SYSTEMATIC REVIEW AND META-ANALYSIS

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CLINICAL ENDOSCOPY

Influence of biliary stents on the diagnostic outcome of endoscopic ultrasound–guided tissue acquisition from solid pancreatic lesions: a systematic review and meta-analysis

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Background/Aims: This meta-analysis analyzed the effect of an indwelling biliary stent on endoscopic ultrasound (EUS)-guided tissue acquisition from pancreatic lesions.

Methods: A literature search was performed to identify studies published between 2000 and July 2022 comparing the diagnostic outcomes of EUS-tissue acquisition (TA) in patients with or without biliary stents. For non-strict criteria, samples reported as malignant or suspicious for malignancy were included, whereas for strict criteria, only samples reported as malignant were included in the analysis.

Results: Nine studies were included in this analysis. The odds of an accurate diagnosis were significantly lower in patients with indwelling stents using both non-strict (odds ratio [OR], 0.68; 95% confidence interval [CI], 0.52–0.90) and strict criteria (OR, 0.58; 95% CI, 0.46–0.74). The pooled sensitivity with and without stents were similar (87% vs. 91%) using non-strict criteria. However, patients with stents had a lower pooled sensitivity (79% vs. 88%) when using strict criteria. The sample inadequacy rate was comparable between groups (OR, 1.12; 95% CI, 0.76–1.65). The diagnostic accuracy and sample inadequacy were comparable between plastic and metal biliary stents.

Conclusions: The presence of a biliary stent may negatively affect the diagnostic outcome of EUS-TA for pancreatic lesions.

Keywords: Endoscopic ultrasound; Fine needle aspiration; Pancreatic cancer; Stent

INTRODUCTION

Pancreatic masses can occur in autoimmune pancreatitis, chronic pancreatitis (CP), pancreatic ductal adenocarcinoma, neuroendocrine tumor, solid pseudopapillary tumor, or commonly metastasis.[1] Computed tomography (CT) is the most widely available modality for assessing distant metastases and resectability. However, it is unable to detect small lesions of <20 mm.[2] In a systematic review of nine studies by Dewitt et al.,[3] endoscopic ultrasound (EUS) was more sensitive than CT for diagnosing pancreatic adenocarcinoma. In a previous series, 6.5% to 10.4% of all patients who underwent pancreaticoduodenectomy had a benign histopathology.[4,5] In the presence of a solid mass suggestive of malignancy, a previous consensus suggested that biopsy proof was not required before resection. However, confirmation of malignancy was considered mandatory for patients with borderline resectable disease to be treated with neoadjuvant therapy before exploration for resection.[6] EUS with fine-needle aspiration (FNA) has a pooled sensitivity and

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specificity of 90.8% and 96.5%, respectively, for the histological diagnosis of malignancy in patients with solid pancreatic masses.[7] Furthermore, needle track seeding and peritoneal carcinomatosis have been reported more frequently with percutaneous sampling than with EUS-guided biopsy.[8]

Patients with a pancreatic mass may present with obstructive jaundice, which is conventionally managed by endoscopic placement of plastic or metal biliary stents. However, the optimal timing of EUS in such cases remains unclear. In centers with facilities for EUS and endoscopic retrograde cholangiopancreatography (ERCP), both biliary stenting and EUS-guided tissue acquisition are conveniently performed during the same session. They are especially beneficial in elderly patients who are unlikely to tolerate repeated procedures.[9,10] EUS before ERCP has the added advantage of assessing resectability of pancreatic tumors and aids in stent selection.

Traditional studies hypothesized that biliary stent placement before EUS-tissue acquisition (TA) has certain disadvantages due to stent-induced material artifacts, inflammatory reaction induced by the stent, pneumobilia, acoustic reverberation, and shadowing, resulting in the understaging of periampullary tumors.[11,12] The presence of a stent may lead to mis-staging of pancreatic adenocarcinomas, resulting in unnecessary laparotomies.[13] However, the impact of a biliary stent on histologic evaluation of pancreatic head masses with EUS-TA is unclear. Therefore, this systematic review and meta-analysis aimed to compare the diagnostic outcomes of EUS-TA in the presence or absence of an indwelling biliary stent.

METHODS

Information sources and search strategy

A comprehensive search of all suitable studies was conducted using the Medline, Embase, and ScienceDirect databases from January 2000 to June 2022. The keywords used were (Pancreas OR Pancreatic) AND (EUS OR "Endoscopic Ultrasound") AND Stent. To ensure that no potentially relevant items were overlooked, the reference lists of the included studies were also manually searched. The study methodology adhered to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines.[14]

Study selection

The PICO criteria used for the comparative studies included (1) Patients: pancreatic mass undergoing EUS-TA; (2) Intervention: patients with biliary stent; (3) Comparison: patients without biliary stent; and (4) Outcomes: diagnostic outcomes including sample inadequacy, sensitivity, accuracy, and number of passes. In accordance with the selection criteria described above, the titles and abstracts of all the studies were independently reviewed by two authors.

Disagreements were resolved by a third reviewer. As long as the study outcomes were mentioned in the text, no restrictions on language were applied. The exclusion criteria were non-comparative studies, case series, and studies involving persons aged <18 years.

Data extraction

Two independent reviewers performed data extraction, and a third reviewer resolved any disagreements. Data were collected under the following headings: study author and year, country of study, study design, number of patients, age and sex distribution, details of pancreatic lesions, availability of rapid onsite evaluation (ROSE), type of intervention used, and diagnostic outcomes.

Definition of outcomes

The primary outcome of the analysis was diagnostic accuracy, defined as the proportion of correct diagnoses made with or without a stent. For the analysis using strict criteria cutoffs, only samples reported as malignant were categorized as positive for malignancy. For the analysis using non-strict criteria, samples reported as malignant or suspicious for malignancy were classified as positive for malignancy. The secondary outcomes of the study were sample inadequacy, sensitivity for the diagnosis of malignancy, and the number of passes. Inadequacy was defined as the proportion of cases in which a tissue specimen could not be obtained for cytological examination. All outcomes were also compared between patients with plastic and metal stents.

Risk of bias in individual studies

After data extraction, the same two reviewers performed a risk of bias (quality) assessment using the validated tools. The Cochrane risk-of-bias tool was used for randomized controlled trials,[15] and the Cochrane Collaboration's risk of bias in non-randomized studies of interventions (ROBINS-I) tool was used for non-randomized studies.[16]

Statistical analysis

Odds ratios (ORs) with 95% confidence intervals (CIs) were

calculated for dichotomous outcomes. Continuous variables were analyzed using mean differences (MDs). Regardless of heterogeneity, the Mantel-Haenszel test for random effects was used. Cochran's Q test and I^2 statistics were used to determine the heterogeneity between the studies. A p-value of Q test <0.1 or I^2 value >50% was considered significant. Funnel plots were visually inspected to assess publication bias. Sensitivity analysis was performed using a leave-one-out meta-analysis, in which one study was excluded from each analysis to analyze each study's influence on the overall effect-size estimate and identify influential studies. The RevMan software (ver. 5.4.1; Cochrane Collaboration), Metadisc (ver. 1.4; Unit of Clinical Biostatistics, Ramón y Cajal Hospital, Madrid, Spain), and STATA software (ver. 17; StataCorp., College Station, TX, USA) were used for the statistical analysis.

RESULTS

Study characteristics and study quality analysis

The search strategy yielded 1,584 studies, of which nine studies[17-25] were included after screening and exclusion. Figure 1 presents the PRISMA diagram of the study selection and inclusion process. Table 1 presents the baseline characteristics of the included studies. All the studies were retrospective, with sample sizes varying from 72 to 842. Most of the studies were from the USA,[17-20,22] and four studies were from Europe.[21,23-25] The mean age of the patients varied from 65.9 to 69.7 years. A male predominance was observed in all the studies, except for the study by Fisher et al.[17] The mean tumor size varied from 27 mm to 33.1 mm. The 22-G or 25-G needle was the most commonly used. Only four studies used strict criteria to define malignancy.[17,23-25] Tables 2 and 3 summarize the diagnostic outcomes for all studies based on the presence or absence of stents and stent type, respectively.[17-25] Supplementary Figure 1 presents the risk of bias assessment using the ROBINS-I tool. Of the nine studies, only three had a moderate risk of bias,[18,21,25] while the remaining six had a high risk of bias.[17,19,20,22-24]

Diagnostic accuracy

A comparison of accurate diagnoses was reported in eight studies with 2,531 patients. The odds of an accurate diagnosis with EUS-TA were significantly lower in patients with indwelling stents than in those without a stent, both using the non-strict criteria (OR, 0.68; 95% CI, 0.52–0.90; I^2=0.0%) (Fig. 2A) and the strict criteria (OR, 0.58; 95% CI, 0.46–0.74; I^2=0.0%) (Fig. 2B). Among patients with metal and plastic stents, the odds of diagnostic accuracy were comparable using the non-strict criteria (OR, 1.18; 95% CI, 0.58–2.42; I^2=53.0%) (Fig. 2C).

Sample inadequacy

Seven studies with 2,458 patients reported sample inadequacy. The sample inadequacy rate was comparable between patients with and without stents (OR, 1.12; 95% CI, 0.76–1.65; I^2=0.0%) without any heterogeneity among the studies (Supplementary Fig. 2). Among patients with stents *in situ*, the inadequacy rate of the sample was comparable between plastic and metal stents with an OR of 0.83 (95% CI, 0.40–1.71; I^2=0.0%) (Supplementary Fig. 3).

Sensitivity

The pooled sensitivity with and without stents using the non-strict criteria was comparable (87%; 95% CI, 85%–89%; I^2=82.4% vs. 91%; 95% CI, 90%–93%; I^2=82.9%, respectively) (Fig. 3A). However, using strict criteria, the pooled sensitivity was higher in those without stents (88%; 95% CI, 86%–90%; I^2=91.1% vs. 79%; 95% CI, 0.76–0.82; I^2=92.4%) (Fig. 3B). Us-

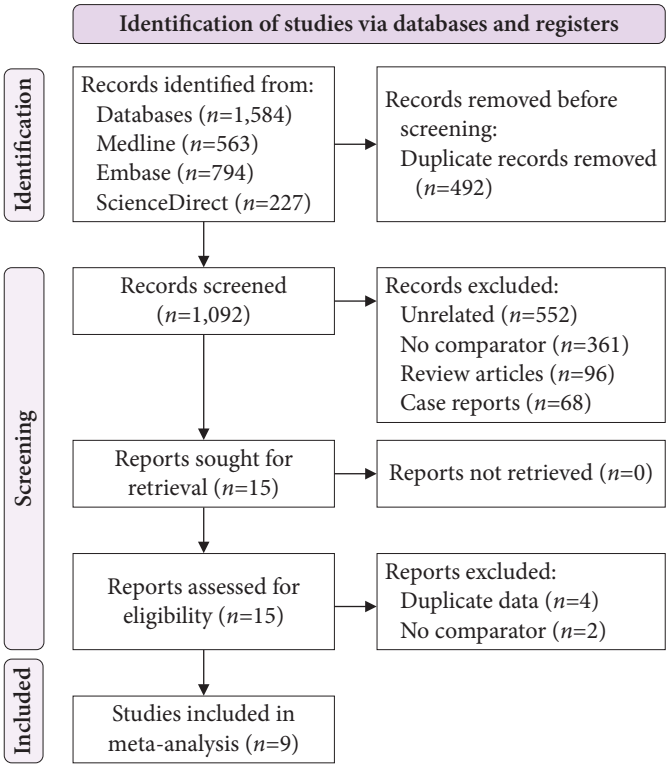

Fig. 1. Preferred Reporting Items for Systematic Review and Meta-Analyses flowchart for the study selection and inclusion process.

Table 1. Baseline characteristics of included studies

Study	Country	Patient (*n*)	Age (yr)	Male/ female (*n*)	Location	Mass size (mm)	Needle size (type)	ROSE	Passes (*n*)	Criteria for malignancy with FNA/B	Final diagnosis
Fisher et al. (2011)[17]	USA	268	68.4	120/148	Head	33.1	22-G/25-G FNA	+	–	Both	Pathologically confirmed adenocarcinoma
Ranney et al. (2012)[18]	USA	214	67.9±12.3	137/77	Head	27±5.0	22-G/25-G FNA	+	2.1±1.7	Non-strict	Surgical cytopathology, death resulting from disease, or long-term follow-up
Siddiqui et al. (2012)[19]	USA	677	65.9	345/332	Head, uncinate	29.2±9.1	22-G FNA	+	5±1.3	Non-strict	Surgical cytopathology, death resulting from disease, or long-term follow-up
Kim et al. (2015)[20]	USA	180	65±12	108/72	Head	>30 (42%)	22-G/25-G FNA	0.45	–	Non-strict	Histologic diagnosis of malignancy on EUS-FNA, surgically resected specimen, and/or other tissue acquisition from endoscopic or percutaneous modalities
Antonini et al. (2017)[21]	Italy	130	69.7±10.1	79/51	Head	30.8±10.4	22-G/25-G FNA	+	3.3±0.8	Non-strict	Surgical cytopathology, death resulting from disease, or long-term follow-up (>6 months)
Kulkarni et al. (2017)[22]	USA	72	667±12.5	37/35	Head	24.1±9.1	22-G/25-G FNA/B	0.967	3.0±1.2	Non-strict	–
Bekkali et al. (2019)[23]	UK	631	65.6±10.8	345/286	Head	31.2±10.6	22-G/25-G FNA/B	0.162	–	Both	Surgical cytopathology, death resulting from disease, or long-term follow-up (>12 months)
Crinò et al. (2021)[24]	Italy	842	68.9±11.1	493/349	Head, uncinate	30.7±8.9	20-/22-/25-G FNB	0.132	2.9±0.7	Both	Surgical cytopathology, death resulting from disease, or long-term follow-up (>12 months)
Constantinescu et al. (2022)[25]	Romania	243	62.1±12.6	138/105	Head, body, tail	20–40 (61.7%), >40 (31.3%)	22-G FNA/B	–	2.1±0.6	Strict	Pathologically confirmed adenocarcinoma

Values are presented as number or mean±standard deviation. Both indicate analyses using strict as well as non-strict criteria.
FNA, fine-needle aspiration; EUS, endoscopic ultrasound; FNB, fine-needle biopsy.

Table 2. Summary of outcomes by study

Study	Stent	No. of patients	Inadequate sample	TP	FP	TN	FN
Fisher et al. (2011)[17]	With stent	98	4	84 (88)	0	0	14 (10)
	Without stent	170	5	157 (158)	0	0	13 (12)
Ranney et al. (2012)[18]	With stent	150	7	128	0	15	7
	Without stent	64	4	58	0	2	4
Kim et al. (2015)[20]	With stent	75	5	55	1	3	16
	Without stent	105	5	92	0	1	12
Antonini et al. (2017)[21]	With stent	56	2	42	0	8	6
	Without stent	74	7	61	0	3	10
Kulkarni et al. (2017)[22]	With stent	34	–	Diagnostic accuracy: 30/34			
	Without stent	38	–	Diagnostic accuracy: 34/38			
Bekkali et al. (2019)[23]	With stent	294	20	196 (237)	0	0	98 (57)
	Without stent	287	21	224 (244)	0	0	63 (43)
Crinò et al. (2021)[24]	With stent	347	6	288 (310)	0 (1)	12 (11)	47 (25)
	Without stent	495	3	440 (461)	0 (0)	16 (16)	39 (18)
Constantinescu et al. (2022)[25]	With stent	68	10	58	0	0	10
	Without stent	175	18	157	0	0	18

Numbers in brackets indicate values with non-strict criteria.
TP, true positive; FP, false positive; TN, true negative; FN, false negative.

Table 3. Summary of outcomes by stent type

Study	Stent type	Patient (*n*)	TP	FP	TN	FN
Ranney et al. (2012)[18]	Metal	45	40	0	3	2
	Plastic	105	88	0	12	5
Siddiqui et al. (2012)[19]	Metal	100	91	0	6	3
	Plastic	577	512	1	50	14
Bekkali et al. (2019)[23]	Metal	157	104 (125)	0	0	53 (32)
	Plastic	137	92 (112)	0	0	45 (25)
Crinò et al. (2021)[24]	Metal	130	114 (123)	0 (0)	0 (0)	16 (7)
	Plastic	217	174 (187)	0 (1)	12 (11)	31 (18)
Constantinescu et al. (2022)[25]	Metal	10	10	0	0	0
	Plastic	58	48	0	0	10

Numbers in brackets indicate values with non-strict criteria.
TP, true positive; FP, false positive; TN, true negative; FN, false negative.

ing non-strict criteria in patients with stents, the sensitivity was lower with metal stents than with plastic stents (83%; 95% CI, 79%–86%; I^2=92.8% vs. 90%, 95% CI, 88%–91%; I^2 = 96.3%) (Fig. 3C).

Number of passes

Five studies have reported differences in the number of passes between the two groups. Patients with stents required more needle passes than those without stents, with an MD of 0.31 (95% CI, 0.05–0.57; I^2=83.0%), with significant heterogeneity among the studies (Supplementary Fig. 4).

Publication bias and sensitivity analysis

No publication bias in the assessment of funnel plots was observed for all assessed outcomes (Supplementary Fig. 5). In the leave-one-out meta-analysis, no significant change in the OR of sample inadequacy or diagnostic accuracy was also noted. However, with the exclusion of studies by Kim et al.,[20] Kulkarni et al.,[22] and Crinò et al.,[24] one at a time, the number of passes was comparable between patients with and without stents. Table 4 summarizes the findings based on the grade of evidence.

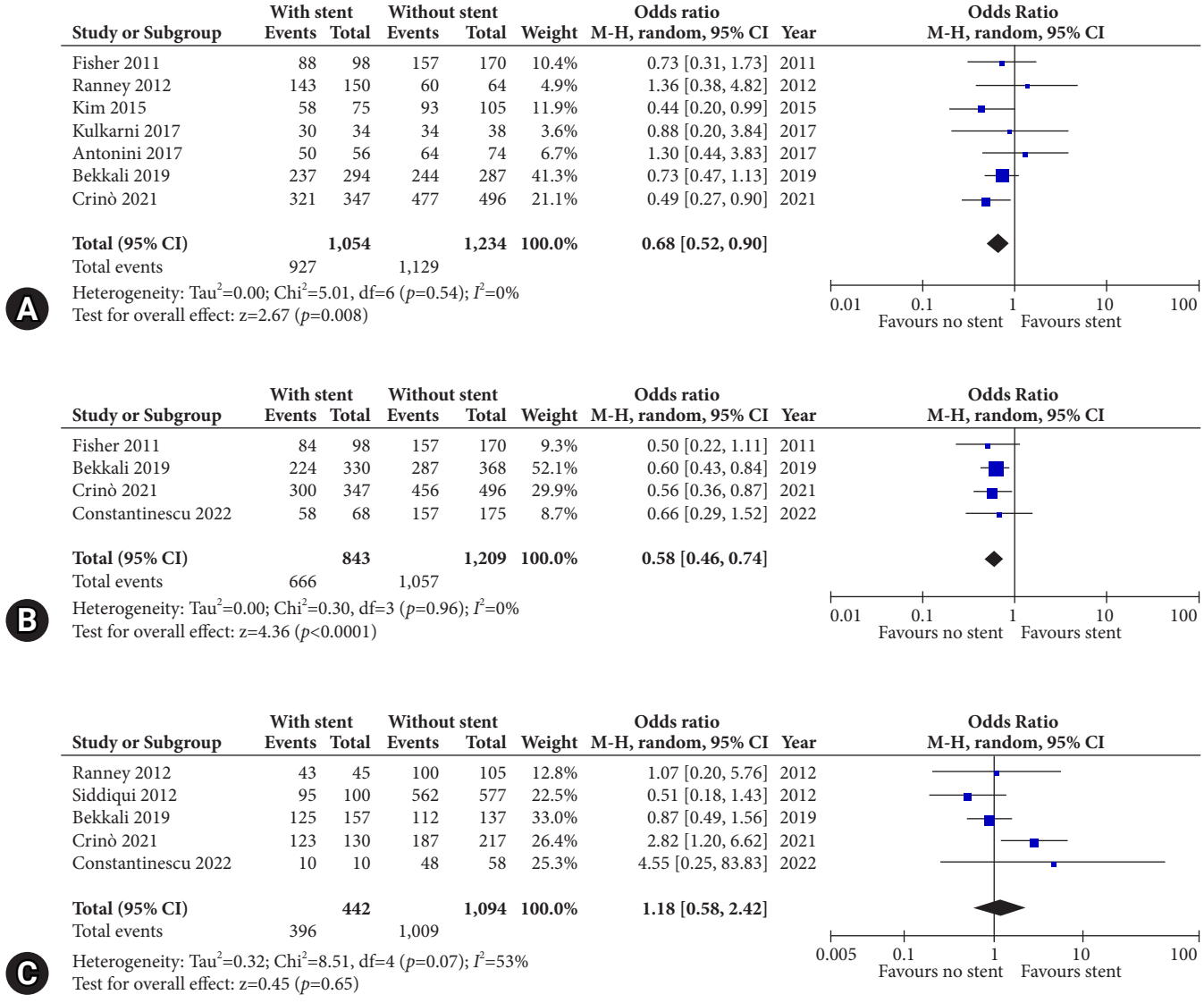

Fig. 2. Forest plot comparing the odds of accurate diagnosis with endoscopic ultrasound–guided tissue acquisition in (A) patients with and without stents using the non-strict criteria, (B) patients with and without stents using the strict criteria, and (C) patients with metal and plastic stents using the non-strict criteria. M-H, Mantel-Haenszel; CI, confidence interval.

DISCUSSION

Currently, no clear consensus on whether ERCP should precede EUS-TA or vice versa exists. This is mainly because of the lack of reliable data regarding the influence of biliary stents on the diagnostic yield of EUS-TA. Bile duct stents can obscure pancreatic and ampullary mass visualization during EUS because of inflammation, pneumobilia, or acoustic shadowing.[11,13,26] The international consensus on endoscopic management of distal biliary strictures has proposed the approach of performing ERCP and EUS-TA in a single session as the diagnostic yield of EUS-TA is not affected by the indwelling stent, and repeated sedation can be avoided.[27] However, the Canadian Society for EUS stated that EUS-TA should precede ERCP.[28] No data on the endoscopist's preference for the first intervention, EUS, or ERCP were available. The present analysis aimed to assess the impact of indwelling biliary stents on the diagnostic outcomes of EUS-TA. The pooled sensitivities with and without stents using the non-strict criteria were comparable (87% vs. 91%). However, the pooled sensitivity was higher in those without

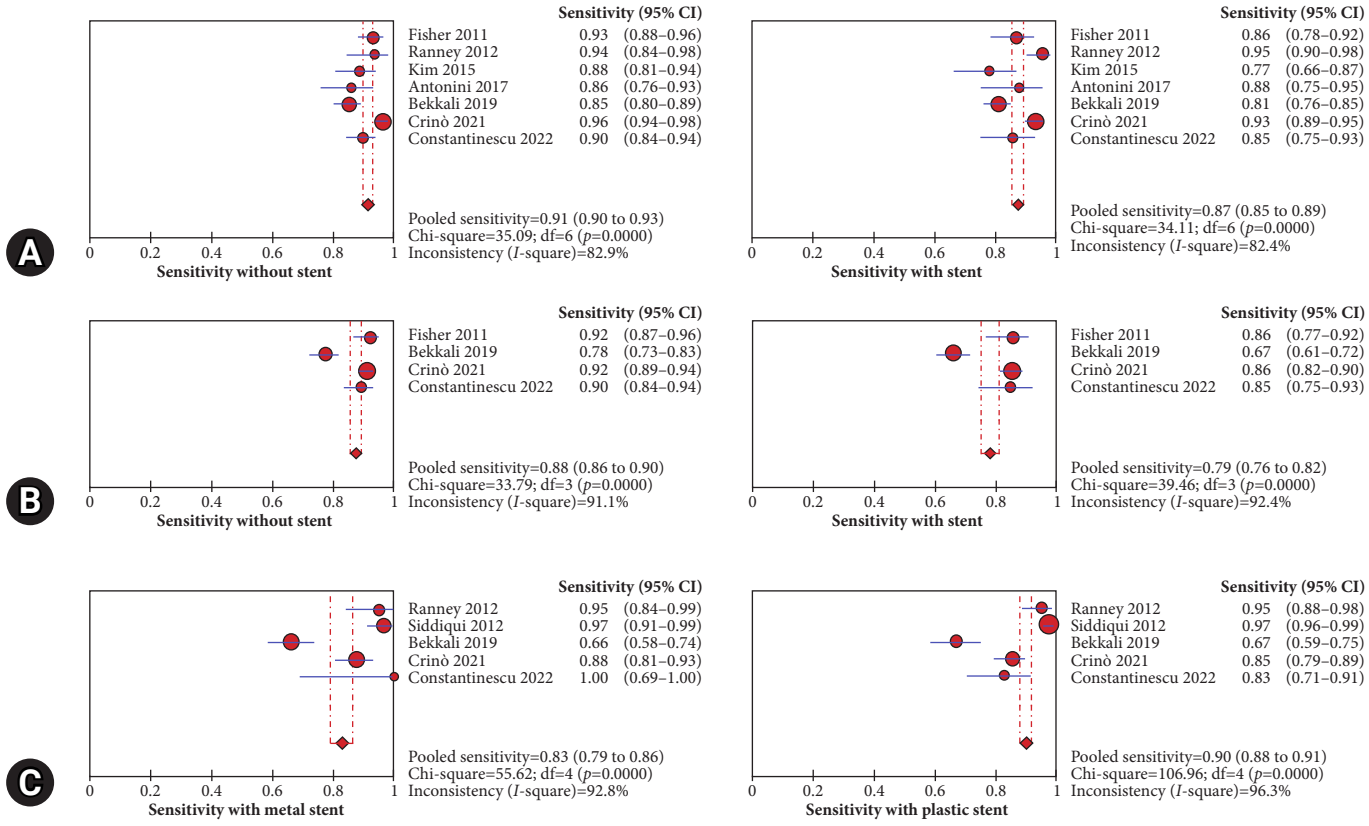

Fig. 3. Forest plot demonstrating pooled sensitivity of endoscopic ultrasound–guided tissue acquisition in (A) patients with and without stents using the non-strict criteria, (B) patients with and without stents using the strict criteria, and (C) patients with metal and plastic stents using the non-strict criteria. CI, confidence interval.

stents (88% vs. 79%) when using the strict criteria. The diagnostic accuracy of EUS-TA was significantly lower in patients with biliary stents than in those without stents, both using the non-strict (OR, 0.68; 95% CI, 0.52–0.90) and strict criteria (OR, 0.56; 95% CI, 0.44–0.73). The sensitivity of EUS-TA in patients with and without stents and its effect on the stent type were analyzed. Using non-strict criteria, the pooled sensitivity was lower with metal stents than with plastic stents (83% vs. 92.8%); however, the diagnostic accuracy was comparable (OR, 1.18; 95% CI, 0.58–2.42). A higher degree of acoustic shadowing with metal stents than with plastic stents may explain the negative impact of metal stents on diagnostic outcomes.

Samples that did not exhibit definitive malignant features were considered suspicious. Some authors have sub-classified samples using strict and non-strict criteria based on whether the samples suspicious for malignancy were considered negative or positive, respectively. Bekkali et al.[23] and Crinò et al.[24] performed two different analyses using two criteria and reported conflicting results, as the type of stent impacted the diagnostic accuracy of EUS-TA in the former study but not in the later study. In our analysis, the odds of an accurate diagnosis with EUS-TA were significantly lower in patients with indwelling stents than in those without stents, using both criteria.

The European Society of Gastrointestinal Endoscopy guidelines suggest performing three to four needle passes with an FNA needle or two to three passes with an fine-needle biopsy needle when onsite pathological evaluation is unavailable.[29]

However, some studies on the approach to patients with solid pancreatic lesions have indicated that three to four passes with the FNA needle and two to three passes with the reverse-bevel needle are adequate.[30-32] However, robust data or guidelines on the impact of an indwelling biliary stent on the number of passes during EUS-TA of a pancreatic mass are lacking. Although significant heterogeneity in this meta-analysis was observed, the patients with stents required more needle passes than those without stents with an MD 0.31 (95% CI, 0.05–0.57). The in-

Table 4. Summary of findings and grade of evidence

Population: Patients with pancreatic mass undergoing EUS-guided tissue acquisition **Intervention:** Patients with biliary stents **Comparison:** Patients without biliary stents									
Outcome	**Anticipated absolute effects (95% CI)**		**Relative effect (OR, 95% CI)**	**No. of patients (study)**	**Certainty assessment**				**Overall certainty of evidence**
	Without stents	**With stents**			**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	
Sample inadequacy	46 per 1,000	<5 per 1,000 (<11 to >30)	1.12 (0.76–1.65)	2,458 (7 studies)	+	–	–	–	Moderate ●●●○
Sensitivity (non-strict criteria)	0.91 (0.90–0.93)	0.87 (0.85–0.89)	–	2,458 (7 studies)	+	–	–	–	Moderate ●●●○
Sensitivity (strict criteria)	0.88 (0.86–0.90)	0.79 (0.76–0.82)	–	1,935 (4 studies)	+	–	–	–	Moderate ●●●○
Diagnostic accuracy (non-strict criteria)	915 per 1,000	<293 per 1,000 (<436 to <92)	0.68 (0.52–0.90)	2,288 (7 studies)	+	–	–	–	Moderate ●●●○
Diagnostic accuracy (strict criteria)	790 per 1,000	<332 per 1,000 (<427 to <205)	0.58 (0.46–0.74)	2,052 (4 studies)	+	–	–	–	Moderate ●●●○
No. of passes	Mean no. of passes=2.83	>0.31 passes >0.05 to >0.57	–	1,438 (5 studies)	+	+	–	–	Low ●●○○
Population: Patients with pancreatic mass undergoing EUS-guided tissue acquisition **Intervention:** Patients with plastic stent **Comparison:** Patients with metal stent									
Outcome	**Plastic stent**	**Metal stent**							
Sample inadequacy	56 per 1,000	<10 per 1,000 (<34 to >40)	0.83 (0.40–1.71)	859 (4 studies)	+	–	–	+	Low ●●○○
Sensitivity (non-strict criteria)	0.90 (0.88–0.91)	0.83 (0.79–0.86)	–	1,536 (5 studies)	+	+	–	–	Low ●●○○
Diagnostic accuracy (non-strict criteria)	922 per 1,000	>166 per 1,000 (<387 to >1309)	1.18 (0.58–2.42)	1,536 (5 studies)	+	+	–	–	Low ●●○○

EUS, endoscopic ultrasound; CI, confidence interval; OR, odds ratio.

creased number of passes may reflect the uncertainty among endoscopists in obtaining an adequate sample with a stent *in situ*.

Two studies have reported the effect of the time interval between ERCP and EUS-TA on diagnostic outcomes in patients with biliary stents. Fisher et al.[17] have reported reduced diagnostic accuracy of EUS-FNA when performed within one day of biliary stenting compared to when performed after one day. Similarly, Crinò et al.[24] also identified a significant correlation between a shorter interval time between ERCP and EUS-TA and decreased diagnostic accuracy. The inflammation caused by CBD instrumentation may likely affect the visualization of the mass on EUS adversely. Kulkarni et al.[22] compared the procedural time between the two groups and have reported a higher procedural time in patients with indwelling stents. However, other studies did not compare the procedural times of both groups; thus, we could not analyze the difference in procedural duration between the two groups.

Fusaroli et al.[13] analyzed tumor (T) and nodal (N) staging data using EUS in patients with periampullary cancer and compared them with surgical T and N staging. Correct T staging by EUS was achieved in 85% of patients without biliary stents compared to 47% in those with stents. Subsequently, Oppong et al.[33] have reported successful vascular staging in 97% of patients with a plastic stent compared with only 54% in those with a metal stent. Our systematic review could not analyze the impact of stents on tumor staging using EUS.

This meta-analysis had several limitations that warrant further investigation. First, significant heterogeneities in the definitions of malignancy across the included studies were noted. Only four studies used strict criteria to classify patients with a positive malignancy. Thus, using strict criteria is essential because oncologists generally do not consider suspicious samples sufficient for initiating chemotherapy. According to Bekkali et al.,[23] additional factors associated with improved accuracy were tumor size, number of passes, and using fork-tip needles. Significant variations in tumor size, needle size (22-or 25-gauge), application of ROSE, and number of passes in the included studies were also observed. However, we were unable to evaluate the effects of these variables. Lastly, we could not assess the impact of associated CP. Constantinescu et al.[25] have reported that patients with associated CP had a higher risk of obtaining false-negative results (OR, 1.92; 95% CI, 1.13–3.26). EUS elastography has been used to differentiate between inflammatory head masses and malignant lesions in patients with CP.[34] Whether EUS elastography can be used to guide tissue acquisition in suspected areas remains an area for future research.

In conclusion, the presence of an indwelling biliary stent may be associated with lower diagnostic accuracy and sensitivity of EUS-TA for pancreatic masses, with an increased number of passes resulting in prolonged procedural time. EUS should precede ERCP with biliary stenting whenever possible. Further prospective multicenter randomized studies using strict criteria are needed to validate these findings in real-time.

Supplementary Material

Supplementary Fig. 1. Risk of bias assessment using the ROBINS-I tool for non-randomized studies.

Supplementary Fig. 2. Forest plot comparing the rate of sample inadequacy with EUS-guided pancreatic tissue acquisition with and without biliary stent.

Supplementary Fig. 3. Forest plot comparing the rate of sample inadequacy with EUS-guided pancreatic tissue acquisition comparing plastic and metal stent.

Supplementary Fig. 4. Forest plot comparing the number of passes with EUS-guided pancreatic tissue acquisition with and without biliary stent.

Supplementary Fig. 5. Funnel plot for assessment of publication bias.

Supplementary materials related to this article can be found online at https://doi.org/10.5946/ce.2022.282.

Ethical Statements

Not applicable.

Conflicts of Interest

The authors have no potential conflicts of interest.

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Author Contributions

Conceptualization: SG, SAf; Methodology: SG, SAf, SAn, SS; Formal analysis: SG, SAf, JV; Project administration: SG, SS; Visualization: SG, SAf, SAn, JV; Software: SG; Validation: SG, SS; Writing–original draft: SG, SAf, SAn, JV; Writing–review & editing: SG, SAf, SAn, SS.

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