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● *Original Contribution*

VALUE OF NEAR-ISOVOXEL ULTRASOUND FOR EVALUATION OF DUCTAL COMMUNICATIONS WITH PANCREATIC CYSTIC LESIONS: CORRELATION WITH MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY

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Abstract—The aim of this study was to determine the value of near-isovoxel ultrasound (ISUS) using xMATRIX technology in assessment of ductal communications with pancreatic cystic lesions. Twenty patients with pancreatic cystic lesions (n = 21) on magnetic resonance cholangiopancreatography (MRCP), underwent 2-D ultrasound (US) and subsequent ISUS using a matrix probe. Two observers assessed the presence of ductal communications with pancreatic cystic lesions for all MRCP, 2-D US, and ISUS images with multi-planar reformation, using a 5-point confidence scale. Weighted-κ statistics and intra-class correlation coefficients were calculated. Inter-observer agreement for MRCP, 2-D US and ISUS was moderate, fair and moderate (0.475, 0.222 and 0.472), respectively. The intra-class correlation coefficients between ISUS and MRCP was higher than that between 2-D US and MRCP (0.8706 vs. 0.5353, observer 1; 0.7206 vs. 0.4818, observer 2, respectively). Correlation and inter-observer agreement were better with MRCP than with 2-D US. We conclude that ISUS may be useful in evaluating ductal communications with pancreatic cystic lesions. (E-mail: leejy@radiol.snu.ac.kr) © **2013 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **Matrix probe, Near-isovoxel ultrasound, 3-D ultrasound, Pancreatic cyst, Ductal communication, Intraductal papillary mucinous neoplasm.**

INTRODUCTION

The presence of ductal communication with a pancreatic cystic lesion is one of the most reliable findings for discriminating branch duct-type intraductal papillary mucinous neoplasm (IPMN) from other pancreatic cystic neoplasms such as serous cystadenoma (SCA) and mucinous cystic neoplasm (MCN) (Koito et al. 1998; Onaya et al. 1998; Procacci et al. 1996, 2001). Among the non-invasive imaging modalities, the technique most commonly used because of its overall high sensitivity and specificity (90%) in detecting ductal communications of branch duct-type IPMNs is magnetic resonance cholangiopancreatography (MRCP), followed by multi-detector computed tomography with multi-planar reformation (MPR) (Sahani et al. 2006; Sainani et al. 2009; Song et al. 2007).

Ductal communications of branch duct-type IPMNs are usually tiny and are not detected on axial images in 40% of cases (Sahani et al. 2006). Therefore, to visualize ductal communications of IPMNs, MPR, especially coronal MPR, which reveals the spatial relationship between the main pancreatic duct and cystic lesions along the long axis of the pancreas, is required. Several studies have reported the benefit of MPR images for evaluating ductal communication in branch duct-type IPMNs (Takada et al. 2005; Yun et al. 2010). Isovoxel, thin-slice volume data are essential to the acquisition of good-quality MPR images.

Therefore, the use of ultrasound (US) has been very limited because 2-D US and even conventional 3-D US do not provide isovoxel, thin-slice volume data. However, xMATRIX technology, recently introduced into the clinical field, was developed to produce near-isovoxel, thin-slice volume data using a matrix phase-array transducer with more than 9200 active elements. Therefore, we conducted this prospective study to determine the value of near-isovoxel ultrasound (ISUS) imaging using xMATRIX technology in evaluation of the presence of ductal communication with pancreatic cystic lesions.

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METHODS

This prospective study was approved by the institutional review board at our institution, and informed consent was obtained from all enrolled patients.

Patients

From November 2009 to September 2010, 440 consecutive patients underwent biliary-pancreas protocol MR imaging, including MRCP, for evaluation of the pancreas at our institution. Eighty-six patients were clinically and radiologically diagnosed with branch duct-type IPMN or SCA on MR imaging. Other cystic lesions diagnosed as MCN and pseudo-cysts were excluded because of the distinctive morphologic and/or clinical features that lead to such diagnoses, that is, large macrocystic appearance and pancreatitis-related history and findings. For these lesions, investigation of communication channels with the pancreatic duct is not important for diagnostic purposes.

Among the 86 patients, 66 were excluded for:

1. Insufficient MRCP image quality (n = 3)
2. Cystic lesions that were too small (<1 cm in diameter) for evaluation (n = 4)
3. Presence of too many (>5) cystic lesions in the pancreas (n = 3)
4. Accompanying malignant disease, that is, advanced stomach cancer, Klatskin tumor or biliary papillomatosis (n = 3)
5. Main duct-type IMPN (n = 2)
6. Surgical removal of pancreatic cystic lesions before inclusion in the study (n = 15) (these patients had undergone pancreatic surgery because of suspected mixed-type IPMN [n = 3] or mural nodules [n = 4], accompanying disease [distal common bile duct cancer, ampulla of Vater cancer, MCN, each n = 1], growing pancreatic cystic lesions [n = 3], large lesion size [5 cm, n = 1] and recurrent pancreatitis [n = 1]).
7. Refusal to participate in this prospective study (n = 36)

Finally, a total of 20 patients (M:F = 8:12, mean age, 61.1 ± 8.84 y) with pancreatic cystic lesions that were likely to be branch duct-type IPMN or SCN were enrolled in this prospective study.

MRCP techniques

All MR examinations were performed with either a 3-T system (Verio, Siemens Medical Solutions, Erlangen, Germany) (12 patients) or a 1.5-T super-conducting system (either Signa Excite [5 patients] or Signa HDxt [3 patients], GE Medical Systems, Milwaukee, WI, USA) using either a 32-channel (Verio) or 8-channel phased-array torso coil (Signa Excite or Signa HDxt). Our MRCP protocol consisted of three sequences: (i) breath-hold single-slice rapid acquisition with relaxation enhancement technique—turbo spin-echo (TSE) or fast spin-echo (FSE); (ii) breath-hold multi-slice half-Fourier acquisition single-shot turbo spin-echo or single-shot fast spin-echo technique; and (iii) respiratory-triggered 3-D TSE or FSE technique. Thick-slab single-slice T2-weighted MRCP images were obtained in at least six planes using the FSE or TSE technique and in the coronal, coronal oblique (±30° and ±60° to the coronal plane so that at least one acquisition was in the plane of the pancreatic duct) and sagittal planes. Thin-slab multi-slice T2-weighted MRCP images were obtained using a half-Fourier acquisition single-shot turbo spin-echo or single-shot fast spin-echo sequence in the coronal plane, and 15 sections were acquired per breath hold (volume of coverage = 60 mm^3).

For 3-D MRCP using TSE on the Verio scanner, parallel imaging (mSENSE, Siemens Medical Solutions) with a reduction factor of 2 was applied in an in-plane phase-encoding direction on 3-D MRCP imaging. The mSENSE allowed acquisition of folded images in each receiver channel by reducing *k*-space sampling and then unwrapping the images during the reconstruction process, which was performed based on a reference scan. For 3-D MRCP on the Signa HDX or Excite scanner, a 3-D fast-recovery fast spin-echo (FR-FSE)

Table 1. MRCP parameters

	Thick-slab single-slice MRCP			Thin-slab multi-slice MRCP			3-D MRCP		
	Scanner1	Scanner 2	Scanner 3	Scanner1	Scanner 2	Scanner 3	Scanner1	Scanner 2	Scanner 3
TR/TE	2500/909	4000/998.9	4000/857.1	4185.7/815	4000/875.4	3750/816.9	4185.7/815	4000/875.4	3750/816.9
Echo train length	256	1	1	69	1	1	69	1	1
Flip angle (°)	180	90	90	130	90	90	130	90	90
Slab thickness (mm)	50	60	50	0.9	2	2	0.9	1	1
Field of view	240 × 240	260 × 260	300 × 300	380 × 380	250 × 250	340 × 340	311 × 311	320 × 320	280 × 280
Matrix	320 × 256	384 × 256	320 × 320	384 × 366	320 × 320	320 × 320	384 × 366	320 × 320	320 × 320

Scanner 1 = Verio (Siemens Medical Solutions, Erlangen, Germany); scanner 2 = Signa Excite (GE Medical Systems, Milwaukee, WI, USA); Scanner 3 = Signa HDxt (GE Medical Systems); MRCP = magnetic resonance cholangiopancreatography; TR/TE = repetition time/echo time.