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Comparison of Endoscopic Ultrasonography and Magnetic Resonance Cholangiopancreatography in the Diagnosis of Pancreatobiliary Diseases: A Prospective Study

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OBJECTIVES: To compare the diagnostic value of endoscopic ultrasonography (EUS) and magnetic resonance cholangiopancreatography (MRCP) in: (a) patients with a dilated biliary tree unexplained by ultrasonography (US) (group 1), and (b) the diagnosis of choledocholithiasis in patients with nondilated biliary tree (group 2).

METHODS: Patients were prospectively evaluated with EUS and MRCP. The gold standard used was surgery or EUS-FNA and ERCP, intraoperative cholangiography, or follow-up when EUS and/or MRCP disclosed or precluded malignancy, respectively. Likelihood ratios (LR) and pretest and post-test probabilities for the diagnosis of malignancy and choledocholithiasis were calculated.

RESULTS: A total of 159 patients met one of the inclusion criteria but 24 of them were excluded for different reasons. Thus, 135 patients constitute the study population. The most frequent diagnosis was choledocholithiasis (49% in group 1 and 42% in group 2, $P = 0.380$) and malignancy was more frequent in group 1 (35% *vs* 7%, respectively, $P < 0.001$). When EUS and MRCP diagnosed malignancy, its prevalence in our series (35%) increased up to 98% and 96%, respectively, whereas it decreased to 0% and 2.6% when EUS and MRCP precluded this diagnosis. In patients in group 2, when EUS and MRCP made a positive diagnosis of choledocholithiasis, its prevalence (42%) increased up to 78% and 92%, respectively, whereas it decreased to 6% and 9% when any pathologic finding was ruled out.

CONCLUSIONS: EUS and MRCP are extremely useful in diagnosing or excluding malignancy and choledocholithiasis in patients with dilated and nondilated biliary tree. Therefore, they are critical in the approach to the management of these patients.

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INTRODUCTION

The diagnosis of pancreatobiliary diseases is a common problem in clinical practice. It is known that ultrasonography (US) is not accurate enough in the diagnosis of the etiology of biliar obstruction due to the presence of air preventing a correct ultrasound transmission (1–3). On the other hand, the presence of stones in the main bile duct may be difficult to demonstrate particularly when the biliary tree is not dilated (4). Endoscopic retrograde cholangiopancreatography (ERCP), that has been classically performed to study pancreatobiliary diseases, is associated with a significant risk of serious complications such as pancreatitis, hemorrhage, perforation, cholangitis, and even death (5). Therefore, an effort to safely and accurately image the pancreatobiliary area has been made in the last few decades.

Endoscopic ultrasonography (EUS) and magnetic resonance cholangiopancreatography (MRCP) have emerged as two low-risk diagnostic techniques with good performance for the diagnosis of biliopancreatic diseases (6–18). Although both techniques have already been compared in this setting, the studies published up to now have small sample sizes and include heterogeneous populations, so it is not possible to obtain from them conclusions definitive enough to be applied in clinical practice (19–23). There are two common situations in patients with pancreatobiliary diseases that have not

been specifically studied, and so the dilemma of choosing the most accurate technique frequently arises: common bile duct dilation with no visible cause on US and suspicion of choledocholithiasis in patients with nondilated biliary tree. Therefore, the aims of the present study were to prospectively and blindly compare the diagnostic value of EUS and MRCP in: (a) the etiologic diagnosis of patients with a dilated biliary tree unexplained by US and (b) the diagnosis of choledocholithiasis in patients with nondilated biliary tree.

PATIENTS AND METHODS

This prospective study was conducted following the STARD statement for reporting studies of diagnostic accuracy (24). It was approved by the institutional review board of the Hospital Clínic, Barcelona, and written informed consent was obtained from all patients.

Study Population

The study was performed between March 2001 and July 2004. To avoid selection bias, all consecutive patients evaluated in the departments of gastroenterology and surgery were asked to participate in this prospective investigation if they met one of the following inclusion criteria: (a) unexplained common bile duct dilation in standard US, independently of clinical symptoms (group 1) and (b) a nondilated common bile duct and a high probability of having choledocholithiasis (cholangitis, jaundice, nonsevere pancreatitis, alkaline phosphatase [ALP] < twice the upper normal limit [UNL] or increased gamma glutamyl trasferase [GGT], alanine aminotransferase [ALT] or aspartate aminotransferase [AST]) (3, 25) (group 2). Although the indication of EUS and MRCP prior to ERCP in this latter group could be discussed, we chose these patients in order to obtain a high prevalence of choledocolithiasis for our study purposes. For ethical reasons, patients with severe pancreatitis were not included since an early ERCP with sphincterotomy is indicated.

Exclusion criteria were (a) contraindications to MRCP (claustrophobia, pacemaker, or any prosthesis contraindicating MR), (b) predictable impossibility to perform a complete exploration of the pancreatobiliary area by EUS (*i.e.*, gastroenteroanastomosis or stenosis), and (c) refusal or inability to provide informed consent.

METHODS

EUS and MRCP were performed within a 24-h period after inclusion in order to minimize the chances of a negative study due to stone passage, and the sequence of the examinations was randomly assigned. To ensure blinding, each examination was performed by a different operator unaware of the result of the other procedure.

The diameter of common bile duct and the site and cause (stones, tumor, or other) of the obstruction were systematically investigated. The common bile duct was considered normal in absence of thickened wall and when the maximum diameter was less than or equal to 7 mm (10 mm in patients with previous cholecystectomy).

In the patients in whom EUS and/or MRCP disclosed malignancy, the gold standard used was the pathological examination of the resected specimen or the cytology obtained by EUS-FNA. In patients without suspicion of malignancy, the final diagnosis was established by means of ERCP or intraoperative cholangiography. When ERCP was performed, opacification of the biliary tree and pancreatic duct was carried out. Moreover, an endoscopic sphincterotomy was systematically conducted after opacification of the common bile duct and the observation of a calculi or biliar sludge emerging through the papilla was considered as gold standard. ERCP was done without knowledge of the results of EUS and MRCP, preventing an overestimation of the tests' accuracy. In patients in whom surgery or ERCP was not performed because of the disappearance of clinical symptoms, normalization of laboratory abnormalities, and lack of abnormalities on EUS and MRCP, clinical follow-up for at least 6 months was used as the gold standard.

EUS Imaging

EUS was performed with a 360° radial echoendoscope, Olympus® GF UM20 or GF UM160 (Olympus Optical Co., Hamburg, Germany). All the procedures were performed under conscious sedation, as previously described (26). Briefly, patients were lying in a left lateral position, with the transducer placed in the distal portion of the second portion of the duodenum and gradually drawn back to the stomach.

The balloon at the tip of the instrument was filled with deaerated water to improve visualization, and water was also instilled in the duodenal lumen to assist coupling. This provides clear visualization of the papilla, common bile duct, hepatic duct, cystic duct, gallbladder, portal vein, hepatic artery, and pancreatic head. EUS was performed by three experienced endosonographers (G.F., A.G., and M.P.) unaware of the results of MRCP if already done.

EUS diagnostic criteria for choledocholithiasis was the visualization of one or more hyperechoic images inside the common bile duct with or without acoustic shadow (Fig. 1). Biliary sludge was diagnosed if small echos not associated with shadowing were seen in the lumen of the bile duct. Hypoechoic masses located in the pancreas, in the wall of the biliary tree, or close to the papilla were considered as tumors (Fig. 2).

MR Imaging

The MRCP examination was performed with a 1.5-T MRI scanner (Signa CVi, General Electric Medical Systems, Milwaukee, WI) with a body phased-array coil. Investigations were performed on fasting patients who were lying supine. A set of axial breath-hold FSPGRE T1-weighted images with fat-saturation and SSFSE T2-weighted images through the liver and pancreas were obtained. Cholangiographic sequences included SSFSE T2-weighted images with thick collimation (single section) in the oblique coronal plane, and thin

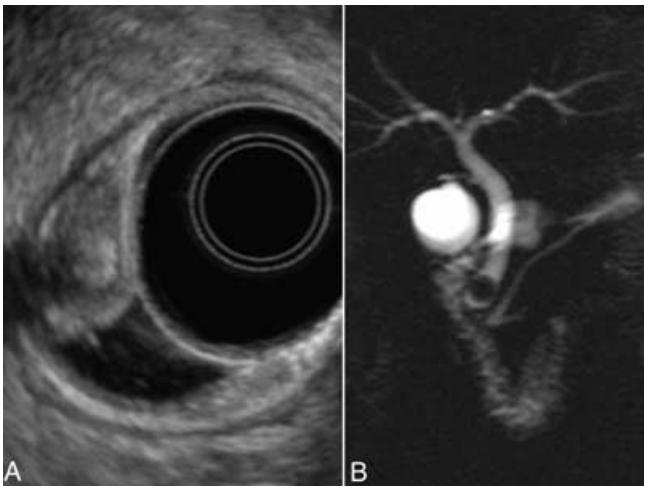

Figure 1. Typical image of choledocholithiasis: (*A*) EUS: hyperechoic spot inside the papilla with acoustic shadow. (*B*) MRCP: round area of hypointensity inside the lumen of the hyperintense bile duct.

collimation (multisection) in the coronal and axial plane. MR studies were assessed in consensus by two abdominal radiologists (M.S., M.P.) unaware of the results of EUS if done.

Common bile duct stone was diagnosed at MRCP when a round, oval, or multifaceted area of signal void (hypointensity) was present inside the lumen of the hyperintense bile duct (Fig. 1). Sludge was considered to be present if low-intensity sediments without signal voids equal to or larger than 2 mm were observed (27). When a neoplasm was suspected in the MRCP examination, an additional dynamic FSPGRE T1-weighted image was acquired after IV administration of 0.2 mL/kg gadopentate dimeglumine. Tumors appeared as a pancreatic hypointense mass on fat-saturated T1-weighted sequences (Fig. 2), a thickened choledochal wall, or an enlarged papilla.

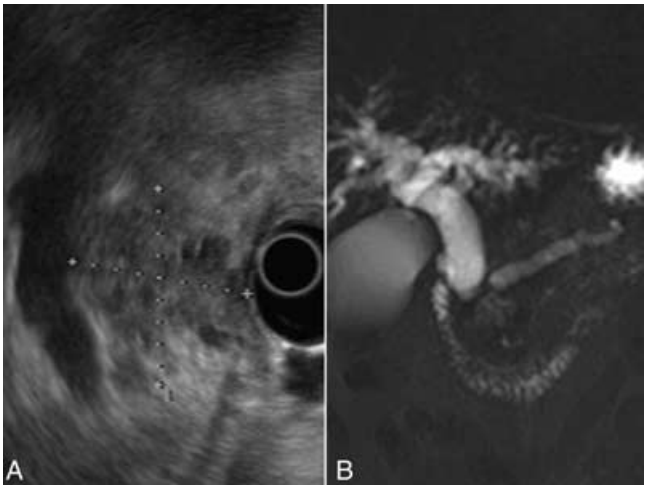

Figure 2. Adenocarcinoma in the pancreatic head: (*A*) EUS image: hypoechoic mass located in the pancreas that contacts with mesenteric vein. (*B*) MRCP: pancreatic hypointense mass with a dilated biliary tree and pancreatic duct.

Statistical Analysis

The sample size was calculated for achieving 80% power to detect an odds ratio of 8 using a two-sided McNemar test with a significance level of 0.05. The mentioned odds ratio is equivalent to a difference between two paired proportions of 15% (which has been considered the smallest clinically significant difference between the two techniques under investigation) (28) that occurs when the proportions in the discrepant cells of the 2 × 2 table (EUS *vs* MRCP) are 16% and 2%, respectively. This calculation was performed using the program PASS 2002 (29). Continuous variables are expressed as mean ± standard deviation. Comparisons between them were done by Student's *t*-test. Comparisons between qualitative variables were performed using the χ^2 test with the Yates' correction when needed.

Sensitivity, specificity, positive and negative predictive values, and accuracy for EUS and MRCP with their 95% confidence interval (CI) were calculated using the standard formulas according to the corresponding gold standard for the two study groups, using the following end points: detection of any cause of obstruction, diagnosis of malignancy, or diagnosis of choledocolithiasis in group 1 and diagnosis of choledocholithiasis in group 2. Concordance between EUS and MRCP was assessed using the McNemar test that evaluates if the discrepancies between both techniques are higher than those observed by chance alone.

To evaluate the clinical impact of EUS and MRCP in the two study groups, likelihood ratios (LR) and pre and post-test positive and negative probabilities of diagnosing either malignancy or choledocholithiasis were calculated. The positive likelihood ratio (positive LR) is used to assess how much the probability of disease increases if the test is positive, while the negative likelihood ratio (negative LR) informs on how much it decreases if the test is negative. Due to the lack of published data on the prevalence of disease (tumor or lithiasis) in patients with common bile duct dilation unexplained by standard US, the pretest probability for group 1 was considered to be the prevalence of tumor or lithiasis in our series, as determined by the gold standard. For the same reason, the pretest probability of having choledocholithiasis in group 2 was considered to be the prevalence of this condition as assessed by the gold standard.

All calculations were made using the SPSS statistical package (SPSS Inc., Chicago, IL).

RESULTS

Between March 2001 and July 2004, one hundred seventy-two patients were considered for inclusion, of whom 13 were excluded because of the presence of one of the exclusion criteria (claustrophobia N = 4, pacemaker N = 3, gastroenteroanastomosis N = 2, lack of informed consent, N = 4). Therefore, one hundred fifty-nine patients (70 men and 89 women) met one of the inclusion criteria during the study period (group 1 N = 75, group 2 N = 84). Twenty-four patients (15%) were excluded from the analysis for different reasons:

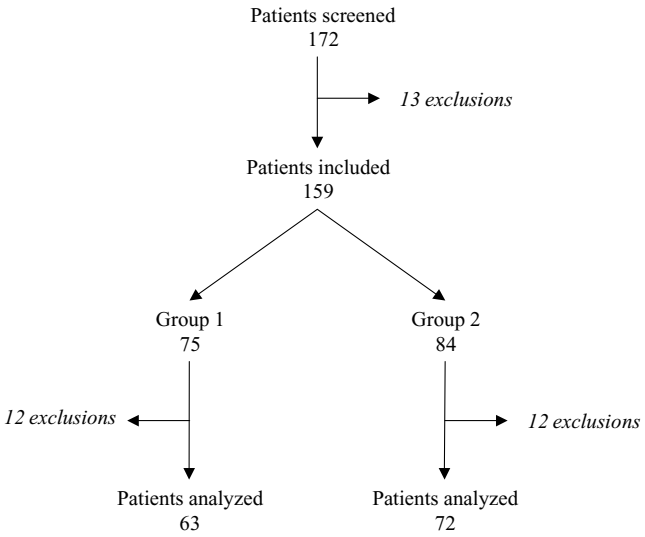

Figure 3. Flow chart of the study.

lack of gold standard (N = 8), no EUS (N = 6), no MRCP (N = 7), and no EUS nor MRCP (N = 3). Thus, 135 patients (group 1 N = 63, group 2 N = 72) constitute the final sample of this study (Fig. 3). Mean age was 68 ± 15 yr (mean ± SD). EUS was performed before MRCP in 70 cases.

The gold standard was ERCP with sphincterotomy in 80 patients, surgery in 19, EUS-FNA in 7, and intraoperative cholangiography in 3 patients. In 26 patients in group 2 an ERCP was not performed because of disappearance of clinical symptoms, normalization of laboratory abnormalities, and lack of abnormalities on EUS and MRCP. All these patients were followed up for at least 6 months and none of them developed biliary complications or laboratory abnormalities. When follow-up was used as gold standard, mean time was 5.8 ± 3.9 months. Mean time between EUS/MRCP and ERCP was 11 ± 13 days (range 1–73 days) and 30 ± 31 days (range 1–106 days) between EUS/ERCP and surgery.

Characteristics of the patients in the two study groups and final diagnosis are described in Table 1. The most frequent

Table 1. Characteristics of Patients With Dilated (Group 1) and Nondilated (Group 2) Biliary Tree

	Group 1 N = 63	Group 2 N = 72	*P*
Age	70 ± 14	66 ± 16	0.187
Gender (M/F)	27/36	34/38	0.611
Serum bilirubin (mg/dL)	6.9 ± 9.2	4.6 ± 5.1	0.085
Common bile duct size (mm)	11 ± 4	6 ± 2	<0.001
Malignancy (%)	22 (35%)	5 (7%)	<0.001
No pathologic findings (%)	6 (9%)	32 (44%)	<0.001
Final diagnosis			
Choledocholithiasis	31 (49%)	30 (42%)	0.380
Cholelithiasis + NBT	2 (3%)	5 (7%)	0.324
Pancreatic cancer	14 (22%)	2 (3%)	<0.001
Other	10 (17%)	3 (4%)	<0.05

Table 2. Clinical and Laboratory Characteristics of Patients With Malignant and Benign Conditions in Patients With Biliary Tree Dilation (Group 1, N = 63)

	Malignancy N = 22	Benign Condition N = 41	*P*
Age	71 ± 12	69 ± 15	0.527
Gender (M/F)	8 /15	19/21	0.326
Bilirubin	13.7 ± 12	2.9 ± 3	<0.001
ALT	356 ± 232	222 ± 206	<0.05
AST	208 ± 111	153 ± 226	0.361
GGT	969 ± 617	503 ± 411	0.001
APL	1,287 ± 866	679 ± 443	0.001
Common bile duct size (mm)	13 ± 4	10 ± 4	0.01
Cholecystectomy	2	8	0.237
Cholelithiasis	28	15	0.063

diagnosis in the two groups of patients was choledocholithiasis (49% in group 1 and 42% in group 2, $P < 0.380$). As expected, the diagnosis of malignancy was more frequent in group 1 than in group 2 (35% *vs* 7%, respectively, $\chi^2 = 14.7$, $P < 0.001$). In group 1, age and the presence of cholelithiasis did not differ between patients with malignant or benign obstruction. By contrast, serum levels of bilirubin, ALT, GGT, and ALP as well as the diameter of the common bile duct were significantly higher when a malignancy was the cause of obstruction (Table 2). No pathologic findings were found in 9% and 44% of patients in groups 1 and 2, respectively ($\chi^2 = 18.6$, $P < 0.001$).

The acceptance of EUS and MRCP was good in all cases and no complications occurred.

Diagnostic Accuracy of EUS and MRCP

GROUP 1. Performance characteristics of EUS and MRCP in patients with unexplained common bile duct dilation in standard US are described in Table 3.

EUS was more sensitive and MRCP more specific in identifying any cause of obstruction, but the differences did not reach statistical significance. The accuracy was similar in both techniques. EUS gave false-positive results in 3 cases (choledocholithiasis in 1 case and choledochal sludge in 2 cases) and had no false-negative results. In the case of MRCP, there was 1 false-positive diagnosis of ampulloma and 4 false negative results (1 ampuloma, 1 choledocholithiasis, and 2 choledochal sludge).

To assess whether differences between EUS and MRCP are of clinical relevance, likelihood ratios and the post-test probability of disease were also calculated. On the other hand, since clinically relevant information is whether the cause of obstruction is a tumor or stones, we analyzed separately patients with a final diagnosis of tumor and those with a definitive diagnosis of common bile duct stones. In this regard, when EUS and MRCP diagnosed malignancy, the probability of having it increased from 35% (prevalence or pretest probability) to 98% and 96%, respectively (positive LR 99 and 47,

Table 3. Performance Characteristics With Their 95% Confidence Interval of EUS and MRCP in the Diagnosis of the Cause of Obstruction, Malignancy, and Choledocholithiasis in Patients With Dilated Biliary Tree (group 1)

	Se (%)	Sp (%)	PPV (%)	NPV (%)	Accuracy (%)
Diagnosis of Cause of Obstruction					
EUS	100 (95–100)	62 (24–91)	95 (86–99)	100 (55–100)	95 (87–99)
MRCP	93 (82–98)	87 (47–100)	98 (90–100)	64 (31–89)	92 (82–97)
Diagnosis of Malignancy					
EUS	100 (87–100)	100 (93–100)	100 (87–100)	100 (93–100)	95 (95–100)
MRCP	95 (77—100)	98 (87–100)	95 (77–100)	98 (87–100)	97 (89–100)
Diagnosis of Choledocholithiasis					
EUS	100 (91–100)	91 (75–98)	91 (76–98)	100 (90–100)	95 (87–100)
MRCP	90 (74–98)	100 (91–100)	100 (90–100)	91 (77–98)	95 (87–99)

*$P > 0.05$ in all cases.

respectively). On the contrary, when EUS and MRCP ruled out malignancy, the probability of having it decreased from 35% to 0% and 2.6%, respectively (negative LR 0 and 0.05, respectively). Similarly, if EUS and MRCP diagnosed choledocholithiasis, the probability of having it increased from 49% (prevalence or pretest probability) to 84% and 99%, respectively (positive LR 11 and 90, respectively). On the contrary, when EUS and MRCP ruled out this diagnosis, the probability of having choledocholithiasis decreased from 49% to 0% and 9%, respectively (negative LR 0 and 0.1, respectively) (Table 4).

GROUP 2. Performance characteristics of EUS and MRCP in patients with clinical suspicion of choledocholithiasis without common bile duct dilation at standard US are described in Table 5. MRCP was more specific and EUS more sensitive in diagnosing choledocholithiasis in this group of patients but, again, no statistically significant differences were found between both techniques. The accuracy of both techniques was similar. EUS gave a false-positive result in 8 cases (4 with diagnosis of choledocholithiasis and 4 with choledochal sludge) and was false negative in 3 (1 patient with a pancreatic cancer in the uncinated process and 2 with choledocholithiasis). The pancreatic cancer was seen on MRCP but this technique was also negative in the 2 patients with choledocholithiasis. On the other hand, 3 MRCP showed false-positive results (1 Klatskin tumor, 1 choledocholithiasis, and 1 choledochal sludge), and 4 false-negative results (choledocholithiasis in all cases).

To assess the clinical relevance of these results, the post-test probability of having choledocholithiasis was calculated. The prevalence of choledocholithiasis (pretest probability) is 42% in our series (Table 1). When EUS and MRCP made a positive diagnosis, the probability of having it increased from 42% to 78% and 92%, respectively (positive LR 5 and 17, respectively). Conversely, if EUS and MRCP ruled out any pathologic finding, the probability of choledocholithiasis decreased from 42% to 6% and 9%, respectively (negative LR 0.08 and 0.1, respectively) (Table 4).

Concordance EUS/MRCP

EUS and MRCP disagreed in only 16 of the 135 patients (11.8%: group 1, N = 6 and group 2, N = 10). According to the gold standard, EUS was correct in 7 patients whereas MRCP was right in the remaining 8. Final diagnosis in these 16 patients was choledocholithiasis (N = 5: 3 patients in group 1 and 2 patients in group 2), ampulloma (one patient in group 1), or no abnormalities (N = 10: 2 patients in group 1 and 8 patients in group 2). No tumor was missed by both techniques in this set of patients.

DISCUSSION

The present study is a prospective and blind comparison between EUS and MRCP in pancreatobiliary diseases focused on two relevant clinical populations that represent a diagnostic problem in clinical practice and that have not been specifically assessed in previous investigations: those with dilated biliary tree and no etiological diagnosis after standard US and those suspected of having choledocholithiasis without biliary tree dilation. Up to now, both techniques had been compared in heterogeneous study populations (patients with and without a visualized cause of obstruction and with and without common bile duct dilation). More specifically, patients with unexplained dilated biliary tree on transabdominal US had never been studied as a group.

Table 4. Pre- and Post-test Positive and Negative Probabilities of Diagnosing Malignancy and Choledocholithiasis

	Prevalence (Pretest Probability)	(Post-test Probabilities)			
		EUS +	EUS −	MRCP +	MRCP −
Group 1					
Malignancy	35%	98%	0%	96%	2.6%
Choledocholithiasis	49%	84%	0%	99%	9%
Group 2					
Choledocholithiasis	42%	78%	6%	92%	9%

Table 5. Performance Characteristics of EUS and MRCP in the Diagnosis of Choledocholithiasis in Patients With *Non*dilated Biliary Tree (group 2)

	Se (%)	Sp (%)	PPV (%)	NPV (%)	Accuracy (%)
EUS	93 (78–99)	81 (66–91)	78 (61–90)	94 (81–99)	86 (76–98)
MRCP	87 (69–96)	95 (84–99)	93 (76–99)	91 (78–97)	92 (83–97)

*$P > 0.05$ in all cases.

Similarly, patients with choledocholithiasis had always been studied without separating them according to the size of the common bile duct. Therefore, the main issue was discerning how confident one might be when applying the data existing in the literature to the patients in clinical practice. Moreover, likelihood ratios and post-test probabilities had never been calculated in this setting. These calculations allow for the application of the results to a particular case, helping physicians in caring for their patients.

Our results show that EUS is more sensitive and MRCP more specific in both study groups, although differences are not statistically significant. It is important to point out that only one tumor was missed with each technique (one ampuloma and a small tumor in the uncinatus process), which was diagnosed with the other technique. In contrast, most false-positive and false-negative results were related to choledocholithiasis and occurred in patients with a nondilated biliary tree (group 2). Reasons for false-positive results are difficult to ascertain, but intraductal artifacts such as blood or air (pneumobilia) or image reconstruction artifacts may have been potential pitfalls (30–33). On the other hand, the gold standard used was ERCP with sphincterotomy in 86 patients and intraoperative cholangiography in 23 patients. Although both are accepted reference tests for choledocholithiasis in the medical literature, it is obvious that a minilithiasis or a small amount of sludge may be missed. Furthermore, the delay between EUS or MRCP and the reference test may account for some of the false-positive results, since it is known that spontaneous migration of the lithiasis may occur.

The results of a recently published review on the comparison of EUS and MRCP for detection of choledocholithiasis are consistent with those of the present investigation although the study populations are different (34). The strengths of the present study are the following: first, reference bias has been avoided by recruiting patients from emergency care, inpatient and outpatient clinic who cover all the spectrum of the disease. Second, the independent and blinded comparison of the EUS and MRCP results with a reference standard enhances the internal validity of the study. Finally, the use of follow-up as gold standard in patients with no pathological findings at EUS and MRCP overcomes verification bias.

Concerning concordance between the compared techniques, the present study demonstrates that both tests usually agree and they are correct. These two facts had never been assessed in the two study groups in a prospective, comparative, and blinded manner.

According to our results, in patients with dilated biliary tree, EUS and MRCP increase the pretest probability of accurately diagnosing malignancy as the cause of obstruction from 35% (prevalence of malignancy in our series) to 98% and 96%, respectively. Contrarily, the probability of having a malignancy causing biliary obstruction decreases from 35% to 0% and 2.6% when EUS and MRCP preclude it. According to these results, both EUS and MRCP are extremely useful to diagnose or exclude malignancy as the cause of obstruction. The probability that the cause of obstruction is choledocholithiasis increases from 49% (prevalence in our series) to 84% and 99% with EUS and MRCP, respectively, if they disclose this diagnosis. On the contrary, this probability decreases from 49% to 0% and 9% if they rule out lithiasis as the cause of obstruction, demonstrating that both techniques under evaluation are also very useful in this setting. In patients with nondilated biliary tree and suspicion of choledocholithiasis, even if the results are not so impressive, both techniques were also very useful (Table 4). Although post-test probabilities may change among different study populations due to variations in the prevalence of tumors and stones, the performance of EUS and MRCP is good enough to allow the generalization of the results of the present investigation.

In conclusion, there are no significant differences in the performance of EUS and MRCP for diagnosing or excluding malignancy and choledocholithiasis in patients with dilated and nondilated biliary tree, and both are extremely useful. Therefore, the use of either one may be based on reasons other than its performance, such as availability or economical issues.

STUDY HIGHLIGHTS

What Is Current Knowledge

- Endoscopic ultrasonography (EUS) and magnetic resonance cholangiopancreatography (MRCP) are low-risk diagnostic techniques with good performance for the diagnosis of biliopancreatic diseases.

What Is New Here

- EUS and MRCP are extremely useful in diagnosing or excluding malignancy and choledocholithiasis in patients with dilated and nondilated biliary tree, and so they are critical in the approach to patient management. Therefore the use of EUS or MRCP in this setting may be based on reasons other than its performance, such as availability or economical issues.
- Concordance between EUS and MRCP in these patients is high and they are usually right.

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CONFLICT OF INTEREST

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