with ampullary stones and MRCP sensitivity, specificity was 100% and was comparable to ERCP.

Discussion

The present study had 50 patients (27 males and 23 females) with age ranging from 10 to 90 years. It was observed that biliary ductal obstruction was more common in male; however, this is in contrast with the study of Coucke E et al. which showed female preponderance. We categorized etiology based on benign and malignant features on imaging MRCP. The most common findings observed in ascending order were choledocholithiasis (18%), stricture (22%) and malignancy (24%). While Choledocholithiasis was the most common benign etiology, bile duct malignancy was the most common malignant etiology of biliary obstruction [Graph 1]. The same results were concluded in study by Owen J. O’Connor et al.

We assessed nine patients having CBD stones, wherein MRCP had both sensitivity and specificity of 100% in detecting bile duct stones whereas sensitivity and specificity of ERCP was 87.5%. Thus MRCP can be considered a superior imaging modality to ERCP in detecting choledocholithiasis. Similar observation were also concluded by Verma D et al. They showed sensitivities and specificity of MRCP for the detection of choledocholithiasis to be 92.3% and 86%. In present study, we also noted location and number of stones found on MRCP which correlated well on ERCP.

CBD strictures, which were seen as narrowing of CBD with upstream dilatation were observed in 11 cases. We saw sensitivity of MRCP to be 93% and specificity of 95% in detecting CBD strictures which was in concordance with Nyree Griffin et al who also reported sensitivity of 91–100%.

While studying 12 patients having CBD tumor, we noticed sensitivity and specificity of MRCP to be 100% which was higher than the finding concluded by Pamos S et al where the sensitivity and specificity was 100 and 83.3%, respectively. MRCP was found to be better in delineating the extent of tumor and other additional cross sectional sequences also helped simultaneously to plan for resectability and evaluate nodal status.

Our study found three cases of ampullary carcinoma on MRCP, among them two were confirmed by HPE. We noted sensitivity and specificity of MRCP to be 100%. In one of our cases, we observed that MRCP suggested ampullary carcinoma whereas ERCP showed no ampullary carcinoma however, biopsy proved malignancy on HPE; thus, it is suggested that MRCP can be considered as superior imaging modality in equivocal cases. In contrary to previous study conducted by Chen WX et al sensitivity and specificity in detection of ampullary carcinoma was 26.83% for MRCP, while in our study it was 100% for MRCP. They found significant difference between MRCP and ERCP, however, owing to small sample size of our study further large dataset would be more confirmatory. MRCP should score over ERCP as it offers additional advantage of simultaneous cross-sectional imaging providing roadmap of biliary tract proximal to site of obstruction aiding in surgical planning.

About 78% cases were detected to have biliary duct dilatation on MRCP which was confirmed on ERCP and MRCP showed 100% sensitivity and specificity in detecting biliary duct dilatation compared to ERCP. According to Angulo et al., diagnostic accuracy of MRCP was found to be greater than 90% in
diagnosing biliary duct dilatation, which was consistent with our study.

Out of total 50 cases, 36% cases had gall bladder stones in whom MRCP showed a sensitivity of 88.89% and specificity of 100%. Similar observation was also made by Calvo MM et al. showing 97.7% sensitivity of MRCP in detecting cholelithiasis.

Pancreatic duct dilatation was detected in four cases and the sensitivity and specificity of MRCP in diagnosing pancreatic duct dilatation in present study was 100%. According to Meng, Z. et al., the sensitivity of MRCP in detecting pancreatic duct dilatation was 72.7% and concluded the superior role of MRI and MRCP in evaluating the dilated ducts for differentiating chronic pancreatitis and pancreatic carcinoma based on the pattern of dilatation.

There were two patients who were detected to have ampullary stones which were confirmed on MRCP [Figure 2]. As per our knowledge, no previous studies have evaluated ampullary stones separately. Possibly most of them might have been included as choledocholithiasis without evaluating location.

Our study found three cases of choledochal cyst on MRCP, among them one was confirmed by HPE. We noted sensitivity and specificity of MRCP to be 100%. According to Park D et al., study sensitivity and specificity of MRCP for choledochal cysts was 96% which was concordance with our study.

In MRCP, we also noted one case having compression of CBD externally at suprapancreatic region by peripancreatic lymph node in a known case of lung cancer and another case showing compression of common hepatic duct by liver malignant lesion.

MRCP has comparable sensitivity for malignancies and offers additional advantage of cross-sectional imaging, hence can be considered to score over ERCP. Sensitivity of MRCP for ancillary findings like gall stones and intrahepatic biliary radical dilatation is comparable to ERCP. While for lower biliary system abnormalities like ampullary stricture and pancreatic duct abnormalities; ERCP may be preferred. For ampullary stones though, MRCP showed equivalent sensitivity but marginally low specificity as compared to ERCP. In one of the cases of ampullary carcinoma, MRCP was positive while ERCP was not, which is likely to be an isolated case, considering the fact that other studies have shown considerably high sensitivity of ERCP compared to MRCP, for ampullary tumor detection [Graph 2 and 3].

Conclusion

While ultrasonography continues to be the first-line imaging modality in obstructive jaundice due to its wide availability, MRCP offers a complementary role with high sensitivity for biliary tract disease such as stones, strictures and malignancies. In cases with suspicion (clinical/CBD-IHBR dilatation on USG) of choledocholithiasis/ampullary stone, it additionally provides information on extrabiliary components of various disease processes. Moreover, MRCP is an excellent non-invasive imaging modality with no complication as compared to ERCP, which is invasive and has possibility of developing post-procedure complication due to uses of contrast and its invasive nature.

Author's contribution

Dr. Patel Viral B. Concept, design, literature search, data acquisition, data analysis and manuscript preparation.

Dr. Musa Raish K. Data analysis, literature search and manuscript preparation.

Dr. Nikhil Patel, Concept, design and literature search.

Dr. Patel Shreya D. Data collection and literature search.

All authors read and approved the final version of the manuscript.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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