



Utility of MRCP in clinical decision making of suspected choledocholithiasis: An institutional analysis and literature review



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ABSTRACT

Background: The ideal treatment algorithm for suspected choledocholithiasis is not yet well defined. Imaging options include magnetic resonance cholangiopancreatography (MRCP), endoscopic retrograde cholangiopancreatography (ERCP), and intraoperative cholangiogram (IOC). MRCP is diagnostic, while the other two modalities can also be therapeutic. Each of these modalities for diagnosis and treatment carries its own set of risks, benefits, and institutional costs. We hypothesized that there would be a significant difference between the biochemical profiles and characteristics of patients who undergo ERCP vs. MRCP vs. operative intervention as the initial choice of treatment/imaging modality.

Methods: We performed a retrospective review of the electronic medical records for all patients with a coded diagnosis of choledocholithiasis from 2011 to 2014. The initial diagnostic modality was assessed for each hospital encounter. The statistical characteristics of MRCP as compared to fluoroscopic imaging of the biliary tree (ERCP, IOC) were analyzed.

Results: Overall, 527 hospital encounters were identified. Initial intervention included ERCP in 63%, MRCP in 12%, and cholecystectomy in 25% of patients. Patients undergoing cholecystectomy first, compared to MRCP or ERCP, tended to have lower values for alkaline phosphatase ($P < 0.001$) and AST ($P = 0.002$) as well as be of younger age ($P < 0.0001$). Of the patients that underwent MRCP as their initial procedure, 82% subsequently underwent either ERCP or laparoscopic cholecystectomy. In patients who underwent an initial MRCP followed by either ERCP or IOC, the predictive performance of MRCP was as follows: sensitivity = 0.90, specificity = 0.86, positive predictive value = 0.97, negative predictive value = 0.60, agreement (Cohen's Kappa) = 0.64.

Conclusions: There is a significant difference in the laboratory evaluation and demographics of patients undergoing ERCP, MRCP, and laparoscopic cholecystectomy. MRCP was followed with a more invasive test a majority of the time. Since MRCP did not change the management of patients with suspected choledocholithiasis, its utility in this patient population should be questioned. Further research is needed to better define the pretest characteristics which would predict which patients do not need further intervention after MRCP as well as defining the most cost-effective strategy.

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1. Introduction

Cholelithiasis constitutes one of the most common problems presented to the general surgeon. Given that 10–15% of adults will have stones present, 20–25 million Americans will have gallstones. It is estimated that 750,000 cholecystectomies will be performed

annually in the United States.^{1,2} Approximately 500,000 ERCPs are performed annually with a large proportion of those having concerns for choledocholithiasis.³ Not surprisingly, the number of surgical common bile duct explorations has been declining, from 25,984 in 1997 to 9518 in 2007.⁴

Given this magnitude of stone disease, there is ongoing debate as to the appropriate initial management of suspected choledocholithiasis. Options for initial management include proceeding directly to the operating room for laparoscopic cholecystectomy and intraoperative cholangiogram (IOC) with clearance of the

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common bile duct, preoperative imaging and intervention with endoscopic retrograde cholangiopancreatography (ERCP), or preoperative magnetic resonance cholangiopancreatography (MRCP). MRCP allows for imaging of the biliary tree at the expense of cost and an ability to intervene. However, it does save the patient exposure to ionizing radiation and obviates the need for two procedures with associated risks and costs.

The purpose of our study was to observe the pre-procedural patient and biochemical characteristics of those individuals being evaluate for suspected choledocholithiasis at our institution. We observed the associations of these characteristics with the initial choice of intervention or imaging. We aimed to determine the sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) of MRCP as compared to the gold standard of a fluoroscopic imaging study – either ERCP or IOC.

2. Methods

Our organization is an integrated multi-specialty health system with a 325-bed community center serving 19 counties over a 3 state region. Following IRB approval, a retrospective review of the electronic medical records for all patients admitted with a diagnosis of choledocholithiasis between 2011 and 2014 was performed. Diagnostic imaging modalities were evaluated. Electronic medical records were examined for patients who underwent both MRCP and a fluoroscopic imaging of their biliary tree, either ERCP or IOC, for suspected choledocholithiasis during the same patient encounter, defined as occurring within 30 days of one another. The demographic information, biochemical characteristics, and common bile duct (CBD) diameter on right upper quadrant ultrasound (RUQ US) were reviewed.

Individual MRCP, ERCP and IOC results, as well as operative reports were evaluated. MRCP was considered to be positive if the radiologist mentioned the presence of a stone or if there was suggestion of a stone during the impressions of the read. ERCP was considered positive if the presence of a stone was mentioned in the attending gastroenterologist procedure note or the radiologist review. IOC was considered positive if the operative note or the radiologist report determined a stone to be present.

ERCP was performed by an attending gastroenterologist with a side viewing Olympus scope (Center Valley, PA). All ERCPs were performed under general anesthesia. MRCP at our institution is performed either on a 1.5 or 3 T GE MRI. Heavily T2 weighted, non-contrast scan with multiplanar images as well as 3D reconstruction of those images were obtained. Images were interpreted by an attending radiologist.

Standard descriptive statistics, including frequencies, medians, means and standard deviations were calculated. Comparisons between groups utilized standard non-parametric statistical tests, including chi-square or Fisher's exact test for categorical comparisons and Wilcoxon Rank Sum or Kruskal-Wallis tests for comparison of ordinal data. Classification performance was assessed through calculation of sensitivity/specificity, predictive values and agreement (Cohen's kappa). SAS version 9.3 was utilized for all calculations. A P value < 0.05 was considered significant for all comparisons.

3. Results

We identified 527 patients undergoing evaluation for suspected choledocholithiasis during the study period. Of these, 322 (61%) were female. Of the 527 patients, 63% ($n = 333$) underwent initial ERCP while 12% and 25% underwent MRCP and laparoscopic cholecystectomy/IOC respectively (Fig. 1). The demographic, laboratory and RUQ US characteristics of the patients stratified to each

treatment or imaging modality listed above were then analyzed.

Patients who underwent ERCP or MRCP tended to be older than patients who proceeded directly to surgery ($P < 0.001$). Additionally, patients who proceeded directly to surgery tended to have lower alkaline phosphatase, aspartate aminotransferase (AST), and total bilirubin values, however; only total bilirubin was significantly associated with the initial procedure performed ($P < 0.0001$). CBD diameter was also significantly associated with the initial procedure ($P = 0.036$) with more patients with a greater diameter found in the initial MRCP/ERCP group compared to the surgery group (Table 1). Median and mean length of stay were not significantly associated with the initial intervention.

Fifty-one patients underwent both MRCP and a fluoroscopic study of the biliary tree (either IOC or ERCP). Four patients were excluded for missing or incomplete results. Of those patients who underwent initial MRCP followed with fluoroscopic study, we found the sensitivity of MRCP to be 90% and specificity to be 86% (Table 2). Additionally, only eleven patients of the 58 (19.0%) included in the analysis did not undergo a fluoroscopic study (ERCP/IOC) after their initial MRCP. These eleven patient charts were individually reviewed. Eight of these patients (73%) were found to have no stones on their initial MRCP. One patient underwent percutaneous cholecystectomy tube placement in interventional radiology. One additional patient declined ERCP as they were currently receiving palliative care, and one patient had an ERCP not captured within the 30-day window. These individual clinical courses are summarized in Table 4.

4. Discussion

It has been suggested that if the pretest probability of choledocholithiasis is sufficiently low (<10%), laparoscopic cholecystectomy with intraoperative cholangiogram is the most cost-effective strategy.^{8,24,28} As the pretest probability increases, MRCP and ERCP may become the more effective intervention.²⁴ Interestingly, two recent studies published simultaneously came to diverging conclusions on the effect of MRCP vs ERCP vs initial laparoscopic cholecystectomy with regards to patient length of stay and cost.^{25,26}

Lin et al. performed a retrospective analysis of 126 patients undergoing treatment for suspected choledocholithiasis.²⁶ This was defined in their study as patients presenting with a dilated CBD (>6 mm + 1 mm per decade above 60 years of age), elevated bilirubin, or had choledocholithiasis observed on imaging or invasive studies. They found that patients who underwent initial cholecystectomy with IOC had an average length of stay of 3.9 days compared to 7.0 days and 6.48 days for those undergoing preoperative ERCP and MRCP, respectively.

Conversely, Ward et al. also evaluated the use of MRCP in patients with suspected choledocholithiasis.²⁵ The authors evaluated 107 patients who underwent MRCP with suspicion for choledocholithiasis. They found that the length of stay was unchanged in patients who underwent an MRCP only (mean = 4.1 days), ERCP only (mean = 4.2 days), and both MRCP and ERCP (mean = 3.4 days). Based on confounding literature we chose to evaluate the role that MRCP had on clinical decision making in our institution.

A PubMed Search for English language, peer reviewed literature using the terms "sensitivity, specificity, ERCP, MRCP" was performed. Seventeen series were reviewed for their statistical characteristics as reviewed in Table 3.^{5–23} There was a large range in the sensitivity and specificity of MRCP when compared to ERCP or IOC with the majority of studies showing values of 80–97% for both. This is in accordance with our calculated sensitivity and specificity of 90% and 86%, respectively. To our knowledge, this is the largest review of the literature for the statistical characteristics of MRCP as

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