Appendix 1

Detailled search strategy

For Pubmed:

("Bile Duct Neoplasms"[Mesh] OR "MBSs"[ti] OR (("Biliary Tract"[Mesh] OR "bile duct*"[tiab] OR "biliary"[tiab] OR "pancreatobiliary"[tiab]) AND ("stenos*"[tiab] OR "cancer*"[tiab] OR "tumor*"[tiab] OR "tumour*"[tiab] OR "malignan*"[tiab] OR "benign*"[tiab] OR "stricture*"[tiab]))) AND ("brush*"[tiab] OR "tissue sampling"[tiab]) AND ("Diagnosis"[Mesh:NoExp] OR "Diagnos*"[tiab] OR "Cytodiagnosis"[Mesh] OR "cytodiagnos*"[tiab] OR "Sensitivity and Specificity"[Mesh] OR "Sensitivity"[tiab] OR "Specificity"[tiab]) NOT ("Case Reports" [Publication Type] OR "Editorial" [Publication Type] OR "Letter" [Publication Type])

For Embase:

('bile duct tumor'/exp OR 'MBSs':ti OR (('hepatobiliary system'/exp OR 'bile duct*':ti,ab OR 'biliary':ti,ab OR 'pancreatobiliary':ti,ab) AND ('stenos*':ti,ab OR 'cancer*':ti,ab OR 'tumor*':ti,ab OR 'tumour*':ti,ab OR 'malignan*':ti,ab OR 'benign*':ti,ab OR 'stricture*':ti,ab))) AND ('brush*':ti,ab OR 'tissue sampling':ti,ab) AND ('diagnosis'/de OR 'Diagnos*':ti,ab OR 'cytodiagnosis'/exp OR 'cytodiagnos*':ti,ab OR 'sensitivity and specificity'/de OR 'Sensitivity':ti,ab OR 'Specificity':ti,ab) NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it)

For Cochrane Library:

('MBSs':ti OR ((('bile' NEXT 'duct*'):ti,ab OR 'biliary':ti,ab OR 'pancreatobiliary':ti,ab) AND ('stenos*':ti,ab OR 'cancer*':ti,ab OR 'tumor*':ti,ab OR 'tumour*':ti,ab OR 'malignan*':ti,ab OR 'benign*':ti,ab OR 'stricture*':ti,ab))) AND ('brush*':ti,ab OR 'tissue sampling':ti,ab) AND ('Diagnos*':ti,ab OR 'cytodiagnos*':ti,ab OR 'Sensitivity':ti,ab OR 'Specificity':ti,ab)

Appendix 2:

Study	RISK OF BIAS				APPLICABILITY CONCERNS		
	PATIENT SELECTION	INDEX TEST	REFERENCE STANDARD	FLOW AND TIMING	PATIENT SELECTION	INDEX TEST	REFERENCE STANDARD
De Bellis	✍	✍	✍	✍	✍	✍	✍
Cotta Ornellas	✍	?	✍	✍	✍	✍	✍
Dumonceau	✍	✍	✍	✍	✍	✍	✍
Fogel	✍	✍	✍	✍	✍	✍	✍
Shieh	✍	✍	✍	✍	✍	✍	✍
Bank	✍	✍	✍	✍	✍	✍	✍
Kylanpaa	✍	✍	?	✍	?	✍	✍
Rosch	✍	✍	✍	✍	✍	✍	✍
Sasaki	✍	✍	✍	✍	✍	✍	✍
Lee	✍	✍	✍	✍	✍	✍	✍
Fior	✍	✍	?	✍	✍	✍	✍
Sugimoto	✍	?	✍	✍	?	?	✍
Roth	✍	?	✍	✍	✍	✍	✍
Mansfield	✍	✍	✍	✍	✍	✍	✍
Foutch	✍	?	?	✍	✍	✍	✍
Wang	✍	✍	✍	✍	✍	✍	✍

✍ Low Risk ✍ High Risk ? Unclear Risk

Appendix 3: data acquisition sheet

Cytology score form

Article title:

Author:

Year of publication:

Type of study according to authors:

RCT / cohort Prospective or retrospective Randomised/non-randomized

Type of intervention: brush design/bile aspirate/nr of passes/dilation prior to brush

Total studiepopulation:

Totale nr of patients with malignancy:

Pancreatic cancer:

Biliary cancer

Nr of patients with only reference test:

Nr of patients with new intervention:

Nr of patients with both tests:

Sensitivity for malignancy reference test:

Sensitivity for malignancy new intervention test:

P-value for sensitivity:

Cellular yield reported:

Impact intervention on cellular yield:

Origin of study: EU/US/AUS/AS/AFR

Risk of Bias: QUADAS-2

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	P. 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	P. 2, Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	P.3, introduction
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	P.3, introduction
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	P. 4, Methods
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	P. 4, Methods
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	P. 4, Methods
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	P. 4,5 Methods
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	P. 5, Methods
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	P. 5, Methods
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	P. 5, Methods
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	P. 5, Methods
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	P. 5, Methods
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	P.4,5 methods
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	n/a
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	P. 5, methods
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	P. 5, methods

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	n/a
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	n/a
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	n/a
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	n/a
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	P 5, results
Study characteristics	17	Cite each included study and present its characteristics.	Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Suppl table 1
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Fig 2
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	P. 7 results
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Fig 2
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	P 8 Discussion
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	P.6 Results
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	P. 7 discussion
	23b	Discuss any limitations of the evidence included in the review.	P. 8 discussion
	23c	Discuss any limitations of the review processes used.	P. 8 discussion
	23d	Discuss implications of the results for practice, policy, and future research.	P. 8 discussion
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	P. 4 methods

Section and Topic	Item #	Checklist item	Location where item is reported
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	P. 4 methods
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/a
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	P. 9
Competing interests	26	Declare any competing interests of review authors.	P. 9
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	P.10

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71