Original Article

대한영상의학회지

Role of Magnetic Resonance Cholangiopancreatography in Evaluation of Choledocholithiasis in Patients with Suspected Cholecystitis
담낭염 의심 환자들에서 담도결석 진단을 위한 자기공명 담췌관 조영술의 역할

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Purpose: To determine the role of magnetic resonance cholangiopancreatography (MRCP) in evaluation of choledocholithiasis in patients with suspected cholecystitis.
Materials and Methods: A total of 78 patients (mean age: 66.06 ± 15.63 years; range: 21–94 years, Male:Female = 31:47) who had experienced symptoms of cholecystitis and who underwent computed tomography (CT), MRCP, and endoscopic retrograde cholangiopancreatography from January 2013 to February 2015 were included in this study. Two reviewers independently interpreted CT and MRCP images to determine the presence or absence of choledocholithiasis and cholelithiasis. Diagnostic performance (sensitivity, specificity, positive predictive value, negative predictive value, and accuracy) was compared between CT and MRCP. Interobserver agreement was also evaluated.
Results: Forty-three patients underwent cholecystectomy. The accuracy of CT and MRCP for detection of gallbladder stones showed no significant difference. The sensitivity and accuracy of MRCP for detection of extrahepatic duct stones were superior to those of CT for both reviewers (reviewer 1: MRCP: sensitivity, 73.3%; accuracy, 76.9%; CT: sensitivity, 50%, accuracy 59%; $p = 0.01$; reviewer 2: MRCP: sensitivity, 75%; accuracy, 73.1%; CT: sensitivity, 50%; accuracy, 56.4%; $p = 0.018$). The interobserver agreement was consistent for both CT (k-value: 0.738) and MRCP (k-value: 0.701).
Conclusion: MRCP showed superior diagnostic performance for the detection of choledocholithiasis with reliable interobserver agreement. Considering the lack of radiation and contrast enhancement, MRCP would be an appropriate first-line modality in evaluation of common bile duct stones in patients with suspected cholecystitis.

INTRODUCTION

Choledocholithiasis may be associated with approximately 10−20% of patients with symptomatic gallstones (1). Although 5−5% of common bile duct (CBD) stones may be asymptomatic, residual CBD stones post-cholecystectomy may cause potential complications including postoperative biliary leakage, re-current biliary colic, cholangitis and pancreatitis. These conditions are associated with major morbidity and mortality (2). Therefore, it is mandatory for clinicians to identify and treat choledocholithiasis preoperatively.

Usually, the initial screening of choledocholithiasis is based on clinical suspicion associated with clinical findings such as biliary colic, jaundice, abnormal hepatobiliary biochemical in-

dex (elevated bilirubin and alkaline phosphatase levels), and imaging data obtained using abdominal ultrasonography (US) or computed tomography (CT) (1, 3). These indicators may be affected by other factors and none of them show conclusive diagnostic accuracy for CBD stones. Although detection of gallstones is over 95% accurate using US, detection sensitivity for choledocholithiasis varies between 50−80%. In addition, the accuracy for early detection of extrahepatic obstruction is low (3, 4). Both CT and US infrequently provide sufficient detailed anatomical information of the biliary tract, which is necessary for surgical interventions (5).

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive technique that can be performed rapidly without exposing patients to ionizing radiation or iodinated contrast materials (1). MRCP displays superior soft tissue resolution and possesses significant accuracy in the diagnosis of choledocholithiasis (1, 4). It has evolved as an alternative or complementary method to endoscopic retrograde cholangiopancreatography (ERCP) in the diagnosis of patients with choledocholithiasis (5, 6). However, its cost-effectiveness is under debate; the indication of MRCP for preoperative evaluation of choledocholithiasis remains unclear.

The purpose of this study was to compare the diagnostic performance of CT and MRCP for the detection of CBD stones in patients with suspected cholecystitis and therefore, to determine the role of MRCP as a preoperative first-line imaging modality for the evaluation of choledocholithiasis.

MATERIALS AND METHODS

Patients

The study protocol was approved by the Institutional Review Board and the need for written informed consent was waived (EMCIRB 16-19). From January 2013 through February 2015, consecutive patients who underwent MRCP without enhancement for suspected cholecystitis were identified retrospectively. The diagnosis of cholecystitis was based on Tokyo guidelines 2013 (7). Patients who underwent preoperative CT and ERCP as a reference standard were included.

Among the 313 patients, the following patients were excluded: 207 patients without diagnostic ERCP data, 11 patients without preoperative CT data, 14 patients who had already un-
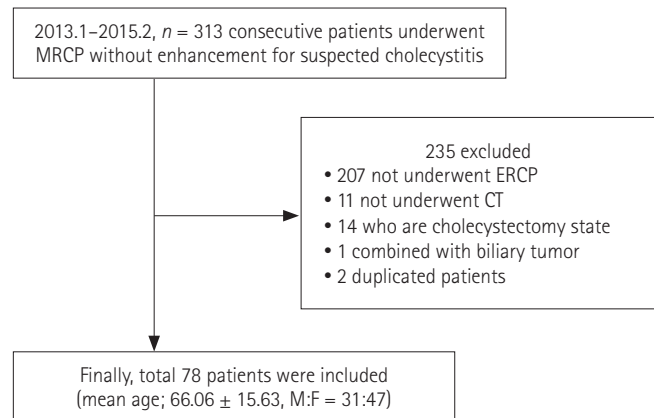

Fig. 1. Flow chart of patient selection. Among 313 patients who underwent magnetic resonance cholangiopancreatography for suspected cholecystitis, 235 patients were excluded. Finally, total 78 patients were included in this study.
CT = computed tomography, ERCP = endoscopic retrograde cholangiopancreatography, MRCP = magnetic resonance cholangiopancreatography

dergone a cholecystectomy, 1 patient with a biliary tumor, and 2 patients who underwent MRCP more than once during the study period (Fig. 1).

Finally, a total of 78 patients were included in this study. All patients underwent a preoperative or preprocedural MRCP, CT, and subsequent ERCP.

MRCP without Enhancement Techniques

MRCP was performed on a 3.0-T scanner (Magnetom Skyra, Siemens Healthcare, Erlangen, Germany) using a phased-array coil after at least a 4-h fast to promote gallbladder filling and gastric emptying. The MRCP protocol consisted of the following five pulse sequences: T2-weighted half-Fourier acquisition single-shot turbo spin-echo (HASTE) axial with a slice thickness (ST) of 4 mm; repetition time (TR)/echo time (TE), 800/92; and a 320 × 240 matrix; T2-weighted fat-saturated (FS) HASTE coronal with an ST of 2 mm; TR/TE, 1500/112; and a 320 × 259 matrix; T1-weighted controlled aliasing in parallel imaging results in higher acceleration axial with an ST of 4 mm; TR/TE, 3.9/1.9; flip angle, 9; and a 384 × 202 matrix; heavily T2-weighted FS fast spin echo axial with an ST of 4 mm; TR/TE, 2400/162; and a 384 × 202 matrix; and thick slab two-dimensional single shot fast spin echo with an ST of 5 mm; TR/TE, 4500/665; and a 348 × 230 matrix. Cases performed before 2015 often contained a respiratory-triggered three-dimensional turbo spin echo (TSE) pulse sequence with fat suppression. Technical parameters were

Table 1. MRCP without Enhancement Protocol

Type of Sequence	Pulse Sequence	Repetition Time (msec)	Echo Time (msec)	Focus of View (mm)	Section Thickness (mm)	Matrix
Axial T2-weighted	HASTE	800	92.0	360 × 270	4	320 × 240
Coronal T2-weighted	HASTE FS	1500	112.0	340 × 340	2	320 × 259
Axial T1-weighted	CAIPIRINHA	3.9 FA: 9	1.9	360 × 270	4	384 × 202
Axial heavily T2-weighted	FSE FS	2400	162.0	350 × 262	4	384 × 202
Oblique	Thick slab 2D SSFSE	4500	665.0	270 × 270	50	348 × 230

CAIPIRINHA = controlled aliasing in parallel imaging results in higher acceleration, FA = flip angle, FS = fat saturation, FSE = fast spin echo, HASTE = half-Fourier acquisition single shot turbo spin echo, MRCP = magnetic resonance cholangiopancreatography, SSFSE = single shot fast spin echo, 2D = two-dimensional

as follows: ST, 1 mm; TR/TE, 3742/695; slice number, 120; flip angle, 125; field of view, 360 mm; and a 384 × 376 matrix. A total of 120 images were reconstructed to complete 39 coronal images with maximum intensity projection (Table 1).

CT Techniques

All CT scans at our institution were obtained using a 64-channel CT scanner (GE discovery CT 750, GE healthcare, Chicago, IL, USA) with the following parameters: section thickness of 3.8 mm, 120 kVp, and 100 mAs; pitch, 1.375:1; table speed, 55 ms; detector collimation, 64 × 0.625 mm. A total of 58 patients underwent routine abdominal and pelvic CT scans that consisted of pre-enhanced and post-enhanced images taken 72 s after a bolus of 110 mL of low osmolar non-ionic contrast medium (Iobrix 300, Accuzen, Taejoon Pharm Co., Seoul, Korea) was introduced at a rate of 2.3−3 mL/s. Nine patients underwent a liver CT protocol consisting of pre, arterial, portal and delayed phases. Two patients underwent biliary CT scans consisting of pre, arterial and portal phases. Another eight patients had outside CT exams and one remaining patient underwent a pre-enhanced scan only.

ERCP Technique

ERCP was performed by an experienced gastroenterologist. All of the procedures were performed under conscious sedation with intravenous midazolam and meperidine using a side-viewing duodenoscope (TJF 260; Olympus Optical, Tokyo, Japan). Under fluoroscopic guidance, the sphincter of Oddi was selectively cannulated with standard or tapered catheters and 10–30 mL 60% iodinated contrast material was injected into the pancreatic and biliary ducts. Appropriate radiograph images of biliary ducts were obtained in all patients.

Imaging Analysis

Two radiologists (one with 7 years of experience and another with 13 years of experience in hepatobiliary imaging) independently and retrospectively reviewed CT and MRCP images according to predetermined uniform criteria, at a picture archiving and communication system workstation (Maroview v5.3, Marotech, Seoul, Korea). Each reviewer interpreted CT and MRCP images with regard to the presence or absence of choledocholithiasis and cholelithiasis. The MRCP images were considered positive for choledocholithiasis when a signal void was observed in at least two planes (axial & coronal) following the axial course of CBD. The fluid level with decreased signal intensity in the dependent portion of dilated CBD was considered sludge. And MRCP images showing intraluminal filling defects in the gallbladder were considered positive for cholelithiasis. Both T2-weighted TSE sequence and T2-weighted HASTE sequences were reexamined for CBD stones in order to rule out flow artifacts. We didn't review raw data of MRCP images in every patient because some MRCP protocol did not included raw data.

CT images were considered positive for choledocholithiasis when intraductal high attenuating focal lesions were observed in unenhanced or enhanced scans following the course of CBD. And CT images showing intraluminal high attenuated focal lesion on pre-enhanced scan were positive for gallbladder stones. Both reviewers were blinded to the other's results and unaware of the ERCP results.

For the purpose of the pathology report, one pathologist analyzed the resected surgical specimen after cholecystectomy.

Statistical Analysis

All the statistical analyses were performed using Medcalc® 7.4.1.0 (MedCalc Software, Mariakerke, Belgium) and SPSS 14.0

(SPSS Inc., Chicago, IL, USA). The description of clinical data was performed using the mean and standard deviation. By using ERCP and stone extraction as a reference standard, the sensitivity, specificity, positive and negative predictive values (NPVs) and diagnostic accuracy of CT, MRCP data were calculated.

Comparison of sensitivity and specificity between CT and MRCP was performed using McNemar's test because the comparison included continuous variables of paired groups. Comparisons of diagnostic accuracy between CT and MRCP were performed using a chi-square test. Kappa statistics were used to analyze the interobserver agreement between the two reviewers. Agreement was considered fair if the k-values range between 0.21−0.40, moderate if they were between 0.41−0.60, good if they were between 0.61−0.80, and very good if the value was greater than 0.81. A p-value of < 0.05 was considered statistically significant.

RESULTS

Clinical Data of the Study Population

Characteristics of the 78 patient participants are listed in Table 2. The mean age of the study population was 66.06 ± 15.63 years (range, 21−94 years); 31 men and 47 women were included. The mean interval between MRCP and ERCP was 1.63 ± 2.82 days

(range, 0−13 days). The mean interval between CT and ERCP was 5.70 ± 10.98 days (range, 0−85 days) and that between CT and MRCP was 4.08 ± 10.44 days (range, 0−83 days).

Comparison of Diagnostic Performance between CT and MRCP for the Detection of Choledocholithiasis and Cholelithiasis

The diagnostic performance of CT and MRCP for the detection of choledocholithiasis is presented in Table 3. The sensitivity of MRCP was determined to be significantly higher than the sensitivity of CT by both reviewers (73.3−75% vs. 50%, $p < 0.001$). Both MRCP and CT modalities showed no significant differences in specificity; however, the accuracy of MRCP was significantly higher than the accuracy of CT (73.1−76.9% vs. 56.4−59%, $p = 0.01$). Both reviewers showed high positive predictive value (PPV) (R1; 93.8−95.7%, R2; 88.2%) but low NPV (R1; 34.8−50%, R2; 31.8−44.4%) in both CT and MRCP for the detection of CBD stones. The kappa value of CT was 0.738 [95% confidence interval (CI); 0.586−0.889]; the kappa value of MRCP was 0.701 (95% CI; 0.538−0.865); therefore, the strength of agreement is considered good.

For reviewer 1, 44 cases displayed true-positive results with MRCP, 16 cases showed true-negative findings, 2 cases showed false-positive findings, and 16 cases showed false-negative findings. For reviewer 2, 45 cases showed true-positive results with MRCP, 12 cases showed true-negative findings, 6 cases showed false-positive findings, and 15 cases showed false-negative findings. The representation of a true-positive case by both reviewers is shown in Fig. 2. A false-positive case and false-negative case are shown in Figs. 3, 4, respectively.

The diagnostic performance of CT and MRCP for the detection of cholelithiasis is shown in Table 4. The sensitivity of MRCP was significantly higher than those of CT by reviewer 2 (97.7%

Table 2. Characteristics of Study Population

	Characteristics of Patients (n = 78)
Age (yr)	66.06 ± 15.63 (range 21−94)
Sex	M:F = 31:47
MRCP-ERCP interval (day)	1.63 ± 2.82 (range 0−13)
CT-ERCP interval (day)	5.70 ± 10.98 (range 0−85)
CT-MRCP interval (day)	4.08 ± 10.44 (range 0−83)

CT = computed tomography, ERCP = endoscopic retrograde cholangiopancreatography, F = female, M = male, MRCP = magnetic resonance cholangiopancreatography

Table 3. Comparison of Diagnostic Performance of CT and MRCP without Enhancement for Detecting Biliary Stones

	Reviewer 1			Reviewer 2		
	CT (95% CI)	MRCP (95% CI)	p–Value	CT (95% CI)	MRCP (95% CI)	p–Value
Sensitivity (%)	50.0 (30/60) (43.4−52.7)	73.3 (44/60) (66.8−76.1)	< 0.001	50.0 (30/60) (43.1−54.4)	75.0 (45/60) (68.2−80.3)	< 0.001
Specificity (%)	88.9 (16/18) (66.8−0.98)	88.9 (16/18) (67.1−0.98)	1.000	77.8 (14/18) (54.9−92.3)	66.7 (12/18) (44.1−84.4)	0.625
PPV (%)	93.8 (30/32) (81.3−98.9)	95.7 (44/46) (87.1−99.2)		88.2 (30/34) (76.1−95.9)	88.2 (45/51) (80.3−94.5)	
NPV (%)	34.8 (16/46) (26.1−38.4)	50.0 (16/32) (37.7−55.1)		31.8 (14/44) (22.4−37.8)	44.4 (12/27) (29.4−56.3)	
Accuracy (%)	59.0 (46/78) (48.8−63.2)	76.9 (60/78) (66.8−81.1)	0.01	56.4 (44/78) (45.8∼63.1)	73.1 (57/78) (62.7−81.3)	0.018

CI = confidence interval, CT = computed tomography, MRCP = magnetic resonance cholangiopancreatography, NPV = negative predictive value, PPV = positive predictive value

vs. 81.4%, *p* = 0.016), however the specificity and overall accuracy of CT and MRCP showed no significant difference by both two reviewers (*p* > 0.05).

Pathologic Results

Among 78 patients, 43 underwent cholecystectomy. Chronic cholecystitis was the most frequent pathology, found in 24 cases, followed by acute cholecystitis, found in 11 cases. The remaining eight cases consisted of two cases of acute on chronic cholecystitis, two cases of xanthogranulomatous cholecystitis, one case of subacute cholecystitis and three miscellaneous cases of gallbladder polyp, cholesterolosis and carcinoid tumor.
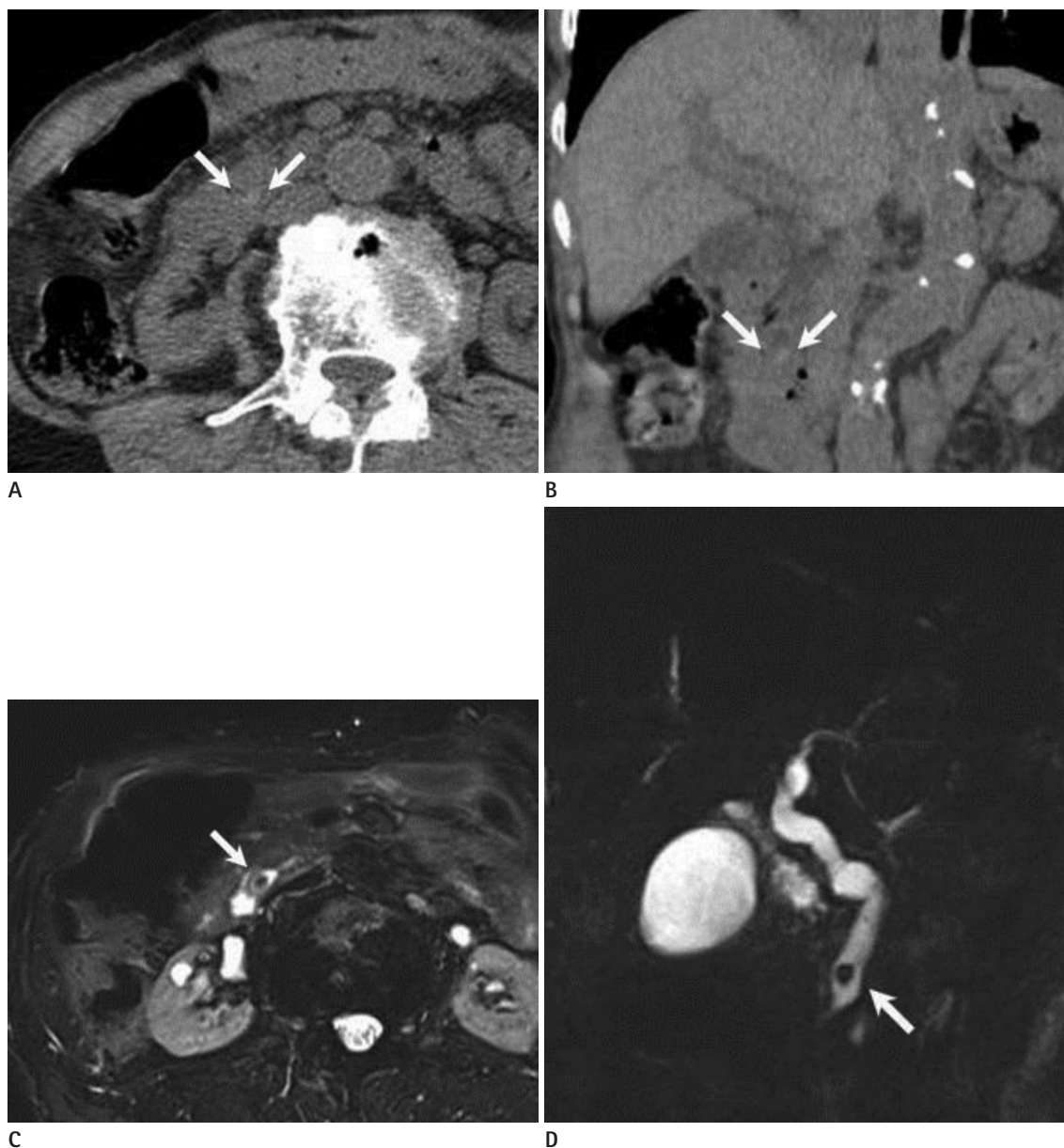

Fig. 2. A 91-year-old female patient, suspected with cholecystitis and true positive MRCP findings for choledocholithiasis.
A, B. Subtle high-attenuating intraductal lesion in far distal CBD is detected retrospectively on unenhanced axial **(A)** and coronal **(B)** CT images (white arrows). Both reviewers interpreted CT as negative for CBD stone.
C, D. Heavily T2-weighted TSE fat-saturated axial **(C)** and triggered 3-dimensional TSE MRCP **(D)** images reveal a visible distal CBD stone (white arrows), which was confirmed with endoscopic retrograde cholangiopancreatography. Both reviewers interpreted MRCP as positive for CBD stone.
CBD = common bile duct, CT = computed tomography, MRCP = magnetic resonance cholangiopancreatography, TSE = turbo spin echo

DISCUSSION

In our study, image analysis by two reviewers revealed that MRCP displayed superior sensitivity and accuracy in the detection of CBD stones as opposed to CT diagnostics.

Previous studies have confirmed the high diagnostic accuracy of MRCP, which is superior to US or CT (1, 8-11). Although the recent meta-analysis reported high specificity (95%) (1), several other studies reported lower specificity (83.3−88%) of MRCP which is similar to our study (12, 13). The specificity of
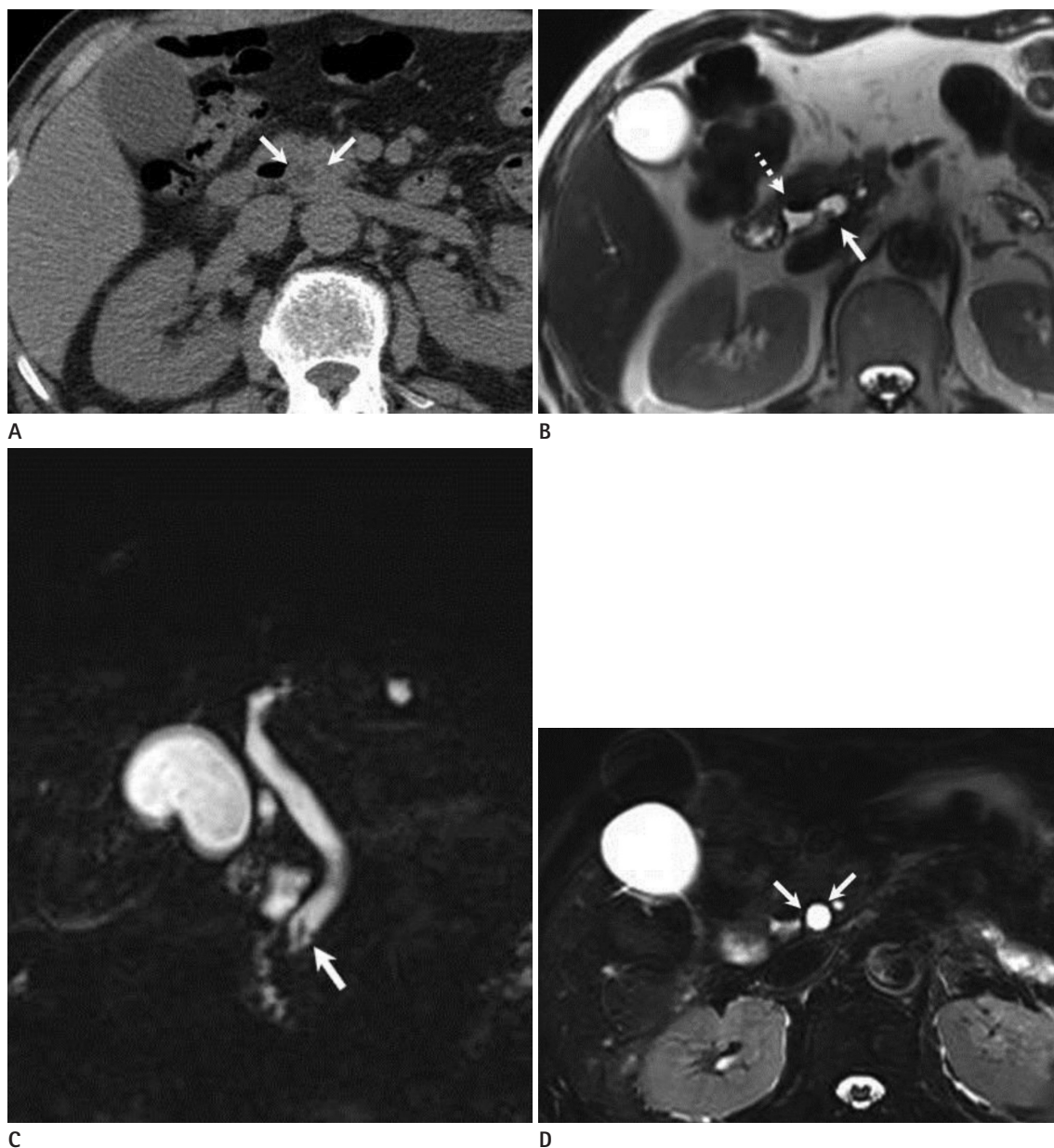
Fig. 3. A 81-year-old male, suspected with cholecystitis and false positive MRCP findings of choledocholithiasis.
A. Unenhanced axial computed tomography image shows no radiopaque bile duct stone in the extrahepatic duct (arrows).
B, C. T2-weighted TSE axial **(B)** and triggered 3-dimensional TSE MRCP **(C)** images shows suspicious intraductal focal signal void in distal CBD (white arrows). Reviewer 2 interpreted MRCP as positive for biliary stone. Small periampullary diverticulum with air fluid level is seen next to distal CBD (arrow with dotted line).
D. Heavily T2-weighted TSE fat-saturated axial image shows no intraductal signal void (arrows), indicating flow artifact rather than true CBD stones. Endoscopic retrograde cholangiopancreatography revealed no presence of CBD stones (not shown).
CBD = common bile duct, MRCP = magnetic resonance cholangiopancreatography, TSE = turbo spin echo

MRCP was not superior to that of CT because CT is relatively specific for the detection of CBD stones. MRCP and CT show comparable specificity not only in previous studies (5, 12), but also in this study.

Therefore, we recommend MRCP as a first-line modality for the detection of CBD stones in patients with suspected chole-
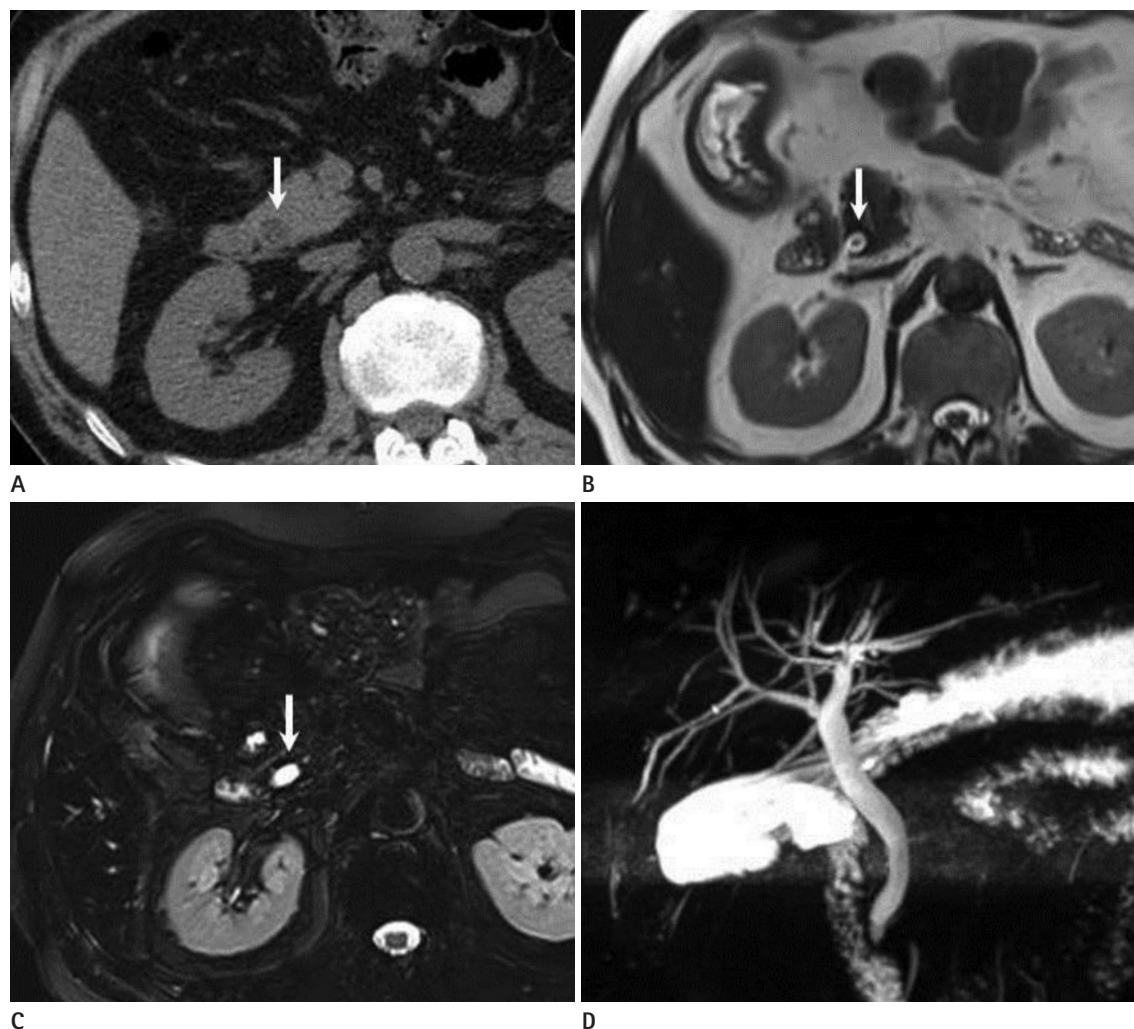

Fig. 4. A 58-year-old male, suspected with cholecystitis and false negative MRCP findings for choledocholithiasis.
A. Unenhanced axial CT image shows no radiopaque stone in the extrahepatic duct (arrow).
B. Focal intraductal signal void in the distal CBD (arrow) is suspected on T2-weighted half-Fourier acquisition single-shot turbo spin-echo axial image.
C, D. This lesion is not visible on other MRCP sequences such as heavily T2-weighted turbo spin-echo fat-saturated (**C**, arrow) and maximal intensity projection reconstruction (**D**) images. Both reviewers interpreted CT and MRCP images as negative for CBD stones. However, cholangiopancreatography revealed a CBD stone, which was removed (not shown).
CBD = common bile duct, CT = computed tomography, MRCP = magnetic resonance cholangiopancreatography

Table 4. Comparison of Diagnostic Performance of CT and MRCP without Enhancement for Detecting Gallbladder Stones

	Reviewer 1			Reviewer 2		
	CT	MRCP	*p*-Value	CT	MRCP	*p*-Value
Sensitivity (%)	86.0 (37/43)	95.3 (41/43)	0.219	81.4 (35/43)	97.7 (42/43)	0.016
Specificity (%)	65.4 (17/26)	50 (13/26)	0.219	61.5 (16/26)	57.7 (15/26)	1.000
PPV (%)	80.4 (37/46)	75.9 (41/54)		77.8 (35/45)	79.2 (42/53)	
NPV (%)	73.9 (17/23)	86.7 (13/15)		66.7 (16/24)	93.8 (15/16)	
Accuracy (%)	78.2 (54/69)	78.2 (54/69)	1.000	73.9 (51/69)	82.6 (57/69)	0.216

CT = computed tomography, MRCP = magnetic resonance cholangiopancreatography, NPV = negative predictive value, PPV = positive predictive value

cystitis. Since MRCP is more sensitive for cholelithiasis than other modalities and provides visual detail of bile duct anatomy, it enables safe cholecystectomy procedures while reducing postoperative complications. Limited protocol MRCP without contrast enhancement can be easily performed and is more time- and cost-efficient than routine MRCP with contrast enhancement. Despite the lack of radiation and even in the absence of contrast media, MRCP is highly accurate in the preoperative detection of CBD stones and other biliopancreatic pathologies (2, 3).

However, MRCP is not specific and cannot guarantee the absence of CBD stones. The specificity of MRCP may limit indications for the detection of small stones less than 5 mm in size (14, 15). Occasionally, there are false-positives and false-negatives. Factors that contribute to false-positive results may include flow artifacts, blood clots, air bubbles, and vascular structures such as the right pancreaticoduodenal artery (16). Two false-positive cases were identified by reviewer 1 and six false-positive cases were identified by reviewer 2, with flow artifact as a contributing influence. To differentiate flow artifact within the tortuous CBD from true CBD sludge, reexamine spin echo sequences using a refocusing 180 pulse additional to HASTE sequence would be recommended; this ensures persistent filling defects seen in the CBD. Spontaneous stone migration during the interval between MRCP and ERCP may also occur (12, 17). In this study, the mean interval between MRCP and ERCP was only 1−2 days. However, some patients experienced a delay of more than 10 days; the possibility of spontaneous migration of biliary stones for patients with longer intervals between MRCP and ERCP cannot be excluded.

MRCP showed high PPV (88.2−95.7%) but low NPV (44.4−50%) in our study, indicating that there were considerable false negatives in both reviewers. As mentioned previously, small sludge occurrences, stones less than 5 mm in diameter, and nondilated CBD less than 8 mm in diameter are potential causes of false-negative results (3, 18). Endoscopic ultrasound (EUS) may be recommended as a second-line modality in cases of negative CBD stones using MRCP in order to rule out small stones (8).

Although several studies comparing EUS and MRCP showed no significant differences between the two modalities in diagnostic performance (19), EUS represents better accuracy in detecting small biliary stones (< 5 mm) (11). A recent study has

demonstrated that calculi smaller than 5 mm may be under-diagnosed in MRCP; nevertheless, MRCP is highly sensitive for the diagnosis of bile duct calculi larger than 5 mm (20). EUS is an invasive and operator-dependent procedure; therefore, inadequate visualization of CBD could be limitations. In addition, EUS is technically demanding in severely ill patients and cannot be performed in patients with altered gastroduodenal anatomy (12). Intraoperative cholangiography (IOC) is another alternative procedure for MRCP. IOC can detect residual CBD stones after endoscopic treatment and prevent biliary tract injury during cholecystectomy (21). However, additional IOC with cholecystectomy increases both the time and cost of operations. It is an invasive and inconvenient procedure, requiring sedation and contrast media, and considerably high false-positive rates up to 26% is another limitation (15). Resource availability, experience, and cost-effectiveness are important factors for consideration when selecting the most clinically appropriate modality of EUS, IOC, or MRCP. The preference to use MRCP results from superior effectiveness, safety and convenience in comparison to other invasive procedures.

We suggest a diagnostic algorithm consisted of MRCP as a preoperative first line modality for patients with suspected cholecystitis. The presence of CBD stones may indicate ERCP with stone extraction followed by cholecystectomy. In the absence of CBD stones, the surgeon may perform cholecystectomy directly. Cases in which MRCP findings for CBD stones are considered negative but abnormal laboratory results, jaundice or dilated CBD (> 8 mm) persist, EUS or confirmative ERCP may compensate the issue of low NPV in MRCP. The possibility of microcalculi can be also ruled out with careful clinical follow-up and therefore, clinicians can avoid useless invasive ERCP and related morbidity according to this algorithm.

This study had some limitations. First, it was a retrospective study; therefore, the MRCP protocol was heterogeneous. MRCP performed early in the study period is limited by only two or three sequences which include T2-weighted HASTE image and single-shot thick slab image. However, these were instrumental sequences for imaging analysis. Although the CT protocol was also heterogeneous, all the CT exams included unenhanced scans, which were substantial for stone evaluation. Second, the mean interval of CT-ERCP and CT-MRCP was approximately 4−6 days; however, some cases exceeded 80 days between diag-

nostic procedures. Therefore, CBD stones could be passed spontaneously between CT-MRCP or CT-ERCP intervals and can alter diagnostic performance. Third, imaging analysis of CT and MRCP were performed in the same day for several cases; therefore, bias may be present in the image interpretation. However, both reviewers analyzed images according to the predetermined criteria for CBD stones in CT and MRCP. Fourth, the entire study population did not undergo cholecystectomy. However, ERCP, the reference standard, was performed for all patients.

In conclusion, limited protocol MRCP without enhancement represented better diagnostic performance for choledocholithiasis than CT with reliable interobserver agreement. Considering the absence of radiation and contrast media, MRCP is appropriate for a first-line preoperative modality in evaluation of CBD stone in patients with suspected cholecystitis.

Acknowledgments

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담낭염 의심 환자들에서 담도결석 진단을 위한 자기공명 담췌관 조영술의 역할

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목적: 담낭염이 의심되는 환자들에서 자기공명 담췌관 조영술(magnetic resonance cholangiopancreatography; 이하 MRCP)의 역할을 알아보고자 하였다.

대상과 방법: 2013년 1월부터 2015년 2월 사이에 담낭염 증상으로 computed tomography (이하 CT), MRCP와 역행성 담췌관 조영술(endoscopic retrograde cholangiopancreatography)을 시행받은 총 78명의 환자들이 포함되었다(평균 나이 66.06 ± 15.63세; 나이 범위 21~94세, 남:여 = 31:47). 두 명의 검토자가 독립적으로 담도결석과 담낭결석 여부에 대해 CT와 MRCP 영상을 분석하였고, CT와 MRCP의 진단능(민감도, 특이도, 양성예측도, 음성예측도, 정확도)을 비교하였다. 관찰자 간 일치도는 k 계수를 이용해 측정하였다.

결과: 43명의 환자가 담낭절제술을 시행받았다. 담낭결석에 대한 정확도는 CT와 MRCP 사이에 유의한 차이가 없었다. 두 명의 검토자 모두에서 담도 결석에 대한 민감도와 정확도는 MRCP가 CT보다 우월하였다(검토자 1: MRCP 민감도 73.3%, 정확도 76.9%; CT 민감도 50%, 정확도 59%; *p* = 0.01, 검토자 2: MRCP 민감도 75%, 정확도 73.1%; CT 민감도 50%, 정확도 56.4%; *p* = 0.018). 관찰자 간 일치도는 CT (k 계수: 0.738)와 MRCP (k 계수: 0.701)가 일관되게 나타났다.

결론: MRCP는 담도결석을 진단하는 데 있어 우월한 진단능을 보였고 관찰자 간 일치도 또한 신뢰할 만하였다. 방사선 조사와 조영제가 없다는 것을 고려한다면, MRCP가 담낭염 의심 환자의 담도결석을 진단하는 첫 번째 검사로 적합하겠다.

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