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Diagnostic impact of computed tomography cholangiography and magnetic resonance cholangiopancreatography on pancreaticobiliary maljunction

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Abstract

Background/Purpose: The aim of this study was to investigate the diagnostic potential of computed tomography cholangiography (CTC) and magnetic resonance cholangiopancreatography (MRCP) in children with pancreaticobiliary maljunction (PBM).

Methods: Fifty-three children with PBM were consecutively treated between 1997 and 2009. Among them, the patients who underwent CTC and/or MRCP preoperatively were enrolled in this study. Computed tomography cholangiography was examined after infusion of meglumine iodoxamate with subsequent 3-dimensional rendering. The visualization of the biliary and pancreatic duct systems was evaluated and compared with that visualized with MRCP. The findings of direct cholangiography were used as the standard of reference.

Results: Of the 53 cases with PBM, 17 cases were examined by CTC, 10 cases by MRCP, and 17 with both. The extrahepatic bile tract was visualized in 32 (94.1%) of 34 patients in CTC and in all 27 patients in MRCP. The intrahepatic bile duct was more frequently demonstrated by MRCP than by CTC (96.3% vs 70.6%, $P = .02$). Pancreaticobiliary maljunction was noted in 13 (38.2%) of 34 with CTC and in 12 (44.4%) of 27 with MRCP. The minimum age for visualization of PBM was at 10 months in CTC and at 1 year and 11 months in MRCP, respectively. The main pancreatic duct was more frequently visualized by MRCP than by CTC (81.5% vs 8.8%, $P < .001$).

Conclusions: Magnetic resonance cholangiopancreatography provides superior visualization of the intrahepatic duct and the pancreatic system when compared with CTC. However, it is still challenging to perform a good-quality examination in young infant. The great advantage of CTC is its ability to produce high-quality images without respiratory artifacts and that it allows accurate assessment of the presence of PBM equivalent to MRCP.

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Pancreaticobiliary maljunction (PBM) is a congenital biliary anomaly commonly associated with congenital biliary dilatation and defined as an anatomical maljunction of the bile and pancreatic ducts outside the duodenal wall forming a long, common channel [1,2]. Freed from the influence of the sphincter of Oddi, pancreatic juice can regurgitate into the biliary tree and bile juice can also enter the pancreatic duct. Overall, these regurgitations are responsible for the clinicopathology of PBM [3].

The definitive preoperative diagnosis of PBM has classically depended on direct cholangiopancreatography, such as endoscopic retrograde cholangiopancreatography (ERCP) and percutaneous transhepatic cholangiography. However, modern noninvasive imaging modalities are beginning to play an important role in the diagnostic workup of patients with suspected PBM. Magnetic resonance cholangiopancreatography (MRCP) is widely used for hepatobiliary and pancreatic disease even in pediatric population [4,5]. According to previous reports, MRCP allows for noninvasive and accurate detection of PBM without irradiation and avoids the lethal complications of unnecessary ERCP and percutaneous transhepatic cholangiography such as pancreatitis and cholangitis [6,7]. Meanwhile, CT cholangiography (CTC) is also a classical, noninvasive method for the evaluation of the biliary system aside from radiation. The contrast material, meglumine iodoxamate (Biliscopin; Schering AG, Berlin, Germany), has a biliary excretory profile. Bile duct imaging obtained from this material shows extensive anatomical detail along with reflection of physiologic bile flow in vivo [8,9]. Authors have previously reported biliopancreatic reflux on CTC and discussed the possibility of visualization of PBM and the pancreatic duct with CTC [10]. More recently, the emergence of multidetector-row CT (MDCT) was a major technological breakthrough that dramatically changed the practice of CT, and the spatial resolution on CTC with MDCT may be superior to that of MRCP.

There are few reports of comparisons between CTC and MRCP for the preoperative assessment of PBM. The purposes of this study were to investigate the feasibility and accuracy of both modalities for the diagnosis of PBM in pediatric patients.

1. Materials and methods

1.1. Patients

From 1997 to 2009, a total of 53 children with PBM were consecutively diagnosed and treated at our institute. There were 17 boys and 36 girls, and their median age at diagnosis was 3.0 years (range, 0 months-17 years). Choledochal dilatation was cystic type (n = 30), fusiform type (n = 20), and nondilatation type (n = 3). Among 50 patients with the choledochal cyst, there were 21 children with Todani Ia, 20 with Ic, and 9 with IV-a.

Twenty-three cases were examined by ERCP preoperatively under general anesthesia, and no major complications were noted. Fifty-one cases underwent definitive surgery, including intraoperative cholangiopancreatography and excision of the extrahepatic bile duct with Roux-en-Y biliary reconstruction. One of the remaining 2 patients without surgery, a 3-month-old girl developed severe liver failure despite external bile drainage, resulting in primary living-donor liver transplantation [11]. The other patient referenced above was on the waiting list for surgery. Patients undergoing CTC and/or MRCP, preoperatively, were enrolled in this study.

1.2. Computed tomography cholangiography

Computed tomography cholangiography was preoperatively performed as we reported previously [10]. Briefly, 1 to 3 mL/kg Biliscopin was administered intravenously over 30 minutes. The CT scanning began 20 minutes after injection. Specific scan protocols varied depending on the CT scanner available at the time of examination. Between 1997 and 2005, a single-slice CT scanner (Asteion VR; Toshiba Medical, Tokyo, Japan) was used, with a 5 mm/s table feed and a pitch of 1.0 (120 kV [peak] and 50-100 mA). From 2006, CT scanning was performed using a 64-detector-row helical CT (LightSpeed VCTs: GE Medical Systems, Milwaukee, WI), with 55 mm per rotation table speed, a pitch of 1.375 (120 kV [peak] and 80-125 mA), and a reconstruction slice thickness of 0.625 mm. Multiplanar reformation images were reconstructed at the workstation, as well as volume rendering reconstructions if needed.

1.3. Magnetic resonance cholangiopancreatography

Routine MRCP imaging was preoperatively performed using the Intera 1.5-T MRI scanner (Philips, Best, The Netherlands) with a body array wrap around coil without breath-holding. Patients were studied in the supine position with a thick-slab 2-dimensional turbo-spin echo, obtaining coronal and oblique coronal 40-mm-thick slices on a 320 × 256 matrix. Secretin (Secrepan; Eisai Corporation, Tokyo, Japan), a polypeptide hormone secreted by duodenal mucosa, was administered intravenously in a dose of 1 U/kg of body weight to increase the fluid signal in the pancreatic duct before 2005. These image sections were processed by the standard maximum-intensity-projection algorithm to obtain views of the entire pancreatobiliary system.

1.4. Sedation

The patients who could not tolerate the examination were sedated with 30 to 50 mg/kg of body weight oral chlorate hydrate or with 30 to 50 mg/kg rectal thiopental sodium.

1.5. Imaging study evaluation

The diagnostic criteria for PBM were as follows: (1) presence of a markedly long, common channel of the common bile duct and a major pancreatic duct more than 10 mm in length and (2) junction of the common bile duct and