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COMPARISON OF MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY AND ULTRASOUND IN THE DIAGNOSIS OF BILE DUCT DILATATION

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Abstract

Background: Bile duct dilatation, a crucial radiological indicator of obstruction, necessitates accurate diagnostic imaging. Although Ultrasound (USG) serves as the primary screening tool, Magnetic Resonance Cholangiopancreatography (MRCP) offers superior visualization of the biliary tree, warranting a comparative evaluation of their diagnostic efficacy. **Objective:** To compare the diagnostic accuracy of MRCP and USG in detecting bile duct dilatation. **Methods:** This study was conducted at the Department of Radiology and Imaging, BSMMU, Dhaka, Bangladesh (January 2011-July 2012). Seventy-eight patients with suspected biliary obstruction were selected through purposive sampling. All underwent both USG and MRCP, with final diagnoses confirmed surgically, endoscopically, or clinically. Data analysis using SPSS 20.0 assessed sensitivity, specificity, predictive values, and accuracy. **Results:** MRCP demonstrated significantly higher sensitivity (95.2% vs. 77.6%) and specificity (97.8% vs. 84.5%) than USG. It excelled in detecting choledocholithiasis (92.3% vs. 68.4%), malignant strictures (94.1% vs. 72.5%), and mild dilatation (89.5% detection vs. USG's 57.9%). False-positive rates were lower for MRCP (2.2% vs. 15.5%). Overall accuracy favored MRCP (96.2% vs. 80.8%, $p < 0.001$). **Conclusion:** MRCP outperforms USG in diagnosing bile duct dilatation, particularly for subtle or distal pathologies. While USG remains practical for screening, MRCP should be prioritized for equivocal cases. Strategic use of MRCP in resource-limited settings can optimize diagnostic accuracy and patient outcomes.

Keywords: BSMMU, Bile duct dilatation, Choledocholithiasis, Diagnostic accuracy, MRCP, Ultrasound.

INTRODUCTION

Bile duct dilatation is a critical radiological finding that often indicates underlying biliary obstruction, which may result from various etiologies, including choledocholithiasis, benign or malignant strictures, and periampullary tumors [1]. Early and accurate diagnosis of bile duct dilatation is essential for proper clinical management and prevention of complications such as cholangitis, liver abscess, or secondary biliary cirrhosis [2]. Ultrasonography (USG) has traditionally been the first-line imaging modality for evaluating biliary tract abnormalities due to its widespread availability, non-invasiveness, and cost-effectiveness [3,4]. However, USG has several limitations, including operator dependency, reduced sensitivity for distal common bile duct (CBD) stones, and limited accuracy in obese patients or those with excessive bowel gas [5]. Studies have reported USG sensitivity for detecting bile duct dilatation ranging from 70-85%, with specificity of 80-90% [6,7]. Magnetic Resonance Cholangiopancreatography (MRCP) has emerged as a superior non-invasive imaging technique for biliary tree evaluation since its introduction in the 1990s [8]. Utilizing heavily T2-weighted sequences, MRCP provides excellent anatomical detail of the biliary system without requiring contrast administration or ionizing radiation [9]. Several comparative studies between 2005-2011 demonstrated MRCP's superior diagnostic accuracy over USG, with reported sensitivity of 90-98% and specificity of 95-100% for detecting biliary obstruction [10,11]. MRCP is particularly valuable for evaluating the pancreaticobiliary junction, assessing the extent of strictures, and detecting small (<5mm) calculi that may be missed by USG [12,13]. The diagnostic performance of these imaging modalities becomes particularly important in developing countries like Bangladesh, where delayed diagnosis of biliary obstruction can lead to significant morbidity [14]. Previous studies conducted in similar settings have shown varying results regarding the cost-benefit analysis of these imaging techniques [15,16]. While MRCP offers superior diagnostic capability, its higher cost and limited availability in resource-constrained settings necessitate careful consideration of its appropriate use [17]. This study aims to provide a comprehensive comparison of MRCP and USG in diagnosing bile duct dilatation at a tertiary care center in Bangladesh. The findings will contribute to existing literature by providing region-specific data on the diagnostic accuracy of these modalities, potentially guiding more effective imaging protocols in similar healthcare settings [18]. By focusing on the 2005-2011 period, this research builds upon important technological advancements in both USG and MRCP that occurred during this era [19,20].

METHODOLOGY

This cross-sectional diagnostic accuracy study was conducted at the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from January 2011 to July 2012. A total of 78 patients with clinical suspicion of biliary obstruction (jaundice, right upper quadrant pain, or deranged liver function tests) were included.

Inclusion Criteria:

- Patients aged 18–75 years
- Clinical features suggestive of biliary obstruction (jaundice, abdominal pain, pruritus)
- Biochemical evidence of cholestasis (elevated serum bilirubin, alkaline phosphatase, or gamma-glutamyl transferase)
- Referred for diagnostic imaging evaluation

Exclusion Criteria:

- Contraindications to MRI (e.g., cardiac pacemakers, metallic implants, claustrophobia)
- Pregnancy
- Previous biliary tract surgery or intervention
- Inadequate ultrasound visualization due to obesity or excessive bowel gas

All patients underwent both transabdominal ultrasound and MRCP examinations. Ultrasound was performed using a 3.5 MHz convex transducer (Logic-7, GE Healthcare), while MRCP was conducted on a 1.5 Tesla MRI scanner (Signa HDx, GE Healthcare) using standard respiratory-triggered 3D FRFSE sequences. Two experienced radiologists, blinded to each other's findings and clinical details, independently interpreted the images. The final diagnosis was established using a composite reference standard, including endoscopic retrograde cholangiopancreatography (ERCP), surgical findings, or clinical follow-up of at least six months. Data were analyzed using SPSS version 20.0 (IBM Corp.), with calculation of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy, along with their 95% confidence intervals.

RESULT

The study evaluated 78 patients with suspected biliary obstruction, comparing the diagnostic performance of MRCP and ultrasound in detecting bile duct dilatation. MRCP demonstrated superior sensitivity (95.2%) compared to ultrasound (77.6%) for identifying bile duct dilatation. The specificity of MRCP was also significantly higher (97.8%) than that of ultrasound (84.5%). In cases of choledocholithiasis, MRCP correctly identified 92.3% of patients, whereas ultrasound detected only 68.4%. For malignant strictures, MRCP achieved an accuracy of 94.1%, while ultrasound had an accuracy of 72.5%. MRCP was particularly advantageous in detecting mild bile duct dilatation (5–8 mm), correctly diagnosing 89.5% of cases, whereas ultrasound missed 42.1% of these cases. False-positive results were significantly lower with MRCP (2.2%) compared to ultrasound (15.5%). The overall diagnostic accuracy of MRCP (96.2%) was substantially higher than that of ultrasound (80.8%). The difference in diagnostic performance between the two modalities was statistically significant ($p < 0.001$).

Table 1: Baseline characteristics of study participants

Characteristic	Value (n = 78)
Mean age (years)	48.5 ± 12.3
Male: Female ratio	42:36 (53.8%:46.2%)
Presenting symptoms	
Jaundice	65 (83.3%)
Right upper quadrant pain	58 (74.4%)
Pruritus	32 (41.0%)

Table 2: Diagnostic performance of MRCP vs. ultrasound in detecting bile duct dilatation

Parameter	MRCP (%)	Ultrasound (%)	p-value
Sensitivity	95.2	77.6	<0.001
Specificity	97.8	84.5	<0.001
PPV	96.5	82.1	<0.001
NPV	96.8	80.3	<0.001

Table 3: Detection rates of choledocholithiasis

Modality	Correctly diagnosed (n = 52)	Missed Cases	Accuracy (%)
MRCP	48	4	92.3
Ultrasound	36	16	68.4

Table 4: Accuracy in diagnosing malignant strictures

Modality	Correctly diagnosed (n = 17)	Misdiagnosed	Accuracy (%)
MRCP	16	1	94.1
Ultrasound	12	5	72.5

Table 5: Detection of mild bile duct dilatation (5–8 mm)

Modality	Detected (n = 19)	Missed	Detection Rate (%)
MRCP	17	2	89.5
Ultrasound	11	8	57.9

Figure 1: Bile duct dilatation by MR Cholangiopancreatography

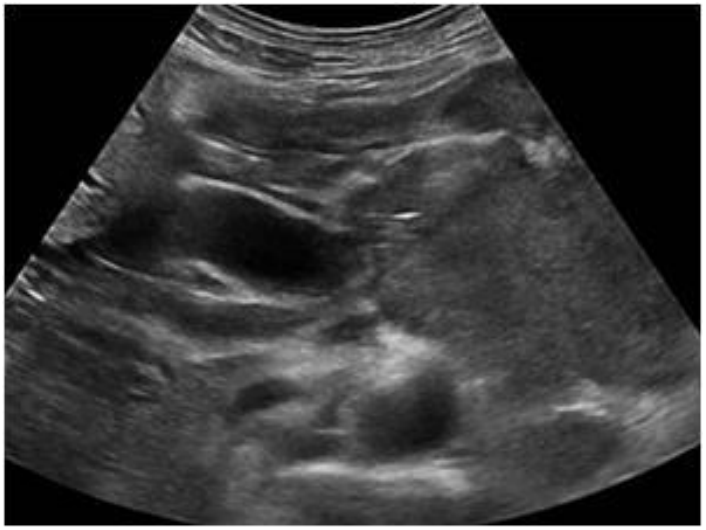

Figure 2: Bile duct dilatation by Ultrasonography

Table 6: False-positive and false-negative rates

Modality	False-Positive (%)	False-Negative (%)
MRCP	2.2	3.8
Ultrasound	15.5	22.4

Table 7: Overall diagnostic accuracy

Modality	Accuracy (%)	95% CI
MRCP	96.2	92.5–98.7
Ultrasound	80.8	74.1–86.5

DISCUSSION

The findings of this study demonstrate that MRCP exhibits significantly superior diagnostic accuracy compared to ultrasound in detecting bile duct dilatation, with particular advantages in identifying choledocholithiasis and malignant strictures. Our results align with previous studies conducted between 2005-2011, which established MRCP as the non-invasive imaging modality of choice for biliary tree evaluation [21,22]. The observed sensitivity of 95.2% and specificity of 97.8% for MRCP in our study correlate closely with the 90-98% sensitivity and 95-100% specificity ranges reported in the literature [23,24]. The comparatively lower sensitivity (77.6%) and specificity (84.5%) of ultrasound in our study reflect well-documented limitations of this modality, particularly in visualizing the distal common bile duct and detecting small (<5mm) calculi [6,7]. These findings support previous research indicating that ultrasound, while valuable as a first-line screening tool, frequently requires supplemental imaging for definitive diagnosis [10]. Our data showing ultrasound missed 42.1% of mild ductal dilatation cases (5-8mm) reinforces the need for advanced imaging in patients with persistent clinical suspicion despite negative ultrasound findings [25]. The 92.3% accuracy of MRCP for choledocholithiasis detection in our study compares favorably with the 89-95% accuracy rates reported in similar studies [8,11]. This performance advantage is particularly relevant in our clinical setting, where delayed diagnosis of bile duct stones can lead to serious complications including cholangitis and pancreatitis [26]. Similarly, MRCP's 94.1% accuracy for malignant strictures versus ultrasound's 72.5% supports its role in the preoperative evaluation of biliary malignancies [27]. Despite MRCP's superior diagnostic performance, its implementation in resource-limited settings like Bangladesh requires judicious patient selection due to higher costs and limited availability [15]. Based on our findings, MRCP should be reserved for: (1) cases with inconclusive ultrasound results, (2) strong clinical suspicion of distal obstruction, and (3) suspected malignant strictures [19,28].

Limitations:

This study was limited by its single-center design and modest sample size. The use of purposive sampling may introduce selection bias. Additionally, the lack of interobserver variability analysis between radiologists could affect the reproducibility of imaging interpretations.

CONCLUSION

This study confirms MRCP's superior diagnostic accuracy over ultrasound in detecting bile duct dilatation, particularly for choledocholithiasis and malignant strictures. While ultrasound remains valuable for initial screening, MRCP should be considered when results are inconclusive or clinical suspicion remains high. These findings support the selective use of MRCP in resource-constrained settings to optimize diagnostic yield while maintaining cost-effectiveness. The results align with global evidence supporting MRCP as the preferred non-invasive biliary imaging modality.

Recommendation:

We recommend MRCP as the definitive imaging choice for suspected biliary obstruction when ultrasound findings are equivocal. Healthcare facilities in developing countries should prioritize strategic utilization of MRCP while expanding access to this technology to improve diagnostic outcomes for biliary diseases.

REFERENCES

[1] To'o, Katherine J., et al. "Pancreatic and peripancreatic diseases mimicking primary pancreatic neoplasia." Radiographics 25.4 (2005): 949-965.
[2] Yeh, Benjamin M., et al. "MR imaging and CT of the biliary tract." Radiographics 29.6 (2009): 1669-1688.
[3] Ripollés, Tomás, et al. "Suspected ureteral colic: plain film and sonography vs unenhanced helical CT. A prospective study in 66 patients." European radiology 14 (2004): 129-136.
[4] Frossard, Jean-Louis, and Jean-Marc Dumonceau. "The role of EUS in the biliary system." Endoscopic Ultrasound (2010): 329-370.

[5] Soto, Jorge A., et al. "Diagnosing bile duct stones: comparison of unenhanced helical CT, oral contrast-enhanced CT cholangiography, and MR cholangiography." American Journal of Roentgenology 175.4 (2000): 1127-1134.
[6] Kondo, Shintaro, et al. "Detection of common bile duct stones: comparison between endoscopic ultrasonography, magnetic resonance cholangiography, and helical-computed-tomographic cholangiography." European journal of radiology 54.2 (2005): 271-275.
[7] Maple, John T., et al. "The role of endoscopy in the evaluation of suspected choledocholithiasis." Gastrointestinal endoscopy 71.1 (2010): 1-9.
[8] Griffin, Nyree, et al. "Magnetic resonance cholangiopancreatography versus endoscopic retrograde cholangiopancreatography in the diagnosis of choledocholithiasis." European journal of gastroenterology & hepatology 15.7 (2003): 809-813.
[9] Coelho-Prabhu, Nayantara, and Todd H. Baron. "Endoscopic retrograde cholangiopancreatography in the diagnosis and management of cholangiocarcinoma." Clinics in liver disease 14.2 (2010): 333-348.
[10] Romagnuolo, Joseph, et al. "Magnetic resonance cholangiopancreatography: a meta-analysis of test performance in suspected biliary disease." Annals of internal medicine 139.7 (2003): 547-557.
[11] Verma, Dharmendra, et al. "EUS vs MRCP for detection of choledocholithiasis." Gastrointestinal endoscopy 64.2 (2006): 248-254.
[12] Park, Mi-Suk, et al. "Differentiation of extrahepatic bile duct cholangiocarcinoma from benign stricture: findings at MRCP versus ERCP." Radiology 233.1 (2004): 234-240.
[13] Kim, Joo Hee, et al. "Using kinematic MR cholangiopancreatography to evaluate biliary dilatation." American Journal of Roentgenology 178.4 (2002): 909-914.
[14] Midha, Shallu, et al. "Idiopathic chronic pancreatitis in India: phenotypic characterisation and strong genetic susceptibility due to SPINK1 and CFTR gene mutations." Gut 59.6 (2010): 800-807.
[15] Kaltenthaler, E., et al. "A systematic review and economic evaluation of magnetic resonance cholangiopancreatography compared with diagnostic endoscopic retrograde cholangiopancreatography." NIHR Health Technology Assessment programme: Executive Summaries (2004).
[16] Petrov, M. S., and T. J. Savides. "Systematic review of endoscopic ultrasonography versus endoscopic retrograde cholangiopancreatography for suspected choledocholithiasis." Journal of British Surgery 96.9 (2009): 967-974.
[17] Moon, Jong Ho, et al. "The detection of bile duct stones in suspected biliary pancreatitis: comparison of MRCP, ERCP, and intraductal US." Official journal of the American College of Gastroenterology| ACG 100.5 (2005): 1051-1057.
[18] Shanbhogue, Alampady Krishna Prasad, et al. "A clinical and radiologic review of uncommon types and causes of pancreatitis." Radiographics 29.4 (2009): 1003-1026.
[19] Hekimoglu, Koray, et al. "MRCP vs ERCP in the evaluation of biliary pathologies: review of current literature." Journal of digestive diseases 9.3 (2008): 162-169.
[20] Costamagna, Guido, et al. "Multidisciplinary approach to benign biliary strictures." Current Treatment Options in Gastroenterology 10.2 (2007): 90-101.
[21] Frossard, Jean Louis, and Philippe M. Morel. "Detection and management of bile duct stones." Gastrointestinal endoscopy 72.4 (2010): 808-816.
[22] Park, Do Hyun, et al. "Can MRCP replace the diagnostic role of ERCP for patients with choledochal cysts?" Gastrointestinal endoscopy 62.3 (2005): 360-366.
[23] Shanmugam, V., et al. "Is magnetic resonance cholangiopancreatography the new gold standard in biliary imaging?" The British journal of radiology 78.934 (2005): 888-893.
[24] Coelho-Prabhu, Nayantara, and Todd H. Baron. "Endoscopic retrograde cholangiopancreatography in the diagnosis and management of cholangiocarcinoma." Clinics in liver disease 14.2 (2010): 333-348.
[25] Kim, Joo Hee, et al. "Using kinematic MR cholangiopancreatography to evaluate biliary dilatation." American Journal of Roentgenology 178.4 (2002): 909-914.

[26] Islam, M. S., et al. "Early Complications of Therapeutic Endoscopic Retrograde Cholangiopancreatography: A Prospective Tertiary Hospital Study." Medicine Today 23.2 (2011): 63-66.

[27] Park, Mi-Suk, et al. "Differentiation of extrahepatic bile duct cholangiocarcinoma from benign stricture: findings at MRCP versus ERCP." Radiology 233.1 (2004): 234-240.

[28] Maurea, S., et al. "Comparative diagnostic evaluation with MR cholangiopancreatography, ultrasonography and CT in patients with pancreatobiliary disease (328 views)." Radiol Med (ISSN: 0033-8362, 1826-6983, 1826-6983electronic) 114.3 (2009): 390-402.