ejpmr, 2016,3(8), 27-32

SJIF Impact Factor 3.628

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

ACCURACY OF MRCP COMPARED WITH ERCP IN THE DIAGNOSIS OF BILE DUCT STONES

Ali Hassoon Jasim[1], Salam Muhamed Jori[2] and Jabir Hasan Obaid[3]*

[1]Radiologist, X-Ray Institute - Baghdad – Iraq.
[2]Consultant Radiologist, X-Ray Institute - Baghdad – Iraq.
[3]Radiologist, Peadiatric & Maternity Hospital - Al-Diwaniya-Iraq.

***Corresponding Author: Jabir Hasan Obaid**

Radiologist, Peadiatric & Maternity Hospital - Al-Diwaniya-Iraq.

Article Received on 25/05/2016 **Article Revised on 14/06/2016** **Article Accepted on 04/07/2016**

ABSTRACT

This study was carried out to determine the accuracy of magnetic resonance cholangio-pancreatography (MRCP) compared with the endoscopic retrograde cholangio-pancreatography (ERCP) in the diagnosis of bile duct stones. During the period from Oct 2014 to March 2015, 52 patients with suspected common bile duct stones and a clear indication for ERCP were included in this prospective study. This study was carried out at the MRI and the ERCP units of Baghdad Medical City Office teaching hospitals. All the patients had both examinations performed within 1-2 week. Patients with absolute contraindications to the MRCP technique were excluded from the study because of the impossibility of their co-operation, as were patients with severe clinical conditions requiring urgent therapeutic intervention. During the study period; the chosen patients ages were ranged from 21 to 86 years, with a mean of 60.5 years, Thirty patients (57.7%) were females and Twenty two patients (42.3%) were males. a sensitivity of 87.8% and specificity of 94.7% were recorded for MRCP. This corresponds to a positive predictive value of 96.6% and a negative predictive value of 81.8%. We concluded that MRCP has high diagnostic accuracy for bile duct calculi; we propose MRCP as the method of choice for the diagnostic imaging of bile duct calculi; ERCP is reserved for therapeutic intervention in this setting.

KEYWORDS: biliary stone, cholelithiasis diagnosis, MRCP, magnetic resonance cholangio pancreatography, ERCP, endoscopic retrograde cholangio-pancreatography.

INTRODUCTION

Cholelithiasis is one of the most common biliary pathology. The incidence of choledocholithiasis in patients with cholelithiasis varies between 5 to 15 percent, out of which 5% are asymptomatic. Although common bile duct (CBD) stones may be silent.[1] Usually, the diagnosis of choledocholithiasis is based on a combination of clinical suspicion (biliary colic, jaundice and cholangitis), bio-chemical analysis (raised conjugated bilirubin and alkaline phosphatase levels) and imaging findings. Unfortunately, all of these individually have varying diagnostic accuracies and none is a completely reliable method for identifying bile duct stones.[2] Primary ductal stones are stones that develop *de novo* in the intrahepatic ducts or common duct. They are far more common in the Asian populations than in the West. These stones are often brownish-yellow in color with a soft muddy consistency; biochemically, they consist of calcium bilirubinate mixed with variable amounts of cholesterol and calcium salts. While the etiology remains conjectural, bacterial infections and biliary stasis are considered the two most important causative factors.[3] Gastrointestinal tract microorganisms such as *Escherichia coli*, *Klebsiella*, *Proteus*, *Bacteroides*, and *Clostridium* have been isolated from the bile of patients with primary duct stones.[3] In addition, bacterial cytoskeletons are invariably seen in primary duct stones under electronic microscope.[4] These bacteria may have a contributory role by producing enzymes that catalyze deconjugation of bilirubin and lysis of phospholipids, which in turn promote the precipitation of calcium bilirubinate and initiate stone formation. Among all the bacteria isolated, *Clostridium perfringens* has been found to produce the highest beta-glucuronidase enzyme activity, which is 34-fold higher than that for *E. coli*, *Corynebacterium* spp., *Enterococcus* spp., and *Klebsiella* spp.[5] On the other hand, the biliary stasis theory is supported by the fact that intrahepatic ductal strictures and proximal dilatation are commonly seen among patients with primary duct calculi[6]. Nevertheless, whether these strictures are the cause or consequence of the intrahepatic ductal calculi remains unresolved.[6] Secondary common duct stones are supposed to have originated from the gallbladder. Conceivably their composition is identical to that of gallstones, which are mainly yellowish cholesterol or

black pigment calculi with a hard and crispy consistency. There are some of predisposing factors which included cirrhosis of the liver, hereditary blood disorders, obesity, low-fibers high-fat diet, prolonged fasting, rapid weight loss, family history and women gender. It is unclear why gallstones migrate into the common duct in some patients. In one study the size of the cystic duct has been reported as the single most important determinant.[7] Accurate methods for diagnosis of bile duct abnormalities with obstructive jaundice are important to both surgeons and endoscopists. Biliary obstruction may be the result of choledocholithiasis, tumors or trauma, but choledocholithiasis is the most common cause. ERCP is still the gold standard for exploration of the bilio-pancreatic region. However, it requires direct cannulation of the common bile or pancreatic duct, sedation, the use of ionising radiation and a team of trained and experienced personnel. It is also associated with complication, such as hemorrhage, sepsis, pancreatitis and bile leak (1 - 7%), and up to 1% mortality.[8]

However, it is an imperfect diagnostic tool and other procedures may be more appropriate gold standards for diagnosis in the future. MRCP is a non-invasive and safe alternative to diagnostic ERCP for imaging the biliary tree and investigating biliary obstruction. MRCP refers to selective fluid-sensitive magnetic resonance imaging (MRI) of the pancreatic and biliary ducts. It was developed in 1991 and techniques have progressively improved since then[8] A major detriment or disadvantage of MRCP is that it is not a therapeutic procedure, whereas ERCP is used for diagnosis and treatment. MRCP also does not have the small but definite morbidity and mortality associated with ERCP. The use of MRCP in diagnosing biliary obstruction may avoid the use of unnecessary invasive procedures such as ERCP. Indications for the use of MRCP include: unsuccessful or contraindicated ERCP; patient preference for non-invasive imaging; patients considered to be at low risk of having pancreatic or biliary disease; patients where the need for therapeutic ERCP is considered unlikely; and those with a suspected neoplastic cause for pancreatic or biliary obstruction. No patient preparation is required for MRCP and sedation is not usually required. MRCP is particularly useful where ERCP is difficult, hazardous or impossible. It is also an important option for patient with failed ERCPs. ERCP and MRCP have different contraindications allowing them to be used as complementary techniques.[10]

In order to determine the sensitivity and specificity of MRCP compared to ERCP, a systematic review was under taken to identify all relevant studies comparing the two techniques using clearly defined inclusion and exclusion criteria. This paper therefore compares the findings of MRCP with diagnostic ERCP for the investigation of biliary obstruction, using accuracy statistics. We also reported study quality, population characteristics and suspected conditions. The paper summarizes the key clinical points reported in a recent Health Technology Assessment Monograph.[11] Since the most common cause of biliary obstruction is choledocholithiasis, we have concentrated mainly on the diagnosis of this condition.

Patients and Methods

During the period from Oct 2014 to March 2015, 52 patients with suspected common bile duct stones and a clear indication for ERCP were included in this prospective study. Patients had to be at least 18 years old. This study was carried out at the MRI units in the hospitals of Medical City Office and the ERCP units of GIT teaching hospital. All the patients had both examinations performed within days of each other. Patients with absolute contraindications to the MRCP technique (cardiac pacemaker, claustrophobia, large patient size, degenerative or ankylotic conditions or senile dementia) and patients with severe clinical conditions were excluded.

The study included patients who were suspected of having choledocholithiasis on the basis of any of the following criteria.

1. A history or presence of any of the following: Intermittent jaundice , Cholangitis which was defined as the presence of fever (> 37.30C), chills, colicky right upper quadrant pain and leukocytosis ,Status of post biliary pancreatitis which was defined according to a history of biliary pancreatitis , and the presence of Post cholecystectomy syndrome**.**
2. Total bilirubin which was > 1.2 mg / dL , ALP which was > 220 IU/L
3. A CBD diameter of > 7 mm at sonography or CBD stones which were suspected / diagnosed at sonography.

All cases of obstructive jaundice where the cause proved to be other than CBD stones (e.g. carcinoma head of pancreas, periampullary carcinoma, CBD strictures, cholangiocarcinoma, etc.) were excluded from the study.

MRCP, MRI and ERCP techniques

MRCP, MRI and ERCP techniques were carried out as previously prescribed.[8-10]

Image analysis

The diagnostic quality, coverage of the relevant anatomy and results of the MRCP were reviewed blinded to the ERCP results. The ERCP was interpreted by an experienced surgeon also after the MRCP results. Results for cholangiography and pancreatography obtained from both techniques were compared. Results were analyzed according to the pathological findings according to which mentioned by.[8-10]

Statistical analysis

Fisher's 2x2 exact test was used to compare between groups. Statistically $p<0.05$ was considered significance.

RESULTS

Patients ages were ranged from 21 to 86 years, with a mean of 60.5 years, Thirty patients (57.7%) were females and Twenty two patients (42.3%) were males. 33 patients (63.5%) showed clinical jaundice and 40 patients (76.9%) showed biochemical jaundice.

MRCP compared to ERCP revealed 29 true-positives,18 true-negatives, 1 false-positive, and 4 false-negatives cases Table 1).

Table (1): MRCP compared to ERCP in 52 patients with suspicion of CBD stones.

MRCP vs. ERCP	N.
True-positive	29
True-negative	18
False-positive	1
False-negative	4
Total	52

The sensitivity was 87.8% and specificity was 94.7% of MRCP vs. ERCP in 52 patients with clinical suspicion of CBD stones as sown (Table 2). These corresponds to a positive predictive value of 96.6% and a negative predictive value of 81.8%. A true-positive finding was shown in fig. 1, and a false-negative finding in fig. 2.

Table (2): Sensitivity, specificity and predictive values of MRCP vs. ERCP in 52 patients with clinical suspicion of CBD stones.

Characteristics	N/N	Percentage
Sensitivity	29/33	87.8
Specificity	18/19	94.7
Positive predictive value	29/30	96.6
Negative predictive value	18/22	81.8
Accuracy	47/52	90.3

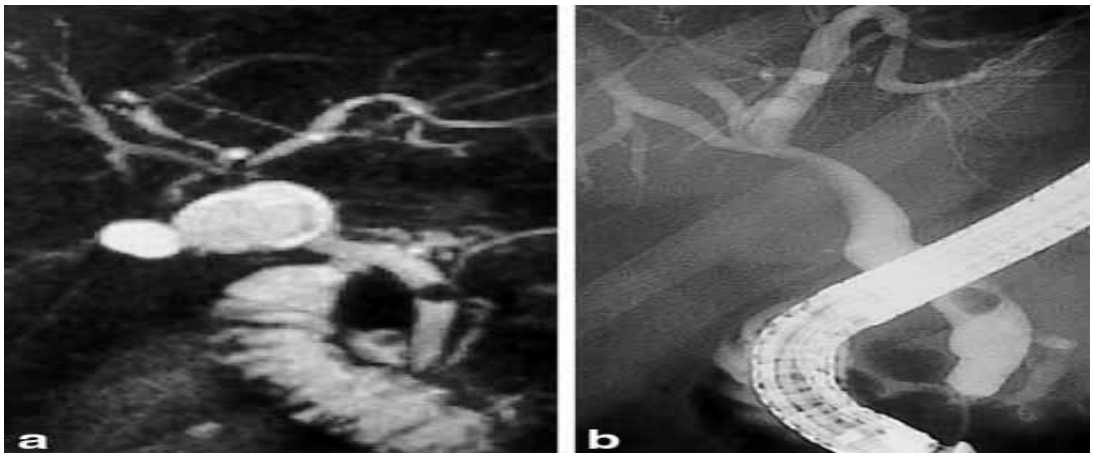

Figure 1: (a) MRCP and b) ERCP reveal a solitary stone in a normal-sized CBD.

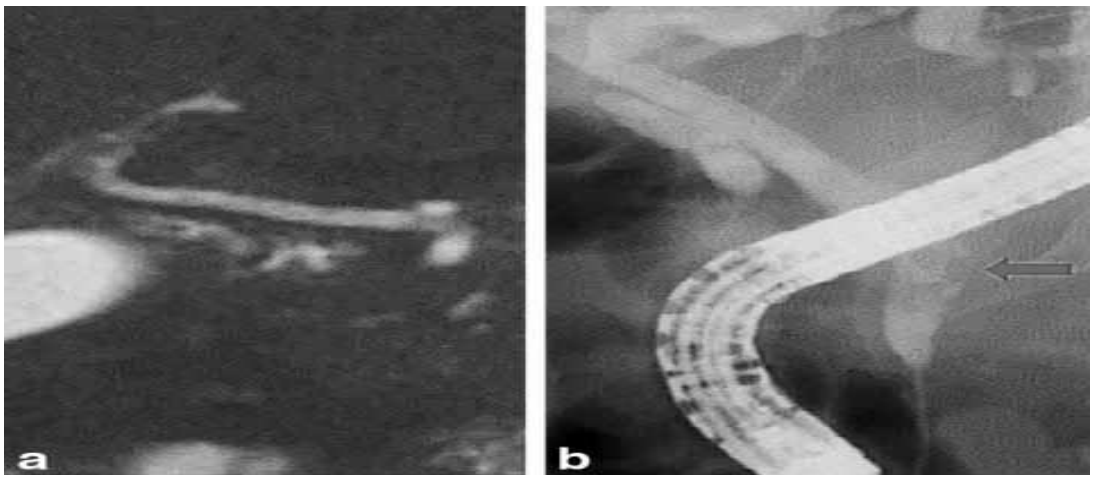

Figure (2) a: False-negative MRCP with two proven distal CBD stonesat b) ERCP.

Table 4: The specificity and sensitivity results.

System	Diagnostic feature	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Main papilla	stone	33.3	85.4	14.3	94.6
Bile ducts	stone	87	80	83.3	84.2
Gall bladder	stone	80	50	80	50

MRCP

Choledocholithiasis was seen in 30 patients, affecting the ampulla of Vater in 7 patients and the bile ducts in 23 patients. Dilated bile ducts was found in 20 patients in conjunction with stones, fig (2).

MRCP failed in 2 patient due to artifacts caused by surgical clips. Two subjects had ascites, leading to failed MRCP due to lack of visibility of the ducts.

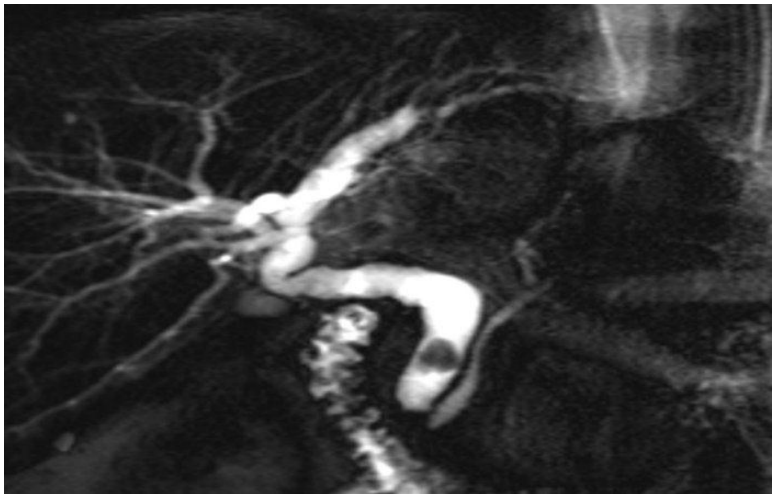

Figure (2): Coronal MRCP demonstrating a low intensity stone impacted in the dilated common bile duct.

ERCP

Choledocholithiasis was found in 33 patients; the bile ducts were involved in 22 patients and the ampulla of Vater in 11 patients of them, dilatation were diagnosed in 16 patients; 14 were seen in the bile ducts, However, ERCP was normal in 3 patients.

ERCP failed in 5 patients due to papillary oedema, impacted stone just above the ampulla, and non-compliance patient fig.3.

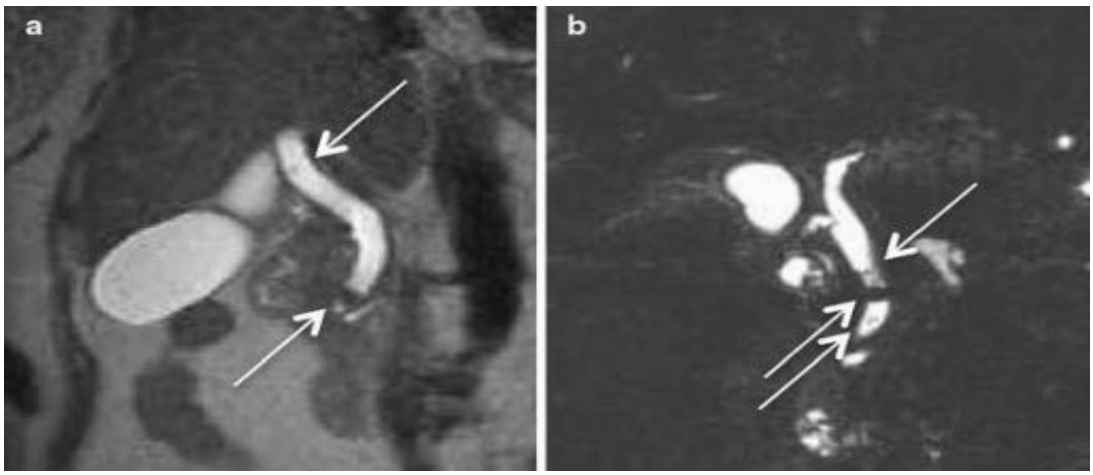

Figure (3): in patient with failed ERCP showing a: Coronal T2 image showing stone in the proximal and distal CPD (arrows), b: MRCP showing stones in the distal CBD.

MRCP vs. ERCP

MRCP correctly diagnosed 29 of the 33 patients with ERCP-proven bile duct calculi, There were 4 false-negative and 1 false-positive results for MRCP. There were 6 false-positive and 2 false-negative results when MRCP was used to diagnose stones in the ampulla. The sensitivity, specificity, and positive and negative predictive values for bile duct calculi were 87%, 80%, 83.3% and 84.2%, respectively (table 4). In the patients with failed MRCP, ERCP was 100% successful. ERCP failed in 1 patient due to papillary edema due to stone impaction. fig(3); in this case, MRCP successfully diagnosed choledocholithiasis and secondary bile duct dilatation. In the patient with the stone impacted just above the ampulla, MRCP was able to show the anatomy of the remaining duct system. MRCP also failed in the patient with severe ascites. In addition, ERCP allowed therapeutic intervention with sphincterotomy, stone extraction and/or stent placement. Where relevant, histology could also be obtained.

DISCUSSION

Diagnostic imaging of the pancreatic-biliary ductal system usually starts with US or CT investigations. The information provided by these methods may be insufficient for diagnosis.[12-16] The aim of our study was to compare the accuracy of MRCP as a diagnostic tool at our institution with invasive ERCP in the diagnosis of bile duct stones, using the parameters of specificity, sensitivity, and positive and negative predictive values. If these values were favorable for MRCP, then the latter could be proposed as the examination of choice for diagnostic imaging of bile duct abnormalities, and then ERCP could be reserved for therapeutic intervention alone. MRCP is a non-invasive and safe alternative to ERCP for imaging the biliary tree and investigating biliary obstruction. Even though evaluation of indications for diagnostic and therapeutic ERCP is not yet finalized, the usefulness of ERCP stands beyond debate. As diagnostic, ERCP is used less and less, the widespread use of the technique could be restricted to expert centers where skill in therapeutic ERCP and management of complications are available. For diagnosis, MRCP offers sufficient advantages over ERCP to be considered as the initial modality. There is no risk of complications associated with the procedure of cannulation of the pancreatic duct, and diagnostic yield is similar in most pathology.

MRCP exceeds the possibilities of ERCP in providing additional information by cross sectional MRI and MR angiography. There is no exposure to ionizing radiation or to potentially risky iodinated contrast medium, and sedation is seldom indicated. Patients should be fasting and the procedure takes a few minutes, usually without sedation. The main potential problems with MRCP are image artifacts and difficulty in patient compliance because of claustrophobia. Image artifacts can be seen as bright signals arising from stationary fluid within the adjacent duodenum, duodenal diverticulae and ascitic fluid. In addition, local areas of signal dropout can be caused by metallic clips following cholecystectomy and defects induced by the right hepatic artery crossing the bile duct. Currently, MRCP has poorer resolution than direct cholangiography and can miss small stones (<4 mm). Obstructing stones are generally easier to identify than non-obstructing stones (especially if smaller than the thickness of the acquired image slices). Small stones may not be distinguishable from sludge, mucin or even blood. Stones >4 mm are readily seen but cannot be differentiated from filling defects such as blood clots, tumor, sludge or parasites. Other mimickers of choledocholithiasis include flow artifacts, biliary air and a pseudocalculus at the ampulla.[17]. In the light of the current data, MRCP has the potential to replace diagnostic ERCP and thereby avoid possible complications related to ERCP. In the study of Taylor and Varghese, the overall sensitivity of 85 - 97%, specificity of 75 - 98%, positive predictive values of 83 - 89%, and negative predictive values of 82 - 98%.[18-19]

In other study, the median sensitivity for the 13 studies of choledocholithiasis was 0.93 (range 0.81 - 1.00) and the median specificity 0.94 (0.83 - 0.99). The review concluded that there is some evidence that MRCP is an accurate investigation compared with diagnostic ERCP.[17] A review included a 67 studies revealed that the overall sensitivity and specificity of MRCP for the diagnosis of biliary stones were 95% and 97% respectively.[20] In a recent prospective study, 33 patients with jaundice due to bile duct stone were examined by ERCP plus vs. MRCP. Diagnostic image quality for ERCP was 88% against 76% for MRCP ($p>0.05$).[21] A study was carried out to evaluate criteria retrospectively for diagnosis bile duct stones, and to compare diagnostic accuracy of this modality with ERCP, it concluded that the accuracy of MRCP is comparable with that of ERCP.[22] In another study, 32 patients with suspected biliary stones were studied prospectively. MRCP was performed immediately before ERCP by separate blinded examiners within 24 hours of admission. The sensitivities of MRCP and ERCP for identifying choledocholithiasis were 80.0% and 90.0%, respectively. The overall agreement between MRCP and ERCP was 90.6% for choledocholithiasis ($p<0.01$). The sensitivity of MRCP in detecting choledocholithiasis decreased with dilated bile ducts (with a bile duct diameter >10 mm it was 72.7%, versus 88.9% in ducts ≤10 mm).[23] In our unit, MRI only supports single-shot fast spin-echo sequences. Newer variants of MRCP, including rapid acquisition with relaxation enhancement (RARE) and half-Fourier acquisition single-shot turbo spin-echo (HASTE), provide superior images. Single-shot RARE and HASTE techniques can be performed in a breath-hold period with a scan time of <20 seconds. The optimal protocol to perform MRCP has not been defined and there continues to be variation across centers. As a general rule, the protocol depends upon the specific MR magnet being used, including its field strength (e.g. 1.5 v. 3T) and the manufacturer, as well as institutional experience and preferences. However, all acquisition protocols obtain heavily T2-weighted images as thick slabs and the images are reformatted in planes to optimize depiction of the hepatic and pancreatic ducts. Volume-rendered images may be used to depict the intra- and extra hepatic bile ducts. The current study revealed that MRCP had sensitivity, specificity, and positive and negative predictive values of 87%, 80%, 83.3% and 84.2%, respectively, for bile duct calculi, which correlates well with results obtained in other parts of the world. It is known that the sensitivity of MRCP for detecting choledocholithiasis decreases with bile duct dilatation (72.7% for bile duct diameters >10 mm v. 88.9% for diameters <10 mm).[23] The reason for the insensitivity in some cases, in our study may be a result of the lower resolution of MRCP than direct cholangiography.

CONCLUSION

We found MRCP with the HASTE fat suppressed breath-hold technique to be easily applied, well-tolerated, and a

sensitive method for diagnosing CBD stones. We concluded that MRCP has high diagnostic accuracy for bile duct calculi. Owing to a small study population, results for other biliary pathology were inconclusive. Consequently, we propose MRCP as the method of choice for the diagnostic imaging of bile duct calculi. ERCP is reserved for therapeutic intervention in this setting. It is well proven in current literature that MRCP has the potential to replace diagnostic ERCP in a wide range of bile duct abnormalities (tumor, stricture, occlusion), thereby avoiding possible complications related to ERCP. At our institution, further study with more patients is needed in future.

REFERENCES

1. Topal B, van de Moortel M, Fieuws S, van Beckevoort D, van Steenbergen W, Aerts R, et al. The value of magnetic resonance cholangiopancreatography in predicting common bile duct stones in patients with gallstone disease. Br J Surg., 2003; 90: 42–47.
2. Varghese JC, Liddell RP, Farrell MA, Murray FE, Osborne DH and Lee MJ. The diagnostic accuracy of magnetic resonance cholangio pancreatography and ultrasound compared with direct cholangiography in the detection of choledocholithiasis. Clin Radiol., 1999; 54: 604–614.
3. Lygidakis, NJ. Incidence of bile infection in patients with choledocholithiasis. Am J Gastroenterol., 1982; 77: 12–17.
4. Leung JW, Sung JY and Costerton JW. Bacteriological and electron microscopy examination of brown pigment stones. J Clin Microbiol., 1989; 27: 915–921.
5. Leung JW, Liu YL, Leung PS, Chan RC, Inciardi JF and Cheng AF. Expression of bacterial beta-gluconidase in human bile: an in-vitro study. Gastrointest Endosc., 2001; 54: 346–350.
6. Bernhoft RA, Pellegrini CA and Motson RW et al. Composition and morphologic and clinical features of common duct stones. Am J Surg., 1984; 148: 77–84.
7. Taylor TV and Armstrong CP. Migration of gallstones. Br Med J., 1987; 294: 1320–1322.
8. Bilbao MK, Dotter CT, Lee TG, et al. Complications of ERCP; a study of 10 000 cases. Gastroenterology., 1986; 70: 314-320.
9. Sheridan MB. Endoscopic retrograde cholangio pancreatography should no longer be used as a diagnostic test: the case in favour. Digestive & Liver Disease., 2002; l 34: 370-374.
10. Hurter D, Vries CD, Potgieter PH, Barry R, Botha FJ, Joubert G. Accuracy of MRCP compared with ERCP in the diagnosis of bile duct disorders. SA J of Radiology., 2008; 4(14): 14-22.
11. Kaltenthaler E, Bravo Vergel Y, Chilcott J, Thomas S, Blakeborough A, Walters SJ, Bouchier H. A systematic review and economic evaluation of magnetic resonance cholangio pancreatography compared with diagnostic endoscopic retrograde cholangiopancreatography. Health Technology Assessment., 2004; 8: 101-102.
12. Topal B, van de Moortel M, Fieuws S, van Beckevoort D, van Steenbergen W, Aerts R, et al. The value of magnetic resonance cholangiopancreatography in predicting common bile duct stones in patients with gallstone disease. Br J Surg., 2003; 90: 42–47.
13. Varghese JC, Liddell RP, Farrell MA, Murray FE, Osborne DH and Lee MJ. The diagnostic accuracy of magnetic resonance cholangio pancreatography and ultrasound compared with direct cholangiography in the detection of choledocholithiasis. Clin Radiol., 1999; 54: 604–614.
14. Lygidakis, NJ. Incidence of bile infection in patients with choledocholithiasis. Am J Gastroenterol., 1982; 77: 12–17.
15. Leung JW, Sung JY and Costerton JW. Bacteriological and electron microscopy examination of brown pigment stones. J Clin Microbiol., 1989; 27: 915–921.
16. Leung JW, Liu YL, Leung PS, Chan RC, Inciardi JF and Cheng AF. Expression of bacterial beta-gluconidase in human bile: an in-vitro study. Gastrointest Endosc., 2001; 54: 346–350.
17. Bernhoft RA, Pellegrini CA and Motson RW et al. Composition and morphologic and clinical features of common duct stones. Am J Surg., 1984; 148: 77–84.
18. Taylor TV and Armstrong CP. Migration of gallstones. Br Med J., 1987; 294: 1320–1322.
19. Bilbao MK, Dotter CT, Lee TG, et al. Complications of ERCP; a study of 10 000 cases. Gastroenterology., 1986; 70: 314-320.
20. Sheridan MB. Endoscopic retrograde cholangio pancreatography should no longer be used as a diagnostic test: the case in favour. Digestive & Liver Disease., 2002; l(34): 370-374.
21. Coakley FV, Qayyum A. Magnetic- resonance-cholangio pancreatography. Gastrointestinal Endoscopy., 2002; 55(7 Suppl): S2-12.
22. Kaltenthaler E, Bravo Vergel Y, Chilcott J, Thomas S, Blakeborough A, Walters SJ, Bouchier H. A systematic review and economic evaluation of magnetic resonance cholangio pancreatography compared with diagnostic endoscopic retrograde cholangiopancreatography. Health Technology Assessment., 2004, 8: 101-102.
23. Baron RL, Stanley R J, Lee JKT, Koehler RE and Lewitt RG. Computed tomography of biliary obstruction. AJR., 1983; 140: 1173.