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Original Article

Secretin-stimulated magnetic resonance imaging/magnetic resonance cholangiopancreatography for the detection of chronic pancreatitis: A meta-analysis

Yuanyuan Liu [1], Xingju Zheng [1], Zixing Huang, Jie Chen, Bin Song*

Division of Radiology, West China Hospital of Sichuan University, Chengdu 610041, China

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of secretin-stimulated magnetic resonance imaging/magnetic resonance cholangiopancreatography (S-MRI/MRCP) as noninvasive modalities in detecting chronic pancreatitis (CP).

Methods: A systematic literature search in the PubMed, EMBASE, Web of Science, Cochrane, and Chinese Biomedical Literature Databases to identify relevant original studies. Study quality was assessed using the Quality Assessment of Diagnostic Accuracy Studies (version 2). Study data were independently extracted to calculate sensitivity and specificity, as well as areas under summary receiver operating characteristic curves (AUCs), and to test for heterogeneity and the threshold effect.

Results: The sample comprised 11 studies including 180 patients with CP and 340 patients without CP. Pooled sensitivity and specificity were 0.72 (95% confidence interval [CI] 0.65–0.78) and 0.87 (95% CI 0.83–0.90), respectively. Pooled positive and negative likelihood ratios were 4.99 (95% CI 2.59–9.61) and 0.32 (95% CI 0.19–0.54), respectively. The diagnostic odds ratio was 23.31 (95% CI 7.50–72.44). The AUC and Q^* index were 0.8631 and 0.7937, respectively. Publication bias was absent ($P = 0.64$).

Conclusions: S-MRI/MRCP had low sensitivity and moderately high specificity for the detection of CP. Large-scale, quality-controlled, prospective studies are needed to verify the diagnostic accuracy of these modalities.

Introduction

Chronic pancreatitis (CP) is an inflammatory disease characterized by irreversible pancreatic parenchymal and ductal changes, as well as exocrine and/or endocrine dysfunction. CP is associated with a mortality rate of 50% within 20–25 years, and an increased risk of pancreatic cancer [1]. Early-stage diagnosis of CP is thus important.

Endoscopic retrograde cholangiopancreatography (ERCP) and pancreatic function tests (especially the direct function test) are considered to be the most sensitive and accurate modalities for the diagnosis of CP, and they enable early diagnosis [2–4]. Because of discrepancies between morphological and functional changes, especially in patients with mild CP [5–9], the combined use of these two methods is recommended for early diagnosis. However, both modalities are invasive, time consuming, and operator dependent. Post-ERCP pancreatitis is an uncommon complication of ERCP [10,11]. A convenient, safe, and accurate modality for early CP diagnosis is thus needed.

Magnetic resonance imaging/magnetic resonance cholangiopancreatography (MRI/MRCP) is becoming the first choice for the diagnosis of CP. Unlike ERCP, MRCP is noninvasive and enables visualization of the pancreatic duct without the use of contrast medium or radiation. However, MRCP does not allow the routine recognition of early ductal abnormalities (especially alteration of side branches) in patients with early-stage CP, leading to a high

Abbreviations: ADC, apparent diffusion coefficient; AUC, area under the summary receiver operating characteristic curve; CI, confidence interval; CP, chronic pancreatitis; DW, diffusion-weighted; ERCP, endoscopic retrograde cholangiopancreatography; FN, false negative; FP, false positive; S-MRI/MRCP, secretin-stimulated magnetic resonance imaging/magnetic resonance cholangiopancreatography; SROC, summary receiver operating characteristic curve; TN, true negative; TP, true positive.

* Corresponding author. Tel.: +86 18980601592.
E-mail address: binsong65@yahoo.com (B. Song).

[1] Yuanyuan Liu and Xingju Zheng contributed equally to this work.

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false-negative (FN) rate [12,13]. Secretin can improve the delineation of ductal morphology (including side branches) and image quality of MRCP [14–19], and it enables the prediction of pancreatic exocrine function by the measurement of duodenal filling with this modality [20–25]. Secretin-stimulated MRI/MRCP (S-MRI/MRCP) is emerging as a noninvasive alternative to diagnostic ERCP and direct exocrine function testing. However, some studies have suggested that S-MRCP or secretin administration is less useful in predicting abnormal exocrine function [26–28]. A recent study showed that the sensitivity and specificity of two or more S-MRI/MRCP features for the differentiation of abnormal from normal pancreatic tissue were 65% and 89%, respectively, compared with surgical histopathology [29].

Most studies examining this issue have been retrospective, with small samples. Thus, the objective of this study was to evaluate the diagnostic accuracy of S-MRI/MRCP for CP.

Materials and methods

Search strategy

This meta-analysis was conducted according to the recommendations outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [30]. The PubMed, EMBASE, Web of Science, Cochrane, and Chinese Biomedical Literature databases were searched using the terms “chronic pancreatitis,” “MRI,” “magnetic resonance imaging,” “NMR imaging,” “MRI scans,” “MRI scan,” “MR tomography,” “NMR tomography,” “MRCP,” “magnetic resonance cholangiopancreatography,” and “secretin” to identify articles published before January 2016. Reference lists of retrieved articles were also searched. Review articles, abstracts, case reports, letters, comments, and guidelines were excluded.

Study selection

Two investigators (Yuanyuan Liu and Xingju Zheng) independently selected eligible primary studies. The inclusion criteria were: (a) use of S-MRI/MRCP as the diagnostic index test; (b) use of histopathology, exocrine function tests, ERCP, or follow-up results as the reference standard; (c) sufficient reporting of data to calculate true-positive (TP), false-positive (FP), FN, and true-negative (TN) rates; and (d) examination of a study population of at least 10 individuals.

Data extraction and quality assessment

The same two investigators independently extracted the following data from included studies: author, publication year, study nation, study population, study design type, reference standard, time interval between index test and reference standard, magnetic field strength, secretin dose, and the data for the calculation of diagnostic results (TP, FP, FN, and TN rates). Study quality was assessed using the Quality Assessment of Diagnostic Accuracy Studies (version 2) [31]. Disagreements were resolved by consensus.

Statistical analysis

First, the Spearman coefficient of correlation between the logit of sensitivity and the logit of (1 − specificity) was computed to confirm the existence of the threshold effect using Meta-DiSc (version 1.4) [32]. A strong positive correlation with a significance of $P < 0.05$ was considered to suggest the existence of the threshold effect [32,33].

The Q statistic of the chi-squared test and the inconsistency index (I^2) were used to estimate the degree of heterogeneity among included studies with Meta-DiSc software, with $P < 0.1$ or $I^2 > 50\%$ considered to indicate the presence of heterogeneity [34]. In cases of notable heterogeneity, diagnostic performance was summarized using a random-effects coefficient binary regression model [35]. The following indexes were calculated: pooled sensitivity and specificity, pooled positive and negative likelihood ratios, and the diagnostic odds ratio. A summary receiver operating characteristic (SROC) curve was constructed, and the area under the SROC curve (AUC) was used to analyze the diagnostic accuracy of S-MRI/MRCP in the detection of CP [36].

Meta-regression analysis was used to determine factors that contributed to heterogeneity [37]. Publication bias was assessed using Stata software (version 12.0; Stata Corporation, College Station, TX, USA) to produce an asymmetry test and Deeks' funnel plot. An inverted symmetrical funnel plot with $P > 0.05$ was considered to indicate the absence of publication bias [38].

Results

The literature search identified 413 articles (Fig. 1), and 11 studies [15–18,20–24,26,29] were eligible and included in the analysis. The characteristics of the included studies are summarized in Table 1. Three studies were prospective and five were

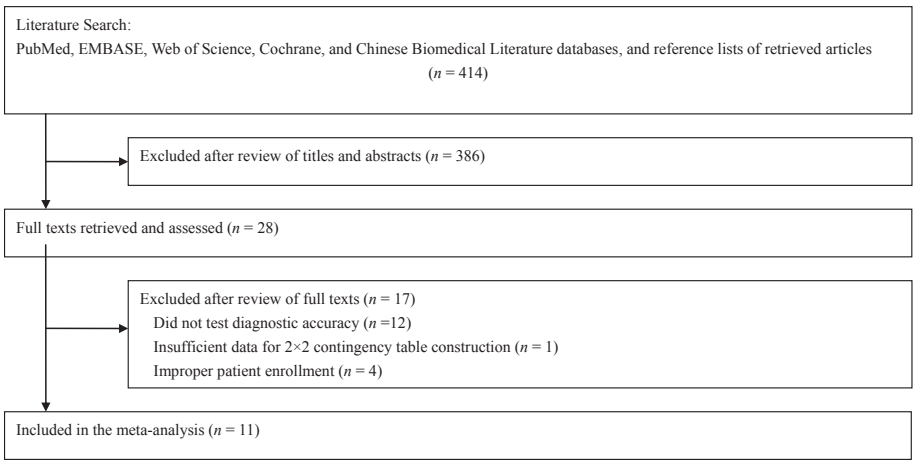

Fig. 1. Flowchart of study selection.

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