

Prospective evaluation of magnetic resonance cholangiography in patients with suspected common bile duct stones before laparoscopic cholecystectomy

Zhong-Wei Ke, Cheng-Zhu Zheng, Ji-Hui Li, Kai Yin and Ji-De Hua
Shanghai, China

OBJECTIVE: To evaluate the predictive value of magnetic resonance cholangiography (MRC) in selected patients before laparoscopic cholecystectomy (LC).

METHODS: Patients with risk factors for common bile duct (CBD) stones scheduled for elective LC from March 1999 to May 2001, underwent MRC followed by endoscopic retrograde cholangiography (ERC) to detect the stones and the accuracy of MRC. Selection of suspected patients was based on clinical, ultrasonographic, and laboratory criteria.

RESULTS: During a 26-month period, a total of 267 patients were studied. Seventy-eight MRC identified patients were found to have CBD stones by ERC or laparoscopic cholangiography in the study. Seven of 78 patients were misdiagnosed as having CBD stones by MRC. In this study, MRC had a sensitivity of 100%, a specificity of 96.3%, a positive predictive value of 91.8%, and a negative predictive value of 100% for the detection of common bile duct stones.

CONCLUSIONS: With the use of LC, ERC is frequently performed before LC to detect CBD stones; but it is invasive with a well-documented complication rate. MRC is a simple non-invasive method for preoperative screening for CBD stones in at-risk patients. In this study if ERC had been limited to patients with a positive MRC, it would have reduced the need for ERC by 68.2%, and the complications of preoperative examination would be minimized significantly.

(*HBDP Int* 2003; 2: 576–580)

Key words: laparoscopy; cholecystectomy; cholelithiasis; magnetic resonance cholangiography; endoscopic retrograde cholangiography

Introduction

The incidence of choledocholithiasis ranges from 8% to 20% in patients underwent cholecystectomy.^[1] The preoperative approach to the diagnosis and management of common bile duct (CBD)

stones in these patients varies significantly, depending on patient preference, expertise of surgical, endoscopic, radiologic personnel, and resource availability.

Definitive diagnosis of choledocholithiasis before laparoscopic cholecystectomy (LC) may provide surgeons with the opportunity to formulate an optimal treatment plan. Clinical, ultrasonographic, and serum chemistry parameters have a sensitivity of 96% to 98% but a low specificity for the identification of patients with CBD stones. With the advent of LC, the use of endoscopic retrograde cholangiography (ERC) to detect and clear CBD stones

From the Department of General Surgery, Changhai Hospital, Second Military Medical University, Shanghai 200433, China (Ke ZW, Zheng CZ, Li JH, Yin K and Hua JD)
Correspondence: Zhong-Wei Ke, MD, Department of General Surgery, Changhai Hospital, Second Military Medical University, Shanghai 200433, China (Tel: 86-21-2507 4527; Fax: 86-21-25074527; Email: weiz6@hotmail.com)

before LC has been increased. But ERC is an invasive procedure with a well-documented complication rate of 0.8% to 10%,^[2] for pancreatitis, cholangitis, perforations, and bleeding. Despite its limitation to patients with risk factors for CBD stones, about one-third to three-fourths of patients may have unnecessary suffering of ERC before LC.^[3,4] Magnetic resonance cholangiography (MRC) is a simple non-invasive technique that requires no contrast and allows detection of biliary pathology with a high degree of sensitivity and specificity.^[5] This study was undertaken to determine the efficacy of MRC for diagnosing choledocholithiasis in patients at high risk for CBD stones.

Methods

From March 1999 to May 2001, 1832 patients were subjected to scheduled elective laparoscopic cholecystectomy. Routine preoperative evaluation for all patients included abdominal ultrasound for determination of cholelithiasis and estimation of CBD size, and serum chemistry determination of bilirubin, alkaline phosphatase, transaminase (AST/ALT), amylase and so on. Those with a history of previous jaundice, previous mild gallstone pancreatitis (acute abdominal pain and at least a four-fold increase in serum amylase activity), abnormal liver function test results (especially abnormal bilirubin result) or a dilated common bile duct (more than 8 mm) on ultrasonography were considered to be highly suspicious of choledocholithiasis.

Before the use of MRC at our hospital, the patients who were determined to have high risk factors for CBD stones underwent preoperative evaluation with ERC. During the period of study, those who were highly suspicious of CBD stones were evaluated with MRC simultaneously before LC. In all patients, 1565 had no risk factors for CBD stones. No patient in this group subsequently presented with symptomatic bile duct stones during the period of study (mean follow-up for 12 months). Risk factors for CBD stones were present in 267 patients, who underwent MRC and ERC as the part of this study. Those patients with jaundice, cholangitis or severe acute gallstone pancreatitis were

excluded and underwent early ERC. Those who had had emergency laparoscopic cholecystectomy were also excluded.

MRC scans were performed on a scanner using a T2-weighted Turbo Spin Echo sequence acquired with non-breath-holding in the coronal plane and interpreted by a group of radiologists. Neither intravenous nor oral contrast agents were administered. The total imaging time for MRC was about 5 minutes. All patients in this study group underwent MRC and ERC within 1 week; the ERC operator was unaware of the MRC result. The stones detected at ERC were cleared endoscopically. Patients with negative results of MRC and ERC or after sphincterotomy were subjected to LC.

At the end of this study, the results of MRC were compared with those of ERC for determination of the diagnostic accuracy of MRC. Statistical analysis was made by the χ^2 test. The sensitivity, specificity, and positive or negative predictive values of MRC were calculated.

Results

During a 26-month period, the 267 patients with risk factors for CBD stones were evaluated with MRC and ERC simultaneously before LC. In this group, 237 patients were female and 30 were male. Their age ranged from 21 to 76 years, with a mean age of 44.7 years.

MRC identified all patients, i.e. 78 patients, who were found to have CBD stones by ERC or laparoscopic cholangiography in the study group (Fig. 1). Seven patients were misdiagnosed as having CBD stones by MRC. The CBD stones identi-

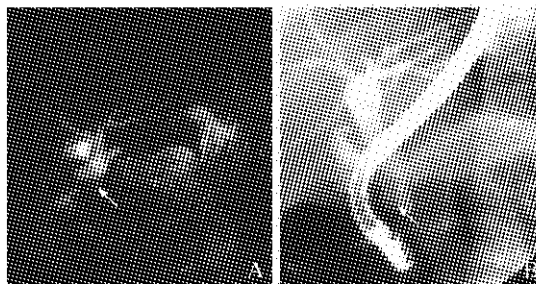
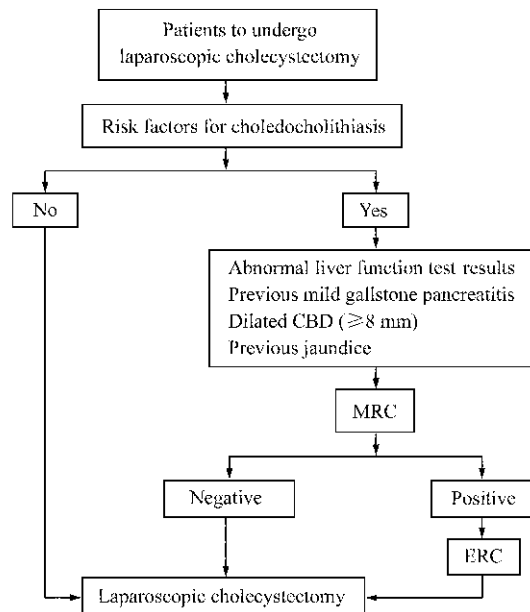


Fig. 1. A: MRC showing two small stones in the distal CBD (arrow); B: the corresponding ERC image.

Table. Comparison of MRC with ERC or laparoscopic cholangiography for the detection of CBD stones

| MRC | ERC or laparoscopic cholangiography | | |
|----------|-------------------------------------|----------|-------|
| | Positive | Negative | Total |
| Positive | 78 | 7 | 85 |
| Negative | 0 | 182 | 182 |
| Total | 78 | 189 | 267 |

**Fig. 2.** Algorithm for the detection of CBD stones before LC.

ified by MRC ranged in size from 2 to 18 mm in diameter. Seventy patients with CBD stones detected by MRC underwent ERC before LC and cleared endoscopically through sphincterotomy. ERC was unsuccessful in the remaining 8 patients who subsequently received laparoscopic choledocholithotomy without complication, confirming the imaging of MRC.

This study showed 182 true-negative, 78 true-positive, 7 false-positive, and 0 false-negative cases. The sensitivity of MRC was 100%, specificity 96.3%, positive predictive value 91.8%, and negative predictive value 100% for the detection of CBD stones (Table).

In all 267 patients, ERC procedures were performed. Nineteen patients (7.1%) had procedure-

related complications: cholangitis (11 patients), pancreatitis (7), and papillary bleeding (1). If ERC was limited to patients with a positive MRC, the number of those patients who need ERC would have been decreased from 267 to 85 ($P < 0.001$). In other words, 68.2% patients (182/267) in this group could be away from ERC and its distress. Hence the change of our clinical algorithm (Fig. 2) resulted in a significant reduction of preoperative ERC and its potential complications.

Discussion

In laparoscopic surgery, the optimal approach to the management of patients with CBD stones and choledocholithiasis remains controversial. One of the factors leading to this controversy is the lack of an accurate, noninvasive method for the diagnosis of choledocholithiasis before LC. Selective cholangiography in cholecystectomy has shown to be safe in open cholecystectomy. For patients with risk factors for CBD stones, cholangiography is performed and if stones are found, bile duct exploration and stone clearance are carried out. The introduction of laparoscopic cholecystectomy has led to decreased use of cholangiography, and laparoscopic bile duct exploration is limited to a few specialized centers. Risk factors for choledocholithiasis are well recognized and there is a tendency to identification of CBD stones before operation. Non-invasive imaging techniques such as ultrasound (US) or computed tomography (CT) are widely used for the diagnosis and monitoring of many pancreatic and biliary diseases. However, these techniques have limitations such as the low sensitivity of ultrasound for detecting common duct calculi, indicating that the diagnosis of several common conditions including tumours (benign and malignant), calculi, sclerosing cholangitis and chronic pancreatitis may still require invasive procedures including ERC or percutaneous transhepatic cholangiography (PTC).^[6,7] ERC is accepted as the gold standard for bile duct imaging and has the advantage of permitting the bile duct to be cleared of stones. However, it is an invasive technique with a reported

mortality rate of up to 10% (7.1% in our study), even performed by experienced hands. Ideally its use should be restricted to therapeutic procedures alone.

An alternative approach is to establish the diagnosis of CBD stones at the time of operation with contrast cholangiography, and the CBD stones can be resolved by laparoscopic, open CBD exploration, or postoperative ERC. Intraoperative cholangiography (IOC) has a false-positive rate of 2% to 16%, which can lead to unnecessary CBD explorations. Furthermore, cholangiography may be unobtainable in 5% to 45% of cases in laparoscopic operation, because of the impacted stone in the cystic ampullae or/and cystic duct, and the atrophic gallbladder. Therefore, there is a need for a less invasive, safe, and highly sensitive diagnostic procedure for patients with suspected CBD stones.

The approach we have adapted in our practice is still to diagnose and manage CBD stones before LC. This approach (MRC) has been used to accommodate the high volume of operative caseloads, limited operative time, and the large number of patients with suspected choledocholithiasis encountered at our hospital. With the addition of MRC as a screening modality for patient selection for ERC, there has been a significant reduction in the number of ERC performed for diagnostic purposes, and the management of patients with suspected choledocholithiasis has been greatly expedited.

MRC is a non-invasive imaging technique that does not require the use of X-ray or contrast media. It utilizes T2-weighted pulse sequences, which provide a high degree of contrast between stationary fluids such as bile, solid organs and blood. It is performed on an outpatient basis without any special patient preparation. MRC has been shown to demonstrate normal and variant biliary anatomy accurately as well as benign and malignant causes of bile duct obstruction. Other studies have previously shown a sensitivity and specificity of 95%–100% in the detection of CBD stones.^[8–10] However, these studies have not looked specifically at its use in the clinical scenario of patients before laparoscopic cholecystectomy.

The present study demonstrates that, in pa-

tients with risk factors, MRC is an accurate imaging technique for the detection of CBD stones before LC. MRC performed in this setting provides valuable information regarding the presence or absence of CBD stones, as well as the size of CBD stones if present. Moreover, the information obtained from MRC can be utilized to select for patients who would benefit from preoperative ERC.^[11–13] Using the information, 68.2% patients (182/267) in our group could be away from ERC and its distress, so we have developed a modified algorithm (Fig. 2). The selective use of MRC based on the proposed algorithm will improve utilization of this imaging modality, while minimizing the need for non-therapeutic ERC and its complications.

Competing interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References

- 1 Liu TH, Consorti ET, Kawashima A, et al. The efficacy of magnetic resonance cholangiography for the evaluation of patients with suspected choledocholithiasis before laparoscopic cholecystectomy. *Am J Surg* 1999;178:480–484.
- 2 Aliperti G. Complications related to diagnostic and therapeutic endoscopic retrograde cholangiopancreatography. *Gastrointest Endosc Clin North Am* 1996;6:379–407.
- 3 Widdison AL, Longstaff AJ, Armstrong CP. Combined laparoscopic and endoscopic treatment of gallstones and bile duct stones: a prospective study. *Br J Surg* 1994;81:595–597.
- 4 Dwerryhouse SJ, Brown E, Vipond MN. Prospective evaluation of magnetic resonance cholangiography to detect common bile duct stones before laparoscopic cholecystectomy. *Br J Surg* 1998;85:1364–1366.
- 5 Bearcroft PW, Lomas DJ. Magnetic resonance cholangiopancreatography. *Gut* 1997;41:135–137.
- 6 Fulcher AS, Turner MA, Zfass AM. Magnetic resonance cholangiopancreatography: a new technique for evaluating the biliary tract and pancreatic duct. *Gastroenterologist* 1998;6:82–87.
- 7 Park MS, Yu JS, Kim YH, et al. Acute cholecystitis;

- comparison of MR cholangiography and US. *Radiology* 1998;209:781–785.
- 8 Liu TH, Consorti ET, Kawashima A, et al. Patient evaluation and management with selective use of magnetic resonance cholangiography and endoscopic retrograde cholangiopancreatography before laparoscopic cholecystectomy. *Ann Surg* 2001;234:33–40.
- 9 Cervantes J, Rojas G. Choledocholithiasis: new approach to an old problem. *World J Surg* 2001;25:1270–1272.
- 10 Boraschi P, Gigoni R, Braccini G, et al. Detection of common bile duct stones before laparoscopic cholecystectomy: evaluation with MR cholangiography. *Acta Radiol* 2002;43:593–598.
- 11 Li JH, Zheng CZ, Ke ZW, et al. Management of aberrant bile duct during laparoscopic cholecystectomy. *HBPD Int* 2002;1:438–441.
- 12 Kats J, Kraai M, Dijkstra AJ, et al. Magnetic resonance cholangiopancreatography as a diagnostic tool for common bile duct stones: a comparison with ERCP and clinical follow-up. *Dig Surg* 2003;20:32–37.
- 13 Topal B, Van de Moortel M, Fieuws S, 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.

Received May 30, 2003

Accepted after revision September 3, 2003

The great tragedy of Science—the slaying of a beautiful hypothesis by an ugly fact.

—T. H. Huxley