Comparison of Magnetic Resonance and Endoscopic Retrograde Cholangiopancreatography in Malignant Pancreaticobiliary Obstruction

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Hypothesis: We hypothesize that magnetic resonance cholangiopancreatography (MRCP) is comparable to endoscopic retrograde cholangiopancreatographic (ERCP) as a diagnostic tool in patients with malignant biliary obstruction.

Design: Eighteen patients with suspected pancreaticobiliary malignancy were evaluated by ERCP and MRCP in 8 months (March 1, 1996, to October 31, 1996). Magnetic resonance cholangiopancreatography was performed with a 1.5-T scanner using 4-mm slices. Images were obtained in a 14- to 28-second breath-hold. Images from MRCP were retrospectively evaluated by a radiologist for image quality, ductal dilation, level of obstruction, and overall diagnostic impression. Images from ERCP were retrospectively evaluated by a biliary endoscopist (L.H.S.) and served as the standard for calculating sensitivity, specificity, and positive predictive values. In addition, intraoperative findings were compared with MRCP results in all patients explored.

Results: Diagnostic-quality MR images were obtained in 18 patients (100%). Diagnostic-quality endoscopic images were obtained in 16 (89%) of 18 attempted biliary cannulations and 11 (78%) of 14 attempted pancreatic cannulations. Magnetic resonance CP accurately delineated the level of extrahepatic biliary ductal obstruction in 13 (87%) of 15 patients. More important, MRCP provided valuable staging information in most patients. Findings from MRCP correlated with operative findings (size and location of tumor and mesenteric vascular involvement) in 8 (80%) of 10 patients who underwent surgery, while failing in 2 patients (20%) with carcinomatosis.

Conclusions: Magnetic resonance CP is a sensitive study for detecting the presence and level of biliary ductal obstruction in patients with cancer. The results are comparable to those of ERCP; however, MRCP provides additional data regarding extent of disease that is not available from ERCP alone.

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After its introduction in the 1970s, endoscopic retrograde cholangiopancreatography (ERCP) revolutionized the diagnosis and management of pancreaticobiliary diseases. It remains the gold standard imaging study for visualizing the pancreatic and distal bile ducts. Conversely, ERCP is an invasive, often difficult, operator-dependent procedure that is associated with relatively frequent complications (≤5%). In addition, ERCP provides little if any information regarding the extent of disease, a critical consideration in planning therapy for patients with cancer. To obtain such information, ERCP must be combined with other imaging studies, usually abdominal computed tomographic scanning.

Surgery remains the primary therapy for nearly all pancreaticobiliary cancers. The resectability of these tumors has been notoriously low, however, resulting in many unnecessary explorations. Although laparoscopy has had a major impact in allowing more accurate staging and identification of unresectable disease with less morbidity, patients are not spared the potential risks of general anesthesia and a highly invasive procedure. Noninvasive preoperative imaging that more accurately determines the extent of disease would represent a significant advance.

See Invited Critique at end of article

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PATIENTS AND METHODS

PATIENTS

The study group comprised 18 patients—7 men and 11 women with a mean age of 66 years (age range, 42-77 years) —with suspected primary or secondary tumors of the distal bile duct or periampullary region seen in 8 months (March 1, 1996, to October 31, 1996). All patients had been evaluated previously with ERCP and subsequently underwent MRCP. Data were collected retrospectively. Malignant obstruction was confirmed by histological examination in 15 (83%) of 18 patients. Two patients with suspected pancreatic cancer had unequivocal radiographic evidence of unresectability, but needle biopsy examination results did not initially confirm the diagnosis. Another patient with an apparent gallbladder carcinoma refused further intervention. Final diagnoses are listed in Table 1.

MRCP TECHNIQUE

Magnetic resonance cholangiopancreatography (MRCP) is a relatively new, noninvasive, non–operator-dependent imaging technique for evaluating pancreaticobiliary diseases. Projectional images similar to direct cholangiograms or pancreatograms are obtained without the use of contrast. In addition to high-quality images of the biliary and pancreatic ducts, MRCP can provide important diagnostic information regarding tumor size and character (solid vs cystic), vascular invasion, or metastatic disease. Since first reported in 1991, modifications in fast MR techniques have improved image quality and have demonstrated high sensitivity and specificity for evaluating a variety of diseases. Whether MRCP will supplant standard imaging studies in patients with malignant biliary obstruction remains an open question.

RESULTS

IMAGE QUALITY

Diagnostic-quality MRCP images were obtained in all 18 patients. In 16 (89%) of 18 patients, ERCP provided adequate cholangiograms but failed in 2 patients (11%) because of difficulty cannulating the bile duct. Successful cannulation and imaging of the pancreatic duct was achieved in 11 (78%) of 14 patients. Three patients were considered technical failures (pancreatic duct could not be cannulated), and cannulation was not attempted in 4 patients. Two ERCP-related complications—pancreatitis (1 patient) and retroperitoneal duodenal perforation (1 patient)—were resolved completely with medical therapy.

Table 1. Summary of Patient Diagnoses

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Patients, No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreatic cancer</td>
<td>5</td>
</tr>
<tr>
<td>Ductal adenocarcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Mucinous carcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Cystadenocarcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Gallbladder carcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Hepatocellular cancer</td>
<td>2</td>
</tr>
<tr>
<td>Hilar cholangiocarcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Ampullary carcinoma</td>
<td>1</td>
</tr>
<tr>
<td>Metastatic cancer</td>
<td>2</td>
</tr>
<tr>
<td>Liposarcoma</td>
<td>1</td>
</tr>
<tr>
<td>Adenocarcinoma of the lung</td>
<td>1</td>
</tr>
<tr>
<td>Transitional cell</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
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Figure 1. A. Endoscopic cholangiogram demonstrating extrinsic compression of the distal common bile duct. The pancreatic duct could not be visualized. B. Magnetic resonance cholangiopancreatogram in the same patient revealed a cystic neoplasm in the head of the pancreas, causing biliary obstruction (small white arrow). A dilated pancreatic duct (small black arrow) and a dilated gallbladder (large white arrow) are also shown.

Figure 2. A. Endoscopic cholangiogram showing a distal common bile duct stricture (arrow). No pancreatogram was obtained. B. Magnetic resonance cholangiopancreatogram in the same patient identifying a mass in the pancreatic head (large white arrow) causing biliary (small black arrow) and pancreatic (large black arrow) ductal obstruction (“double duct sign”). A dilated gallbladder is also shown (small white arrow).

Figure 3. A. Endoscopic retrograde cholangiopancreatogram showing a dilated common bile duct consistent with previous cholecystectomy and a normal pancreatic duct. Slight evidence of an incompletely filled right posterior sectorial hepatic duct (arrow). B. Sagittal magnetic resonance cholangiopancreatographic (MRCP) reconstruction in the same patient revealing a right hepatic lobe mass (small arrow) compressing the right posterior sectorial hepatic duct (large arrow). C. A more anterior MRCP reconstruction further defining the relationship between the mass (large arrow), the right posterior sectorial hepatic duct (small arrow), and the main right hepatic duct (immediately to the left of the tumor).
DUCTAL DILATION

Images from MRCP had slight evidence of pancreatic ductal dilation in 5 patients, 2 of which were thought to be of normal caliber on ERCP (100% sensitivity, 75% specificity, and 60% positive predictive value). In 3 patients who failed endoscopic pancreatography, MRCP demonstrated not only pancreatic ductal dilation but also the underlying cause (Figure 1 and Figure 2). Images from MRCP diagnosed intrahepatic biliary ductal dilation in 14 patients; ERCP confirmed 12 of these (100% sensitivity, 50% specificity, and 77% positive predictive value). In 10 patients, MRCP correctly identified extrahepatic biliary ductal dilation but misdiagnosed 3 of 6 patients with nondilated ducts (100% sensitivity, 50% specificity, and 77% positive predictive value). By contrast, MRCP identified a periampullary mass causing biliary ductal obstruction in 2 patients who failed endoscopic cholangiography. In a third patient with hepatocellular cancer, MRCP demonstrated a mass as the cause of right posterior sectorial hepatic duct obstruction (Figure 3). Also, in 1 patient without ductal dilation on ERCP, MRCP revealed a mass in the uncinate process of the pancreas.

LEVEL OF OBSTRUCTION

Two patients had obstruction of the proximal bile ducts. In 13 (87%) of 15 patients, MRCP correctly identified the level of biliary ductal obstruction compared with ERCP findings: 12 (92%) of 13 patients with mid-distal obstruction (92% sensitivity, 67% specificity, and 92% positive predictive value) and 1 (50%) of 2 with proximal obstruction (50% sensitivity, 100% specificity, and 100% positive predictive value).

EXTENT OF DISEASE AND ASSESSMENT OF RESECTABILITY

Correlation of MRCP results with operative findings was possible in 10 patients (Table 2), 3 of whom had clearly unresectable disease but underwent palliative procedures. Seven patients had apparently resectable tumors: 5 subsequently underwent complete resection and 2 had carcinomatosis and therefore did not undergo resection. Overall, MRCP correctly predicted

Table 2. Disposition of 18 Patients Based on Preoperative Investigations

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Patients, No.</th>
<th>Finding</th>
<th>Patients, No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palliative</td>
<td>3</td>
<td>Superior mesenteric artery/portal vein encasement</td>
<td>3</td>
</tr>
<tr>
<td>Curative</td>
<td>5</td>
<td>Metastatic disease</td>
<td>4</td>
</tr>
<tr>
<td>Complete resections</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unresectable</td>
<td></td>
<td>Refused surgery</td>
<td>1</td>
</tr>
<tr>
<td>(carcinomatosis)</td>
<td></td>
<td></td>
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Figure 4. Magnetic resonance cholangiopancreatogram showing pancreatic adenocarcinoma clear of (A and B) and invading (C and D) the mesenteric vessels. A, Gadolinium-enhanced T1-weighted image showing a pancreatic tumor (small arrow) and a clear, uninvolved tissue plane around the adjacent superior mesenteric vein and artery (large arrow). B, T2-weighted image at the same level again showing the mass (white arrow) clear of the superior mesenteric artery and vein (black arrow). C, T2-weighted image demonstrating the tumor (small arrow) encasing the superior mesenteric artery (large arrow). D, Gadolinium-enhanced T1-weighted image at the same level again showing tumor encasement of the superior mesenteric artery (arrow).
therapy. Assessment for regional lymph nodal and dis-
sectability should be the primary initial objective because re-
complete resection remains the only potentially curative

In pancreaticobiliary cancers, as in all patients with cancer, ac-
turate disease staging is essential for planning therapy. In

All study patients had either primary or secondary pan-
resectable disease preoperatively. Other factors, such as
morbidly to the patient, need for additional studies, and
cost must also be considered.

As an emerging technique for imaging the biliary and
pancreatic ducts, MRCP must be critically evaluated be-
before standard diagnostic studies are abandoned. Direct
comparison of MRCP to established diagnostic methods
is an important initial step in this process. Correlation
of MRCP results with intraoperative findings, however,
will ultimately determine its value.

Results of this study confirm the ability of MRCP
to detect biliary and pancreatic ductal dilation with great
sensitivity, show that the overall diagnostic impression
based on MRCP correlate closely with that of ERCP, and
demonstrate the capacity of MRCP to assess disease ex-
tent. Ten patients were predicted to have unresectable
disease, which was confirmed at surgery in 3 and by needle
biopsy examination in 5. Seven patients were predicted
to have resectable tumors; 5 underwent complete resec-
tion. Furthermore, MRCP provided accurate informa-
tion regarding the extent of vascular involvement in 5
of 6 patients, failing to detect portal vein adherence in
only 1. In 8 of 10 patients who underwent surgery, MRCP
correctly predicted the extent of disease. Two cases of
carcinomatosis, notoriously difficult to detect before sur-
gery, were missed. Previous studies of MRCP, al-
though documenting the sensitivity of detecting biliary
and pancreatic ductal dilation, have not correlated the
results to intraoperative findings.


Thus, MRCP combines accurate images of the bili-
ary and pancreatic ducts and adjacent extraductal struc-
tures. The implications are clear. First, many patients
might avoid ERCP and its associated morbidity—not only
procedure-related complications but also postsurgical
complications related to contaminated bile. There is now
substantial evidence that preoperative biliary intuba-
tion does not improve outcome after surgery, and actu-
ally increases the incidence of bile contamination and
postoperative complications. Many of these stents are
placed to prevent cholangitis after injecting contrast above
a stenotic bile duct, a practice that MRCP may substan-
tially reduce. Second, MRCP, as a single study, may pro-
vide all the necessary diagnostic and staging informa-
tion, sparing patients from undergoing multiple studies.

This study demonstrates the great potential of MRCP
and suggests that it will likely evolve into the study-of-
choice in evaluating patients with pancreaticobiliary ma-
lignancies. However, the small number of patients in this
study and others prevents a definitive statement to this
effect. A large, prospective study comparing MRCP with
standard imaging (ERCP plus computed tomographic scan-
ing), with correlation of both to operative find-
ings, is required. Certainly, MRCP cannot replace the
therapeutic applications offered by direct cholangiogra-
phy. However, by demonstrating unresectable disease and
the level of biliary obstruction, MRCP may help direct
the appropriate intervention (endoscopic vs percuta-
neous biliary intubation).

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In the past 3½ decades we have witnessed the introduction of multiple new imaging techniques: endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography, transcutaneous ultrasonography, computed tomography (CT), and, most recently, endoscopic ultrasonography and magnetic resonance cholangiopancreatography (MRCP). All techniques have their proponents, and each has inherent advantages and limitations. Currently, there seems to be no universally accepted consensus on the imaging procedure-of-choice in patients with presumed or suspected mechanical biliary obstruction, as either a diagnostic or a staging procedure.

Georgopoulos and colleagues from Memorial Sloan-Kettering Cancer Center, New York, NY, suggest that MRCP might be the optimal diagnostic test (ie, the safest test, with high sensitivity, specificity, and positive predictive value) and should replace ERCP—and I believe they are correct, although this study does not prove it. Results of their preliminary study (only 18 patients) suggest that the noninvasive MRCP is as accurate as the invasive ERCP. This study, however, has several limitations that I am certain the authors would acknowledge. First, small numbers and a wide spectrum of sites of extrahepatic biliary obstruction limit definitive conclusions. Second, there is no comparison with CT (as a diagnostic procedure), which begs the question of whether MRCP was even necessary (if the CT showed a mass and the proximal [hepatic] extent of resection).

These criticisms aside, this study and several recent others address the use of MRCP for diagnosis of various pancreatobiliary disorders. What should we conclude? MRCP may well replace diagnostic (but not therapeutic) ERCP in patients with suspected mechanical disorders of the pancreaticobiliary ductal systems—the driving forces are both accuracy (roughly equivalent) and safety (noninvasiveness). Cost and availability are other aspects that will need to be addressed.

Results of this study also attempt to suggest (indirectly) that MRCP adds data important for “staging” local vascular involvement, etc. However, this study, rightfully so with so few patients, does not and cannot pursue this topic. A better study addressing staging is that by Trede and colleagues, who believe that MR is superior to CT in staging pancreatobiliary neoplasms. Further studies with a direct comparison of MR and MRCP with CT (the current gold standard) will be necessary to answer this challenge.

Concerning diagnosis and staging, we as surgeons need to maintain both an open mind and a malleable approach to the evaluation of patients with jaundice; CT, MRCP, staging laparoscopy, and peritoneal cytology all have potential benefits that may change as new procedures become available.

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REFERENCES