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Comparative diagnostic performance of imaging modalities in chronic pancreatitis: a systematic review and Bayesian network meta-analysis

Ping Yu[1†], Xujia Zhou[1,2†], Li Yue[3], Ling Zhang[1], Yuan Zhou[1,4*] and Fei Jiang[1,4*]

Abstract

Purpose We aimed to perform a Bayesian network meta-analysis to assess the comparative diagnostic performance of different imaging modalities in chronic pancreatitis(CP).

Methods The PubMed, Embase and Cochrane Library databases were searched for relevant publications until March 2024. All studies evaluating the head-to-head diagnostic performance of imaging modalities in CP were included. Bayesian network meta-analysis was performed to compare the sensitivity and specificity between the imaging modalities. The Quality Assessment of Diagnostic Performance Studies (QUADAS-2) tool was used to evaluate the quality of studies.

Results This meta-analysis incorporated 17 studies. Network meta-analytic results indicated that endoscopic ultrasonography (EUS) achieved the highest surface under the cumulative ranking (SUCRA) value at 0.86 for sensitivity. Conversely, magnetic resonance imaging (MRI) demonstrated best specificity, recording the highest SUCRA value at 0.99. Ultrasonography (US) displayed comparatively lower sensitivity than endoscopic retrograde cholangiopancreatography (ERCP) (relative risk[RR]: 0.83, 95% Confidence Interval[CI]: 0.69–0.99) and EUS (RR: 0.73, 95% CI: 0.57–0.91). MRI outperformed all other imaging modalities in terms of specificity.

Conclusions It appears that EUS demonstrates higher sensitivity, while MRI exhibits higher specificity in patients with chronic pancreatitis. However, it is crucial to note that our analysis was limited to the diagnostic performance and did not evaluate the cost-effectiveness of these various imaging modalities. Consequently, further extensive studies are needed to assess the benefit-to-risk ratios comprehensively.

Keywords Diagnostic performance, Imaging modalities, Chronic pancreatitis, Meta-analysis, Compare

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Introduction

Chronic pancreatitis (CP) is an inflammatory condition of the pancreas that leads to severe, often disabling symptoms and significantly reduces the quality of life [1]. Characterized by persistent abdominal pain and the progressive loss of pancreatic function, CP poses substantial challenges in both management and diagnosis [2]. The condition typically manifests through a spectrum of clinical symptoms, including severe abdominal pain, malabsorption, and diabetes mellitus, and is further complicated by the gradual development of endocrine and exocrine insufficiencies [3].

CP comprises several subtypes with distinct pathological characteristics: alcoholic, idiopathic, hereditary, autoimmune, and tropical CP. These subtypes demonstrate varying radiological features, which can significantly influence the diagnostic accuracy of imaging modalities [4–6]. Given the progressive nature of CP and its varied clinical presentations, early and accurate diagnosis is crucial to improving patient outcomes. However, there remains a lack of international consensus regarding the optimal diagnostic imaging modalities, especially during the early stages of the disease [7]. Traditional diagnostic methods rely on a combination of clinical assessment, pancreatic function tests, and imaging findings [8]. Among these, imaging techniques play a vital role [9]. Techniques such as endoscopic ultrasonography (EUS), endoscopic retrograde cholangiopancreatography (ERCP), magnetic resonance imaging (MRI), computed tomography (CT), ultrasonography (US), magnetic resonance cholangiopancreatography (MRCP), and secretin-enhanced magnetic resonance cholangiopancreatography (sMRCP) are crucial [10, 11]. These modalities not only help assess the morphological changes in the pancreas but are essential for planning therapeutic strategies.

This systematic review and Bayesian network meta-analysis aims to critically evaluate the comparative diagnostic performance of these imaging modalities in chronic pancreatitis.

Materials and methods

Our comparative diagnostic performance analysis utilized a network meta-analysis, an advanced extension of traditional pairwise meta-analysis. This method generates estimates for all conceivable pairwise comparisons within a network by integrating data from both direct and indirect comparisons. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension statement for reporting on our network meta-analysis [12].

Search strategy

We conducted a comprehensive literature search using the PubMed, Embase, and Cochrane Library databases, covering publications up to March 2024. The complete search strategy is detailed in Supplementary Table 1. To ensure thorough coverage, we also manually examined the reference lists of initially selected articles to identify additional relevant studies.

Inclusion and exclusion criteria

Population (P): suspected patients of chronic pancreatitis; Interventions (I): diagnostic assessments using imaging modalities(EUS, ERCP, MRI, CT, US, MRCP, and sMRCP); Comparators (C): each imaging modality was evaluated against the others through head-to-head comparisons; Outcomes (O): diagnostic accuracy, measured in terms of sensitivity and specificity. Study Designs (S): retrospective, prospective or cross-sectional studies were included.

Exclusion criteria were: (1)duplicated articles; (2) abstracts without full texts, editorial comments, letters, and case reports, reviews, previous meta-analyses, (3) articles with irrelevant titles or abstracts; (4) studies with incomplete data necessary for calculating sensitivity and specificity. In addition, only the most recent publication was included for studies using the same dataset to ensure the use of the most up-to-date data.

Retrieval of relevant articles

Two researchers independently reviewed the titles and abstracts of the articles retrieved, applying the specified inclusion and exclusion criteria. Subsequently, the full texts were assessed to confirm the studies' eligibility. Any discrepancies between the researchers were resolved through discussion until a consensus was reached.

Quality assessment

To assess the methodological quality in systematic reviews of diagnostic test accuracy, the QUADAS-2 tool is frequently employed [13]. This tool is composed of seven items categorized into four key domains: patient selection, index test, reference standard, and the flow and timing. The risk of bias for each of these criteria is evaluated as low, high, or unclear. If the study did not mention a certain criterion, the risk is classified as unclear. Each study was independently reviewed by two researchers, with any disagreements resolved through discussion among all contributing authors.

Data extraction

The 17 included articles were independently reviewed by two reviewers. Detailed study information such as the author, the year of publication, the country, and the type of study, and reference standard were systematically recorded. Additionally, patient characteristics were extracted, including the total number of patients, age, and male/female. Technical details related to comparison

of the imaging and the outcomes of the diagnostic tests-including true-positive, false-positive, false-negative, and true-negative counts. Any discrepancies encountered during the review process were diligently addressed through discussion between the reviewers until a consensus was achieved.

Statistical analysis

The primary outcome of the study was to assess the relative risk (RR) of sensitivity or specificity across various imaging modalities among patients suspected of having CP.

To conduct our Bayesian network meta-analysis, we first created a network-node plot illustrating the comparisons made in the meta-analysis [14]. This plot visually represented the direct comparisons between diagnostic groups, based on the number of studies included. Next, we employed the Markov chain Monte Carlo (MCMC) method to estimate the posterior distribution of each parameter [15]. We also evaluated the goodness of fit of our random-effects model using the deviance information criteria (DIC). For assessing the relative risk of sensitivity or specificity associated with each imaging modality, we utilized the surface under the cumulative ranking curve (SUCRA) metric [16]. This metric helped us quantify and compare the performance of different modalities.

The results of our analysis were presented in a league table, which included estimates of the relative effects for all pairwise comparisons. These estimates were expressed as RR values for sensitivity and specificity, along with their respective 95% confidence intervals (CI). Statistical significance in the network meta-analysis was determined based on whether the 95% CI covered 1. In addition, funnel plot was performed to evaluate the publication bias [17]. All data analyses and computations were conducted using R version 4.1.2.

Results

Literature search and study selection

Our initial search identified a substantial number of publications, amounting to 1106 in total. Following the removal of duplicate studies, 625 unique studies remained. However, upon closer examination against our inclusion criteria, 599 studies were further excluded from our analysis. A thorough evaluation of the complete texts of 26 articles was conducted next. Of these, 9 articles were found to be ineligible for our study. The reasons for their exclusion included insufficient data ($n=5$), duplication in study population ($n=1$), and non-head-to-head comparison ($n=3$). Ultimately, 17 articles met our inclusion criteria and were included in the network meta-analysis [18–34]. To provide our selection process, we utilized the PRISMA flow diagram, which is depicted in Fig. 1.

Quality assessment and study description

The risk of bias assessment, conducted using the QUADAS-2 tool, is visually represented in Fig. 2. Specifically, 1 study were identified as having a "high risk" in terms of the patient selection bias due to they didn't include consecutive patients. Moreover, 1 study were graded as "high risk" in the flow and timing domain due to some participants exclusion from data analyses. Overall, despite these specific biases identified, the overall quality assessment did not raise major concerns regarding the quality of the included studies.

A total of 17 studies comprising 1,245 patients with 7 diagnostic imaging modalities were analyzed. The patient distribution across imaging modalities was as follows: US included 626 patients, ERCP studied 553 patients, CT examined 404 patients, EUS assessed 272 patients, MRCP evaluated 292 patients, sMRCP included 131 patients, and MRI analyzed 40 patients. Each node represented a unique imaging modality, the direct comparisons between modalities included 6 between US and ERCP, 6 between US and CT, 5 between CT and ERCP, 3 between EUS and US, 2 between MRCP and sMRCP, and 1 each between MRI and CT, CT and EUS, EUS and ERCP, MRCP and ERCP, as well as MRCP and EUS (Figs. 3 and 4). The study and patient characteristics are summarized in Tables 1 and 2.

Network meta-analysis for sensitivity in all available studies

The random-effects model, with a DIC of 70.32, proved to be a natural fit. To evaluate the sensitivity's relative risk across various imaging modalities, the SUCRA metric was applied. The results ranked the imaging techniques for CP patients as follows: EUS at the top with a probability of 0.89, followed by ERCP (0.60), sMRCP (0.52), MRI (0.49), CT (0.48), MRCP (0.36), and US (0.16). Significant statistical differences in RR were observed between diagnostic imaging with US versus ERCP (RR: 0.83, 95% CI: 0.69–0.99) and US versus EUS (RR: 0.73, 95% CI: 0.57–0.91), as documented in Table 3. No publication bias was detected in the funnel plot (Fig. 5), ensuring the reliability of these findings.

Network meta-analysis for specificity in all available studies

The random-effects model, with a DIC of 64.7, proved to be a natural fit. To evaluate the sensitivity's relative risk across various imaging modalities, the SUCRA metric was applied. The results ranked the imaging techniques for CP patients as follows: MRI at the top with a probability of 0.99, followed by EUS (0.58), ERCP (0.54),

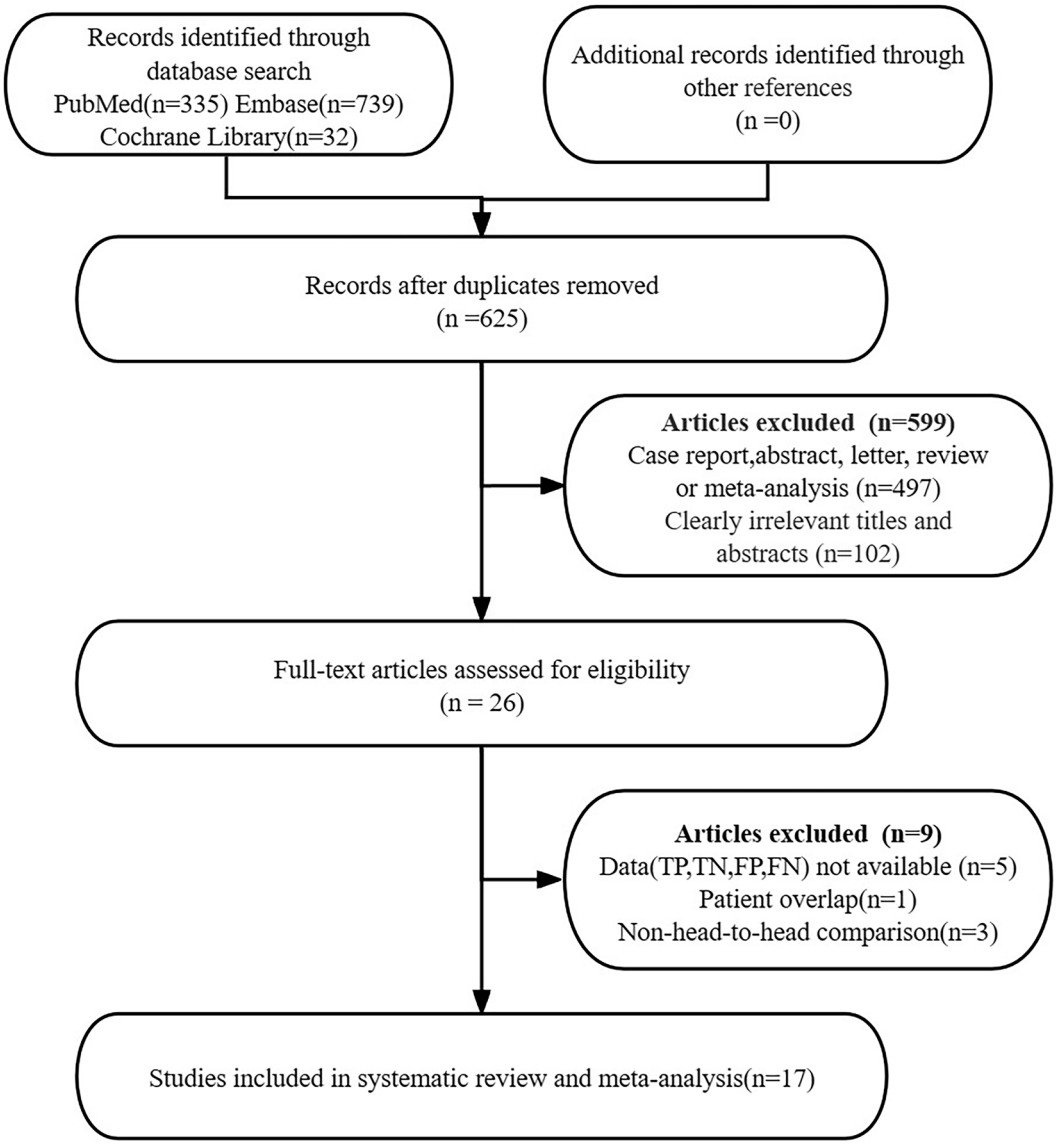

Fig. 1 PRISMA flow diagram illustrating the study selection process

MRCP (0.53), sMRCP (0.36), CT (0.31), and CT (0.48), and US (0.16). Significant statistical differences in RR were observed between diagnostic imaging with MRI versus all of other imaging modalities, as documented in Table 3. No publication bias was detected in the funnel plot (Fig. 6), ensuring the reliability of these findings.

Discussion

In 2018, the United European Gastroenterology evidence-based guidelines highlighted the superiority of EUS for the diagnosis of CP, particularly due to its high sensitivity in detecting early-stage disease [35]. However, the 2020 ACG Clinical Guideline recommended MRI or CT as the first-line diagnostic tools for CP [36]. Both MRI and CT are suggested as the primary choices due to their availability, reproducibility, and validation against other modalities for diagnosing CP [36]. EUS is recommended only if there is still uncertainty about the diagnosis after cross-sectional imaging has been performed. Recent studies corroborate the robust diagnostic performance of various imaging modalities in CP, yet a comprehensive comparison across these tools remains elusive. Therefore, this Bayesian network meta-analysis aims to bridge this gap by comparing the diagnostic performance of different imaging modalities.

In this Bayesian network meta-analysis, the diagnostic performance of various imaging modalities for CP was assessed. EUS demonstrated the highest sensitivity with a SUCRA value of 0.86, attributed to its detailed visualization capabilities of pancreatic parenchyma and ductal anatomy, facilitating the detection of early CP changes. Conversely, MRI showed superior specificity with a

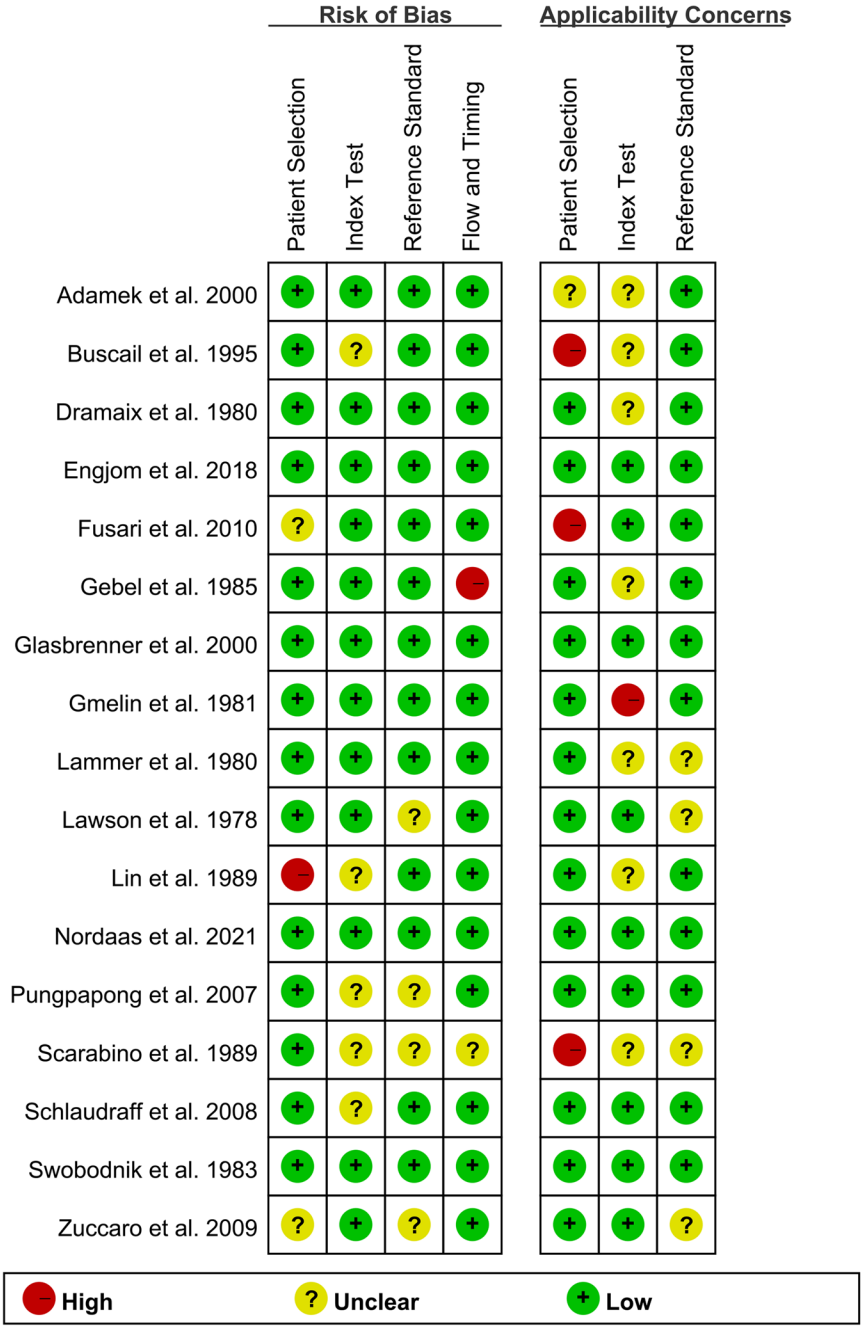

Fig. 2 Risk of bias and applicability concerns of the included studies using the Quality Assessment of Diagnostic Performance Studies QUADAS-2 tool

SUCRA value of 0.99, likely due to its excellent contrast resolution that effectively differentiates CP from other pancreatic conditions, minimizing false positives. Comparatively, US exhibited lower sensitivity than ERCP and EUS, possibly due to its limited imaging detail, which is less effective in detecting subtle tissue changes necessary for early CP diagnosis. For the other diagnostic tools compared in this study, no significant differences in sensitivity and specificity were observed.

Our systematic review and Bayesian network meta-analysis build upon and extend the findings of previous meta-analyses, such as those by Issa et al. 2017(7), which focused on the diagnostic performance of various imaging modalities for CP. Issa et al. 2017 incorporated 43 studies that primarily relied on indirect comparisons among imaging tools. Consistent with our findings, they reported that the sensitivity of EUS and ERCP was significantly higher than that of US. However, a notable limitation of their analysis was the lack of direct comparisons

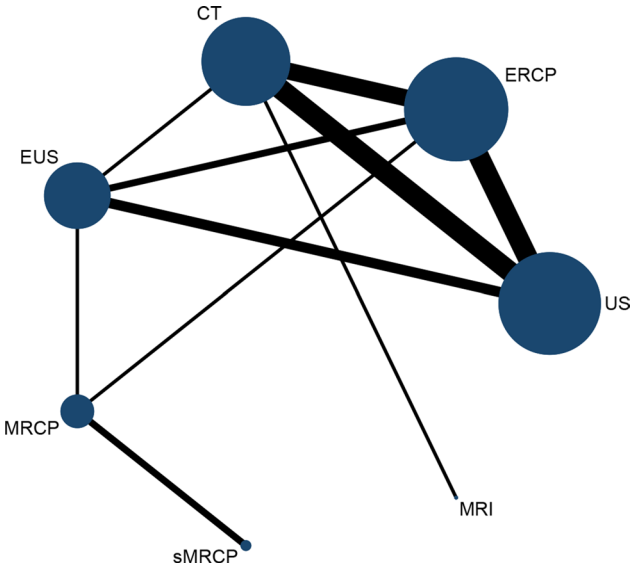

Fig. 3 Network diagram of all eligible studies evaluating the sensitivity of seven diagnostic imaging modalities for chronic pancreatitis in the Bayesian network meta-analysis. The node size corresponds to the number of patients, and the line width reflects the number of studies included

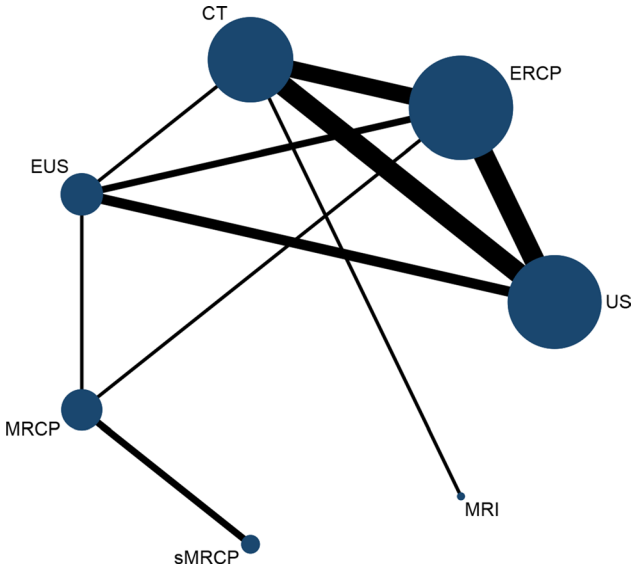

Fig. 4 Network diagram of all eligible studies evaluating the specificity of seven diagnostic imaging modalities for chronic pancreatitis in the Bayesian network meta-analysis. The node size corresponds to the number of patients, and the line width reflects the number of studies included

involving MRI, which prevented conclusive statements regarding its specificity. Our study addresses this gap by including studies that directly compare MRI with other modalities. Furthermore, our study exclusively included head-to-head comparative studies (17 in total), which strengthens the reliability of the diagnostic performance assessments. By doing so, we provide a refined analysis that not only confirms previous findings regarding the superior sensitivity of EUS and ERCP but also enhances understanding of MRI's specificity in diagnosing CP. This methodological enables us to derive a more precise ranking of diagnostic performance through the SUCRA scores.

Each diagnostic tool for chronic pancreatitis-EUS, MRI/MRCP, sMRCP, CT, ERCP, and US, has unique strengths and limitations that influence their clinical use(9, 35). EUS is highly sensitive, especially valuable in the early stages of the disease but requires experienced operators and is operator-dependent [37]. MRI/MRCP provides non-invasive and radiation-free imaging, offering clear visualization of pancreatic and ductal structures, yet may not detect mild forms of the disease [38, 39]. sMRCP enhances the diagnostic capabilities of MRCP by improving visualization of the pancreatic duct and assessing exocrine function, although its effectiveness can be limited without secretin enhancement [40]. CT excels in detecting pancreatic calcifications and providing detailed anatomical views but involves radiation exposure and has lower sensitivity for early pancreatic changes [31]. ERCP, while providing detailed images of the pancreatic ducts and enabling therapeutic interventions, is invasive and carries risks such as pancreatitis [18, 19]. US is widely available and cost-effective but varies in image quality due to patient body type and operator skill, making it less effective for early or mild pancreatic changes [19, 41].

The choice of diagnostic tool often depends on equipment availability, patient-specific factors, and institutional preferences, which can lead to debates within the clinical physicians about the most suitable method. Additionally, corroborating results from

Table 1 Study and patient characteristics of the included studies

Author, year	Type of imaging test	Study characteristics			Patient characteristics		
		Country	Study design	Reference standard	No. of patients	Mean/Median age	Male/Female
Adamek et al. 2000	MRCP vs. ERCP	Germany	Pro	Pathology and/or follow-up imaging	124	Mean(range):55.1(19–80)	76/48
Buscail et al. 1995	US vs. ERCP vs. CT vs. EUS	France	Pro	Pathology and/or follow-up imaging	81	Mean ± SD: (51 ± 12)	60/21
Dramaix et al. 1980	US vs. CT	France	Pro	Pathology and/or follow-up imaging	50	NA	33/17
Engjom et al. 2018	US vs. EUS	Norway	Pro	Follow-up imaging	92	Mean ± SD: (54 ± 15.3)	36/56
Fusari et al. 2010	MRI vs. CT	Italy	Pro	Pathology	40	Mean ± SD: (62 ± 13)	22/18
Gebel et al. 1985	US vs. ERCP	France	Retro	NA	56	NA	NA
Glasbrenner et al. 2000	EUS vs. ERCP	Germany	Pro	Pathology	95	Median(range):54(20–75)	67/28
Gmelin et al. 1981	US vs. ERCP vs. CT	Germany	Pro	Pathology and/or follow-up imaging	41	Mean:54	28/13
Lammer et al. 1980	CT vs. ERCP	Germany	NA	NA	107	NA	NA
Lawson et al. 1978	US vs. ERCP	USA	Retro	Pathology and/or follow-up imaging	75	NA	NA
Lin et al. 1989	US vs. EUS	China	NA	NA	33	NA	NA
Nordaas et al. 2021	US vs. CT	Norway	Cross-sectional	Follow-up imaging	73	Mean ± SD: (54 ± 13)	30/43
Pungpapong et al. 2007	MRCP vs. EUS	USA	Pro	Pathology and/or follow-up imaging	99	Mean ± SD: (55 ± 14)	47/52
Scarabino et al. 1989	US vs. ERCP vs. CT	Italy	NA	NA	63	NA	NA
Schlaudraff et al. 2008	MRCP vs. sMRCP	Germany	Pro	Pathology and/or follow-up imaging	67	Mean ± SD: (56 ± 15)	36/31
Swobodnik et al. 1983	US vs. ERCP vs. CT	Germany	Pro	Pathology and/or follow-up imaging	75	Mean(range):49.3(27–82)	42/33
Zuccaro et al. 2009	MRCP vs. sMRCP	USA	Retro	Follow-up imaging	69	Mean ± SD: (43.5 ± 12)	24/45

EUS ultrasonography; ERCP endoscopic retrograde cholangiopancreatography; MRI magnetic resonance imaging; CT computed tomography; US ultrasonography; MRCP magnetic resonance cholangiopancreatography; sMRCP secretin-enhanced magnetic resonance cholangiopancreatography; TP true positive; PB patient-based; LB lesion-based; Pro prospective; Retro retrospective; TP true positive; TN true negative; FP false positive; FN false positive; NA not available

different tools may be necessary to enhance diagnostic accuracy. Future models that integrate multiple diagnostic tools may improve overall diagnostic performance by leveraging the complementary strengths of each technique.

Our study faces several limitations that must be acknowledged. Firstly, by strictly limiting our inclusion to studies that offer direct pairwise comparisons, only 17 studies qualified for analysis, resulting in a smaller sample size for some comparisons. Secondly, due to the paucity of available data, our findings are confined to evaluating the sensitivity and specificity of the imaging modalities. We did not extend our comparison to other outcomes or assess cost-effectiveness. Therefore, larger prospective studies are necessary to comprehensively compare these imaging modalities in the future.

Table 2 Technical aspects of included studies

Author, year	Type of imaging test	TP, FP, FN, TN (First imaging)	TP, FP, FN, TN (Second imaging)	TP, FP, FN, TN (Third imaging)	TP, FP, FN, TN (Forth imaging)
Adamek et al. 2000	MRCP vs. ERCP	MRCP: TP:50,FP:4,FN:7,TN:63	ERCP: TP:51,FP:6,FN:6,TN:61	NA	NA
Buscail et al. 1995	US vs. ERCP vs. CT vs. EUS	US: TP:26,FP:4,FN:18,TN:14	ERCP: TP:33,FP:0,FN:11,TN:18	CT: TP:33,FP:1,FN:11,TN:17	EUS: TP:39,FP:0,FN:5,TN:18
Dramaix et al. 1980	US vs. CT	US: TP:11,FP:2,FN:7,TN:30	CT: TP:11,FP:0,FN:7,TN:32	NA	NA
Engjom et al. 2018	US vs. EUS	US: TP:34,FP:1,FN:18,TN:39	EUS: TP:39,FP:2,FN:13,TN:38	NA	NA
Fusari et al. 2010	MRI vs. CT	MRI: TP:7,FP:0,FN:1,TN:32	CT: TP:7,FP:0,FN:1,TN:32	NA	NA
Gebel et al. 1985	US vs. ERCP	US: TP:18,FP:1,FN:4,TN:33	ERCP: TP:33,FP:0,FN:11,TN:18	NA	NA
Glasbrenner et al. 2000	EUS vs. ERCP	EUS: TP:38,FP:10,FN:3,TN:34	ERCP: TP:36,FP:8,FN:5,TN:36	NA	NA
Gmelin et al. 1981	US vs. ERCP vs. CT	US: TP:13,FP:0,FN:6,TN:22	ERCP: TP:17,FP:2,FN:2,TN:20	CT: TP:16,FP:2,FN:3,TN:20	NA
Lammer et al. 1980	CT vs. ERCP	CT: TP:25,FP:10,FN:14,TN:58	ERCP: TP:33,FP:2,FN:6,TN:66	NA	NA
Lawson et al. 1978	US vs. ERCP	US: TP:10,FP:0,FN:16,TN:49	ERCP: TP:19,FP:1,FN:7,TN:48	NA	NA
Lin et al. 1989	US vs. EUS	US: TP:6,FP:0,FN:1,TN:26	EUS: TP:7,FP:0,FN:0,TN:26	NA	NA
Nordaas et al. 2021	US vs. CT	US: TP:34,FP:3,FN:17,TN:19	CT: TP:36,FP:5,FN:17,TN:15	NA	NA
Pungpapong et al. 2007	MRCP vs. EUS	MRCP: TP:26,FP:6,FN:14,TN:53	EUS: TP:37,FP:4,FN:3,TN:55	NA	NA
Scarabino et al. 1989	US vs. ERCP vs. CT	US: TP:5,FP:34,FN:7,TN:17	ERCP: TP:10,FP:17,FN:2,TN:34	CT: TP:12,FP:15,FN:0,TN:36	NA
Schlaudraff et al. 2008	MRCP vs. sMRCP	MRCP: TP:6,FP:4,FN:3,TN:49	sMRCP: TP:7,FP:2,FN:2,TN:51	NA	NA
Swobodnik et al. 1983	US vs. ERCP vs. CT	US: TP:14,FP:0,FN:13,TN:54	ERCP: TP:25,FP:0,FN:2,TN:54	CT: TP:20,FP:1,FN:7,TN:53	NA
Zuccaro et al. 2009	MRCP vs. sMRCP	MRCP: TP:13,FP:6,FN:15,TN:35	sMRCP: TP:13,FP:13,FN:15,TN:28	NA	NA

EUS ultrasonography; ERCP endoscopic retrograde cholangiopancreatography; MRI magnetic resonance imaging; CT computed tomography; US ultrasonography; MRCP magnetic resonance cholangiopancreatography; sMRCP secretin-enhanced magnetic resonance cholangiopancreatography; TP true positive; TN true negative; FP false positive; FN false positive; NA not available

Table 3 Results of league table

US	1.12 (0.98, 1.39)	1.04 (0.9, 1.28)	1.14 (0.95, 1.55)	1.13 (0.85, 1.66)	1.06 (0.7, 1.73)	912.15 (1.43, 2282128217.72)
0.83 (0.69, 0.99)	ERCP	0.94 (0.76, 1.1)	1.02 (0.82, 1.31)	1.01 (0.74, 1.38)	0.95 (0.61, 1.45)	**796.9 (1.27, 2020984886.98)**
0.87 (0.7, 1.04)	1.05 (0.85, 1.26)	CT	1.09 (0.87, 1.47)	1.08 (0.78, 1.56)	1.02 (0.65, 1.62)	**858.67 (1.37, 2175540531.83)**
0.73 (0.57, 0.91)	0.88 (0.7, 1.09)	0.84 (0.65, 1.1)	EUS	0.99 (0.72, 1.34)	0.93 (0.59, 1.4)	**782.97 (1.24, 1974009559.35)**
0.92 (0.65, 1.31)	1.11 (0.81, 1.54)	1.05 (0.76, 1.56)	1.25 (0.92, 1.78)	MRCP	0.94 (0.68, 1.25)	**789.08 (1.24, 1979033060.55)**
0.85 (0.46, 1.56)	1.03 (0.57, 1.86)	0.98 (0.54, 1.84)	1.17 (0.65, 2.14)	0.93 (0.56, 1.52)	sMRCP	**842.17 (1.32, 2092796214.9)**
0.87 (0.43, 1.7)	1.05 (0.52, 2.05)	1 (0.52, 1.92)	1.19 (0.58, 2.39)	0.94 (0.44, 1.97)	1.02 (0.41, 2.48)	MRI

The risk estimates of sensitivity and specificity were presented as RR with 95% CI. Statistical significance was given in bold and established when the 95% CI did not cover 1. The risk of ICH comparisons should be read from left to right in lower left of chart(sensitivity), and it should be read from right to left in upper right of chart(specificity). RR, relative risk; CI, confidence interval

EUS ultrasonography; ERCP endoscopic retrograde cholangiopancreatography; MRI magnetic resonance imaging; CT computed tomography; US ultrasonography; MRCP magnetic resonance cholangiopancreatography; sMRCP secretin-enhanced magnetic resonance cholangiopancreatography

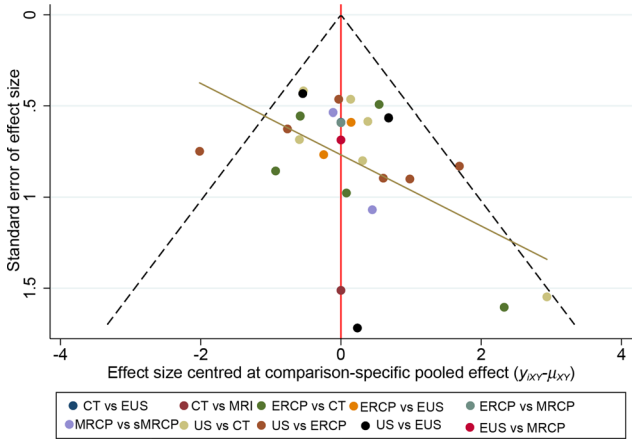

Fig. 5 Funnel plot to assess the publication bias for sensitivity in the included studies

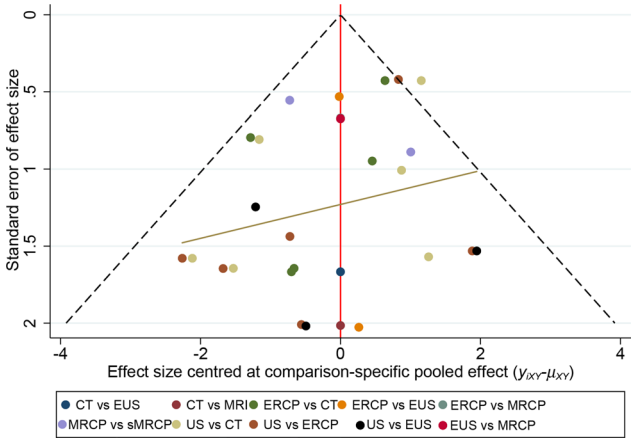

Fig. 6 Funnel plot to assess the publication bias for specificity in the included studies

Conclusion

It appears that EUS demonstrates higher sensitivity, while MRI exhibits higher specificity in patients with chronic pancreatitis. However, it is crucial to note that our analysis was limited to the diagnostic performance and did not evaluate the cost-effectiveness of these various imaging modalities. Consequently, further extensive studies are needed to assess the benefit-to-risk ratios comprehensively.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12880-024-01541-9.

Supplementary Material 1

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Author contributions
PY, XZ were responsible for data curation, formal analysis, methodology, software utilization, and drafting the original manuscript. LY, LZ were responsible for data curation, formal analysis, YZ, FJ handled conceptualization, supervision, validation, visualization, and review and editing of the manuscript. All authors contributed significantly to the manuscript and approved the final version for submission.

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Data availability
The original contributions presented in the study are included in the article. Further inquiries can be directed to the corresponding authors.

Declarations

Ethics approval and consent to participate
This is a systematic review and meta-analysis, ethics approval and consent to participate are not applicable.

Consent for publication
Not applicable. The manuscript does not include the participant's identification image or other personal or clinical details.

Competing interests
The authors declare no competing interests.

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