Differentiation of Intraductal Papillary Mucinous Neoplasms From Other Pancreatic Cystic Masses: Comparison of Multirow-Detector CT and MR Imaging Using ROC Analysis

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Purpose: To compare the diagnostic performance of multirow-detector computed tomography (MDCT) and magnetic resonance imaging (MRI) in the differentiation of intraductal papillary mucinous neoplasms (IPMNs) from other pancreatic cystic masses.

Materials and Methods: A total of 53 patients with pathologically proven pancreatic cystic lesions who had undergone MDCT and MRI were included in this study. Two radiologists analyzed the morphologic features of the lesions and graded the lesion conspicuity on each examination. The readers assigned their confidence level regarding the differentiation of IPMN from other lesions and predicting ductal communication of the lesion. The radiologists’ diagnostic confidence was compared using receiver operating characteristic (ROC) analysis.

Results: The Az values for each observer for predicting ductal communication of the lesion and differentiating IPMN from other lesions were as follows: For MRI they were respectively 0.949 and 0.995 for reader 1, and 0.916 and 0.932 for reader 2. For MDCT they were respectively 0.790 and 0.875 for reader 1, and 0.774 and 0.850 for reader 2. In addition, for differentiating IPMNs from other lesions, MRI was significantly more accurate than MDCT (P < 0.05) for one observer, but for the other observer there was no significant difference between the two examinations (P = 0.059). For predicting ductal communication of the cystic lesions for both observers, MRI was significantly more accurate than MDCT (P < 0.05). The weighted κ values indicate good agreement (κ = 0.61) between observers for MDCT, and excellent agreement (κ = 0.82) for MRI.

Conclusion: Pancreatic MRI shows better diagnostic performance than MDCT for differentiating IPMNs from other cystic lesions of the pancreas.

Key Words: pancreas; intraductal papillary mucinous neoplasm; pancreatic cystic mass; multirow-detector computed tomography; magnetic resonance imaging


WITH THE WIDESPREAD USE of cross-sectional imaging modalities for the evaluation of abdominal diseases, cystic neoplasms of the pancreas are being increasingly recognized. However, their accurate characterization and differentiation have presented challenges for cross-sectional imaging modalities due to their overlapping morphologies; therefore, the decision as to whether to observe or to operate on these cystic pancreatic lesions remains difficult (1–3). As the malignant potential of many pancreatic cystic tumors is well known, this concern has led to an increasing number of resections of pancreatic cystic lesions (2).

Various imaging modalities, including ultrasound (US), computed tomography (CT), MR cholangiopancreatography (MRCP), and endoscopic retrograde cholangiopancreatography (ERCP), have been used for the evaluation of pancreatic cystic lesions (4–9). The recent introduction of the multirow-detector CT (MDCT) scanner for pancreatic imaging has allowed the acquisition of optimal dynamic images with high temporal resolution and high z-axis resolution. This raises the expectation of further improvements in the diagnostic accuracy of pancreatic CT imaging for evaluating pancreatic neoplasms (10,11). In addition, several studies have indicated that MR pancreatobiliary imaging using breath-hold half-Fourier acquisition single-shot turbo spin-echo (HASTE) with a phased-array body coil allows high-quality imaging of the pancreatobiliary system (7,12,13). To our knowledge, however, there has been no comparative study of MRI combined with MRCP and MDCT for the characterization of pancreatic cystic neoplasms. The purpose of our study, therefore, is to com-
pare the diagnostic accuracy of MRI with MRCP and MDCT imaging for the characterization of common pancreatic cystic neoplasms, with special emphasis on the differentiation of IPMN and other cystic neoplasms.

**MATERIALS AND METHODS**

**Patient Population**

We searched our radiologic database for patients with pancreatic cystic lesions who had undergone MDCT and MRI within a one-month period between January 2002 and February 2006. During this time period at our institute, MDCT combined with ERCP or MRCP was used as the standard-of-care examination for patients with pancreatic cystic masses. The search revealed 76 patients, 23 of whom were excluded because they had no histologic proof of the lesion. In addition, pancreatic cystic masses less than 3 cm in diameter are serially followed by CT. Therefore, 53 patients (24 women and 29 men, age range = 31–76 years, mean age = 57.7 years) were enrolled in this study, and all of their lesions were confirmed by histopathologic examination. Therefore, IPMNs (N = 31), microcystic serous cystadenomas (N = 6), oligocystic serous cystadenomas (N = 5), mucinous cystadenomas (N = 4), pseudocysts (N = 6), and cystic islet cell tumor (N = 1) were included in this retrospective study. This study was approved by the institutional review board of our hospital, and written informed consent was not required by the review board due to the retrospective study design. Histopathologic confirmation of the 53 cystic lesions in 53 patients was obtained in all patients by the pathologic findings of the surgical specimens in 52 patients, and by sonographically guided percutaneous aspiration cytology and elevation of amylase of the aspirate in the one patient with a pseudocyst.

**MR Examination**

MRI was performed on a 1.5-T unit (Magnetom Vision or Sonata; Siemens, Erlangen, Germany) with a phased-array coil. Both T1- and T2-weighted images were obtained in the transverse plane. A breath-held T2-weighted HASTE sequence and a breath-held T1-weighted gradient-echo (GRE) sequence (with or without fat saturation) were performed. T2-weighted HASTE imaging was performed using the following parameters: TR/TE = ∞/95 msec; flip angle = 150°; echo train length = 192; matrix = 256 × 192; and 19-second imaging time for 20 slices. Breath-held T1-weighted GRE imaging was performed with parameters of TR/TE = 170/2.4 and 5.0 msec; flip angle = 70°; matrix = 256 × 192; and one signal average. For all sequences, a 7-mm slice thickness was used with a 20% intersection gap. The field of view (FOV) was 320–350 mm and was adjusted according to patient size. A three-quarter FOV was used in the phase-encoding direction.

Two kinds of MRCP images were obtained using a coronal thick-slab, single-slice turbo spin-echo (TSE) sequence or a multislice HASTE sequence with fat saturation (14). Thick-slab, single-slice MRCP images were obtained using the following parameters as well as coronal and ±15° and 30° oblique coronal orientations: TR/TE = 2800/1100 msec; flip angle = 180°; number of signal averages = 1; matrix = 256 × 240; slice thickness = 60 mm; acquisition time (TA) = 3 seconds; and FOV = 30 × 30 cm². Coronal multislice MRCP images were obtained using the following parameters: TR/TE = 1220/84 msec; flip angle = 180°; one signal average; matrix = 256 × 204; 15 slices; slice thickness = 4 mm; FOV = 30 × 30 cm²; and TA = 18 seconds. Multiple maximum intensity projections (MIPs) for the MRCP images (coronal ± 90°), were generated from multislice HASTE data set on a separate MRI workstation (Siemens Leonardo). In all cases these steps were performed by the same experienced MR technician, who had 15 years of experience in 3D reconstruction.

**MDCT Examination**

Multiphasic helical MDCT was performed on a Sensation 16 (Siemens Medical Solutions, Forchheim, Germany), LightSpeed (GE Medical Systems, Milwaukee, WI, USA), or MX8000 (Marconi Medical Systems, Cleveland, OH, USA) scanner, and imaging consisting of precontrast, arterial-dominant, and portal-dominant phases. After administration of 120 mL of nonionic contrast material (Ultravist 370; Schering AG, Berlin, Germany) at a rate of 3 mL/second using a power injector, arterial, pancreatic, and portal venous phase CT scans were obtained. The scanning parameters for the MDCT scanners were as follows: a gantry rotation time of 0.5–0.75 second, 4 × 2.5 mm or 8 × 1.25 mm or 16 × 0.75 mm detector configuration, 2.5–3.2-mm slice thickness, pitch of 1.25–1.75, 3-mm reconstruction interval for both phases, 160 mA, 120 kVp, and a 512 × 512 matrix. In 25 patients for whom an eight- or 16-slice scanner was used, for multiplanar reconstruction the images were additionally reconstructed with a 20% to 25% overlap, 1–1.25-mm section thickness, and 0.75–1-mm spacing. Although the CT protocols varied for each scanner, in general, for arterial phase scanning, a six-second delay was used after the maximal Hounsfield Unit (HU) of the aorta reached 100 HU using bolus tracking. Pancreatic phase and portal venous phase images were obtained approximately 38 seconds and 70 seconds, respectively, after the start of contrast administration.

For the 25 patients with thin-slice images (1–1.25 mm thick), the reconstructed images were subsequently postprocessed at a commercially available workstation (ADW 4; GE Medical Systems, or Leonardo; Siemens). In all patients, coronal subvolume MIPs and 2D curved reformations were generated by a technologist trained in image postprocessing. Two-dimensional (2D) curved reformations were obtained by interactively placing a cursor on a stack of transverse, sagittal, coronal, or oblique sections along the course of the main pancreatic duct.

**Image Analysis**

Two abdominal radiologists who were experienced in interpreting abdominal CT and MR images in their daily clinical practice for at least six years reviewed the images separately. They were blinded to the specific diag-
noses and clinical information. All CT and MR images were reviewed on a picture archiving and communication system (PACS; Marotech 5.3, Seoul, Korea) workstation. Two separate sets of images were analyzed, i.e., the MDCT image set (unenhanced, arterial, pancreatic, and portal phase images, and multiplanar reconstruction images if available) and the MRCP image set (unenhanced T1- and T2-weighted images, coronal HASTE images, and single-slab and multislice MRCP images). To minimize any learning bias, we scheduled a one-week interval between the two interpretation sessions, and the images were randomly presented regardless of whether they were CT or MR images.

**Recording of Findings**

The reviewers independently reviewed the CT and MR images in terms of the following morphologic features of the lesions and abnormalities of the pancreas parenchyma: location (head, neck, body, or tail); internal features, such as the presence of septi (unilocular vs. multilocular vs. pleomorphic), mural nodule, or solid component and central-cyst wall calcification; outer shapes (smooth vs. lobulated); the presence of pancreatic duct (MPD) dilatation divided into upstream, downstream, or up- and downstream pancreatic duct dilatation; the presence of cyst communication with the pancreatic duct; and parenchymal atrophy with/without calcifications or swelling (inflammation).

**Lesion Conspicuity**

For each image set, each observer recorded the presence and segmental location of the lesions (i.e., head, neck, body, or tail) and assessed the lesion conspicuity for each sequence on the basis of lesion-to-pancreas contrast. A standardized template form for each examination was completed on which the interpreter indicated the segmental location of each lesion. If a lesion crossed segmental boundaries, the lesion was assigned to the segment with the greatest involvement. For each image set, quality scores were assigned as follows: 1 = poor; 2 = fair; 3 = good; and 4 = excellent. Poor lesion-to-pancreas contrast was defined as an uncertain lesion with signal intensity (SI) or attenuation similar to that of the adjacent pancreas parenchyma, fair indicated that the lesion was seen but was only slightly hyperintense or hypoattenuated relative to the background pancreas parenchyma, good indicated that the lesion was moderately hyperintense or hypoattenuated relative to the background pancreas parenchyma, and excellent indicated that the lesion was markedly hyperintense or hypoattenuated relative to the background pancreas parenchyma.

**Internal and External Features of the Cysts**

The cystic tumors were categorized by their internal and outer features as follows: a unilocular cyst with/without lobulation, a multilocular cyst with/without lobulation, a pleomorphic cyst, and a cyst with a solid component (15). A unilocular cyst was defined as a pancreatic cyst without internal septa, a solid component, or calcification (5; Fig. 1). Septation was defined as being composed of internal locules forming polygonal shapes due to contact with each other. A “multilocular shape” was defined as a conglomeration of two or more round cysts, and multilocular cysts were further classified into microcystic lesions and macrocystic lesions according to the diameter of the internal cysts (Fig. 2). “Macrocystic” was defined as when internal cysts are larger than 2 cm in diameter. A “pleomorphic cystic shape” was defined as one containing three or more cysts, including oval, tubular, or clubbed-finger-like cysts. The reviewers then determined the outer margin of the cystic lesions (e.g., lobulated vs. smooth). A “lobulated shape” was defined as being the shape of a simple closed curve that could not be described as the borders of the same circle. A “smooth shape” was considered to be a simple closed curve with the borders of the same circle.

**Communication of the Cysts With the Pancreatic Duct**

In addition, the reviewers distinguished cysts from the pancreatic duct by paging through the images on the PACS monitor. The pancreatic duct was noted as being normal or dilated and was then analyzed regarding whether there was a definite cyst communicating with the pancreatic duct. The pancreatic duct was considered to be dilated when its diameter was greater than 3 mm. The communication was defined as a neck or a channel that connected the pancreatic cyst to the nor-

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Figure 1. A 68-year-old man with a pathologically proven intraductal papillary mucinous tumor. **a:** Transverse MDCT image shows a round cystic lesion (arrow) without definite septation or lobulation or pancreatic duct communication. Both reviewers diagnosed this lesion as mucinous cystadenoma. A transverse HASTE image (**b**) and coronaL MRCP image (**c**) show communication of the pancreas cystic mass with the small pancreatic ductal branch (arrow). This lesion was pathologically proven to be intraductal papillary mucinous neoplasm with moderate dysplasia. **(a)**
One of the three gastrointestinal pathologists with more than 10 years of experience in evaluating the pancreas examined each pathologic specimen. Communication of the cystic lesions with the main pancreatic duct was obtained on surgical specimens in 32 cases (31 cases were IPMNs and one case was a pseudocyst).

**Statistical Analysis**

A receiver operating characteristic (ROC) curve was constructed to compare the performance of the MDCT image set with that of the MRCP set in determining whether a lesion was an IPMN. Nonparametric ROC analysis was performed using MedCalc software (MedCalc, Mariakerke, Belgium). This analysis, which was based on the method developed by Hanley and McNeil (23), yielded an empirical ROC curve and nonparametric estimate of Az with a 95% confidence interval. The differences between the areas under the ROC curves were determined using a univariate z-score test. The relative sensitivity, specificity, and area under the ROC curves (Az) were calculated for each test. The sensitivity and positive predictive values of both the MR and CT images were compared with the McNemar test. A two-tailed P-value less than 0.05 was considered to indicate a significant difference.

To assess interobserver agreement for the evaluation of the two imaging techniques, we calculated the kappa statistic for multiple observers (24). The agreement among the blinded observers is reported in terms of kappa values: those greater than zero indicate a positive correlation, less than 0.20 indicate poor agreement, 0.21–0.40 indicate fair agreement, 0.41–0.60 show moderate agreement, 0.61–0.80 show good agreement, and greater than 0.81 indicate excellent agreement. The significance of the difference between the kappa values of the two imaging techniques was tested using the z-test.

**RESULTS**

In the qualitative analysis, the lesion conspicuity was better on MRI than on MDCT (5 ± 0.14 vs. 4 ± 0.69; P < 0.0001) (Fig. 3). In addition, 19 of the study 53 patients (35.8%) with pancreatic cystic lesions showed dilation of the MPD related to the lesions, i.e., 13 IPMNs (41.9%; 13/31) and six other cystic lesions. Furthermore,
among the 13 patients with IPMNs accompanied by ductal dilation, eight showed both upstream and downstream ductal dilation, while five showed only downstream ductal dilation. However, there was no case of IPMN with only upstream ductal dilation. Of the six patients with other cystic lesions, two had serous cystadenomas, one had mucinous cystadenoma (Fig. 3), and three had pseudocysts. All of these lesions showed upstream MPD dilation.

The diagnostic confidence of the reviewers regarding communication of the cystic lesions with the pancreatic duct was also higher on MRI than on MDCT (3.5 ± 1.8 vs. 2.6 ± 1.4; \( P < 0.05 \)) (Fig. 2). In addition, when we compared the diagnostic confidence of the reviewers on MDCT with 2D curved reformation images in 25 patients with that on MRI regarding ductal communication of the cystic lesions, MRI showed higher diagnostic confidence.

Figure 3. A 51-year-old woman with pathologically proven serous microcystic cystadenoma. a,b: Transverse MDCT scans obtained during the portal venous phase show diffuse dilatation of the pancreatic duct (arrowhead) with a multiseptated cystic mass (arrow). The reviewers diagnosed this lesion as IPMN on CT. c: A coronal thick-slab TSE MRCP image shows a multiseptated cystic mass with upstream dilation of the pancreatic duct. Note that the downstream pancreatic duct is not dilated. On this image it is difficult to determine whether there is ductal communication of the cystic lesion with the pancreatic duct. d,e: Coronal HASTE images show multiple fine septa and no definite evidence of ductal connection to the cystic mass. Both reviewers made the correct diagnosis of serous microcystic cystadenoma.
Sensitivity and Specificity of the MRCP Image Set and the MDCT Image Set for Differentiating IPMN From Other Cystic Lesions and for Diagnosis of IPMN

Table 1
Az Values Obtained With the MRCP Image Set and the MDCT Image Set to Establish Ductal Communication of the Cystic Lesions and for Diagnosis of IPMN

<table>
<thead>
<tr>
<th></th>
<th>MDCT (Az)</th>
<th>MRI (Az)</th>
<th>P value</th>
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<td>Reviewer 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ductal</td>
<td>0.790</td>
<td>0.949</td>
<td>0.010</td>
</tr>
<tr>
<td>communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnosis of IPMN</td>
<td>0.875</td>
<td>0.995</td>
<td>0.010</td>
</tr>
<tr>
<td>Reviewer 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ductal</td>
<td>0.774</td>
<td>0.916</td>
<td>0.012</td>
</tr>
<tr>
<td>communication</td>
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<td></td>
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<tr>
<td>Diagnosis of IPMN</td>
<td>0.850</td>
<td>0.932</td>
<td>0.059</td>
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</table>

IPMN = intraductal papillary mucinous neoplasm.

confidence than MDCT (3.66 ± 1.58 vs. 3.18 ± 1.29; P < 0.05).

ROC Analysis

Each MDCT or MRCP image set depicted all 53 cystic lesions. For all 53 lesions, the calculated Az values for each observer with the MDCT and MRCP image set for ductal communication of the cystic lesions and for differentiation between IPMN and non-IPMN lesions are shown in Table 1. For MRI the Az values for each observer for differentiating IPMN from other lesions were 0.995 and 0.932, respectively. For MDCT they were 0.875 and 0.850 for readers 1 and 2, respectively. For differentiating IPMN from other lesions for reader 1, MRI was significantly more accurate than MDCT (P < 0.05); for reader 2, MRI was significantly more accurate than MDCT, but there was no significant difference between the two examinations (P = 0.059).

In addition, the two observers achieved higher diagnostic performance in predicting ductal communication of the cystic lesions with the MRCP set than with the MDCT set, and the difference in the Az values of both image sets was statistically significant (P < 0.05). The Az values for the MDCT set for reviewers 1 and 2 were 0.790 and 0.774, and those for the MRCP set were 0.949 and 0.916, respectively.

Overall, the MRCP set showed greater sensitivity compared to the MDCT set for diagnosing IPMN and there was a significant difference in the sensitivities of the two imaging sets (Table 2; P < 0.05). However, there was no statistically significant difference in specificity for diagnosing IPMN observed by either of the two observers (P > 0.05). The kappa values were 0.611 for the MDCT image set and 0.817 for the MRCP image set, thus indicating good and excellent interobserver agreement, respectively, regarding the diagnosis of IPMN.

Specific Diagnosis of Pancreatic Cystic Lesions

According to the diagnostic criteria provided to the reviewers, the diagnostic accuracy of the correct diagnoses of the MDCT and MRCP image sets were 81.1% and 94.3% for reader 1, and 69.8% and 86.8% for reader 2, respectively. The difference in diagnostic accuracy between the two examinations was statistically significant for both reviewers (P < 0.05). However, there were several cases of misdiagnosis on both examinations for both reviewers, i.e., two cases for reviewer 1 and four cases for reviewer 2. Reviewer 1 misdiagnosed a case of microcystic serous cystadenoma as IPMN, and a case of IPMN as serous cystadenoma. Reviewer 2 misdiagnosed two cases of pseudocysts as IPMN, a serous microcystic adenoma as IPMN, and an oligocystic serous adenoma as mucinous cystadenoma.

DISCUSSION

Clinical decision-making regarding pancreatic cystic lesions is driven by the likelihood of causing harm with and without treatment (25–27). Although the differential diagnosis of cystic lesions of the pancreas is wide, they can be broadly divided into low- and high-risk lesions (26). Low-risk lesions, such as simple cysts, pseudocysts, and serous cystadenomas, are generally not resected, but high-risk lesions, such as mucinous cystic neoplasms, IPMN, and cystic solid tumors, are considered to need surgical resection due to their high risk of malignant transformation. The surgical strategy can be altered depending on the character of the pancreatic cystic lesions (27). Although radiologic findings of pancreatic cystic lesions are crucial for making the decision whether to observe or to operate, preoperative attempts to definitively diagnose cystic tumors as benign, premalignant, or malignant using invasive and noninvasive techniques have thus far had only limited success (2,4,27). Therefore, there is an obvious clinical need to improve the preoperative diagnostic accuracy of characterizing pancreatic cystic lesions using recent MDCT or MRI techniques. Despite the fact that there have been advances in MR technology and MDCT, only a few publications in the literature have described the performance of MDCT and MRCP for evaluating pancreatic cystic lesions (10).

Table 2
Sensitivity and Specificity of the MRCP Image Set and the MDCT Image Set for Differentiating IPMN From Other Cystic Lesions

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
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<tr>
<td>Reviewer 1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MDCT</td>
<td>83.9 (26/31)</td>
<td>86.4 (19/22)</td>
<td>89.6 (26/29)</td>
<td>79.2 (19/24)</td>
</tr>
<tr>
<td>MRI</td>
<td>96.8 (30/31)</td>
<td>90.9 (20/22)</td>
<td>93.8 (30/31)</td>
<td>95.2 (20/21)</td>
</tr>
<tr>
<td>Reviewer 2</td>
<td></td>
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<tr>
<td>MDCT</td>
<td>77.4 (24/31)</td>
<td>86.4 (19/22)</td>
<td>88.9 (24/27)</td>
<td>73.1 (19/26)</td>
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<tr>
<td>MRI</td>
<td>96.8 (30/31)</td>
<td>86.4 (19/22)</td>
<td>90.9 (30/33)</td>
<td>95 (19/20)</td>
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<tr>
<td>Consensus</td>
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<tr>
<td>MDCT</td>
<td>80.6</td>
<td>86.4</td>
<td>89.3</td>
<td>76.1</td>
</tr>
<tr>
<td>MRI</td>
<td>96.8</td>
<td>90.8</td>
<td>92.3</td>
<td>95.1</td>
</tr>
</tbody>
</table>

PPV = positive predictive value, NPV = negative predictive value.
Our results, which attempted to compare the diagnostic accuracy of MRI with MRCP and MDCT imaging for the characterization of common pancreatic cystic neoplasms, indicated that the diagnostic accuracy of making a specific diagnosis was better with the MRCP image set than the MDCT image set ($P < 0.05$). We believe that the better performance of MRCP than MDCT was attributable to the intrinsic high soft-tissue contrast of MRI. This was documented by our results, which indicated that the ratings for lesion conspicuity and diagnostic confidence for classification of the ductal communication were significantly higher on the MRI set than on the MDCT set (Fig. 3). Furthermore, the MRCP image set showed better interobserver agreement regarding the diagnosis of IPMN than did the MDCT image set. Considering the morbidity of pancreatic resection and the importance of making the correct diagnosis during the treatment decision-making process (28–30), our study results are valuable. Based on these results, we postulate that MRI including MRCP is preferable to MDCT for characterizing cystic pancreatic lesions when a focal cystic pancreatic lesion is detected on US.

Among various kinds of pancreatic cystic lesions, IPMN is one of the mucin-producing tumors of the pancreas, and it is widely accepted by clinicians that all IPMNs have the potential to be malignant (31,32). The surgical treatment of IPMN differs from that of serous cystadenomas and mucinous cystic neoplasms (10). Although the surgeon can usually locate the tumor preoperatively in patients with serous cystadenomas and mucinous cystic neoplasms, and can accordingly plan a segmental pancreatic resection, this is not always the case for patients with IPMN. Therefore, radiologic differentiation between IPMN and other cystic tumors is important in the determination of the appropriate treatment.

In our study the MRI image set including MRCP showed a significantly higher mean $Az$ value and higher sensitivity for the diagnosis of IPMN than the MDCT image set. Previous studies demonstrated that the presence of communication of the pancreatic cystic lesion with the MPD is one of the most reliable findings for the diagnosis of IPMN (33,34). We believe that the better performance of the MRI set for the diagnosis of IPMN was attributed to the greater predictability of the MRCP set regarding the ductal communication of the lesion with the main pancreatic duct compared to MDCT ($P < 0.05$). Several previous studies with high-quality MRCP also demonstrated that it is superior to ERCP for the evaluation of IPMN (35,36). Recently, Sahani et al (10) described MDCT combined with 2D curved reformation can provide imaging details of IPMN, including communication of the branch duct type IPMN with the main pancreatic duct, that are almost equivalent to those provided on MRCP. In our study, although 2D curved reformation images were available for only 25 patients (25/53, 47%), in those patients the diagnostic confidence of MRCP set for ductal communication of the cystic lesion was higher than that of the MDCT set with MPR images (Fig. 1). Although MDCT with various post-processing techniques has enhanced the capability of CT for the evaluation of pancreatic pathology by provid-

Our study has several limitations. First, this was a retrospective study; therefore, a precise correlation of the CT features with the histopathologic findings was not feasible. Second, 2D curved reformatted CT images, which are known to be useful for estimating the ductal communication of pancreatic cystic lesions with the pancreatic duct (10), were available for only 25 patients (25/53, 47%). However, in those patients the diagnostic confidence of the MRCP set for ductal communication of the cystic lesion was higher than that of the MDCT set with MPR images. Third, our MR protocol included unenhanced T1- and T2-weighted images as well as MRCP images, but did not include dynamic contrast-enhanced, 3D, spoiled GRE imaging. The addition of gadolinium-enhanced, 3D-GRE imaging may improve the accuracy of MRI compared to MDCT. Fourth, in our study there were only six cases of pseudocyst, which is the most common cystic lesion in the pancreas, because many patients with pseudocysts are easily diagnosed based on their clinical history and therefore do not undergo MRCP. Considering that many pseudocysts have ductal communication, the small number of patients with pseudocysts in our study may have resulted in an optimistic bias. Lastly, the patients included in this study were from a selected group of patients with cystic pancreatic lesions who had undergone MDCT and MR examinations before surgery; therefore, our data contain an inadvertent patient selection bias.

In conclusion, MRCP with unenhanced axial images has better diagnostic performance than MDCT for differentiating IPMNs from other cystic lesions of the pancreas, and is able to provide a more accurate diagnosis of pancreatic cystic lesions.

**REFERENCES**


