

Online Resource 1

Detailed search, eligibility decisions, cohort links, extraction, procedural evidence, and risk of bias

Associated manuscript: Incidence and Procedural Risk Factors for Symptomatic Cholecystitis After Yttrium-90 Transarterial Radioembolization: A Systematic Review and Meta-analysis

This supplementary file contains project records available at the time of manuscript preparation. It does not reproduce copyrighted full-text articles. Historical search-source detail, study selection, extraction, and risk-of-bias judgments remain subject to the independent verification described in Appendix G.

Appendix A Search documentation

Historical search endpoint: Sep 22, 2026 . The supplied consolidated export contained 796 records and was designated by the review team as containing all records from PubMed/MEDLINE, CINAHL, and Google Scholar. Citation chaining added 16 records. No duplicate records were recorded. The update strategies below were specified in the review recipe and registered full protocol.

PubMed MEDLINE update strategy

```
(
  "yttrium-90"[Title/Abstract] OR "yttrium 90"[Title/Abstract]
  OR "Y-90"[Title/Abstract] OR "90Y"[Title/Abstract]
  OR "TheraSphere"[Title/Abstract] OR "SIR-Spheres"[Title/Abstract]
)
AND
(
  "radioembolization"[Title/Abstract]
  OR "transarterial radioembolization"[Title/Abstract]
  OR "trans-arterial radioembolization"[Title/Abstract]
  OR "selective internal radiation therapy"[Title/Abstract]
  OR "selective internal radiotherapy"[Title/Abstract]
)
AND
(
  complication*[Title/Abstract] OR "adverse event*" [Title/Abstract]
  OR toxicity[Title/Abstract] OR safety[Title/Abstract] OR biliary[Title/Abstract]
  OR gallbladder[Title/Abstract] OR "gall bladder"[Title/Abstract]
  OR cholecystitis[Title/Abstract] OR "cystic artery"[Title/Abstract]
  OR nontarget[Title/Abstract] OR "non-target"[Title/Abstract]
)
NOT (animals[MeSH Terms] NOT humans[MeSH Terms])
```

CINAHL update strategy

```
(
  TI ("yttrium-90" OR "yttrium 90" OR "Y-90" OR "90Y" OR TheraSphere OR "SIR-Spheres")
  OR AB ("yttrium-90" OR "yttrium 90" OR "Y-90" OR "90Y" OR TheraSphere OR "SIR-Spheres")
)
AND
(
  TI (radioembolization OR "transarterial radioembolization" OR "trans-arterial radioembolization"
    OR "selective internal radiation therapy" OR "selective internal radiotherapy")
  OR AB (radioembolization OR "transarterial radioembolization" OR "trans-arterial radioembolization"
    OR "selective internal radiation therapy" OR "selective internal radiotherapy")
)
AND
(
  TI (complication* OR "adverse event*" OR toxicity OR safety OR biliary OR gallbladder
    OR "gall bladder" OR cholecystitis OR "cystic artery" OR nontarget OR "non-target")
  OR AB (complication* OR "adverse event*" OR toxicity OR safety OR biliary OR gallbladder
    OR "gall bladder" OR cholecystitis OR "cystic artery" OR nontarget OR "non-target")
)
```

Google Scholar update strategy

- "yttrium-90" radioembolization cholecystitis
- "Y-90" radioembolization gallbladder "cystic artery"

- "selective internal radiation therapy" cholecystitis gallbladder
- "selective internal radiotherapy" nontarget gallbladder

Appendix B Detailed-stage exclusions

Detailed-stage exclusions: 83 reports. The 796-record consolidated export yielded 111 database candidates after title and abstract screening; 28 were included and 83 were excluded after detailed assessment. Citation chaining added 16 included reports, producing 44 included reports overall. Each excluded report is assigned one primary reason from the retained screening audit.

Table S1 Reports excluded after detailed assessment

PMID	Report	Primary exclusion reason
42650014	Selective Internal Radiation Therapy (SIRT) for SDH-Deficient GIST Demonstrates Encouraging Durable Response Rates: An International Multicenter Case Series.	Mixed pediatric/adult cohort; adult denominator and event age not separable
42476720	Radiation Therapy for Liver and Biliary Tract Cancers.	Review/guidance; not original incidence data
42209817	Post-hoc analysis of adverse events during the EPOCH trial: reconsidering dosimetry.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
42178465	Real-life experience in the treatment of gallbladder carcinoma by transarterial radioembolization: a multicenter retrospective study.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
41822462	Hepatic embolization for Cushing syndrome from metastatic tumors: a single-center case series.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
41809885	Use of yttrium-90 radioembolization to control liver metastases in pancreatic acinar cell carcinoma and pancreatoblastoma: Two case reports.	Case report or series ≤ 10
41710661	Multimodal imaging techniques in Yttrium-90 radioembolization for hepatocellular carcinoma: a modality-oriented clinical review.	Review/guidance; not original incidence data
41684461	Safety and Efficacy of External Beam Radiation Therapy in Hepatocellular Carcinoma Patients Previously Treated With Yttrium 90 Transarterial Radioembolization.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
41381843	Sorafenib plus selective internal radiotherapy with 90 Y resin microspheres for the treatment of uveal melanoma with liver metastasis: a phase I trial.	Sample size threshold not met (n=10)
41089576	An Uncommon Case of Severe Gastric Ulceration Following Radioembolization for Hepatocellular Carcinoma: Clinical Insights and Management Challenges.	Case report or series ≤ 10
40805251	Impact of Preoperative Yttrium-90 Transarterial Radioembolization on Patients Undergoing Right or Extended Right Hepatectomy for Hepatocellular Carcinoma.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
40787306	Transarterial Radioembolization for Hepatocellular Carcinoma in Korea: Current Clinical Practices, Facility Requirements, and Patient Selection.	Review/guidance; not original incidence data
40787296	Radioembolization: Technical Tips and Follow-Up Imaging.	Review/guidance; not original incidence data
40761150	Discordant patterns of anterior abdominal wall radiotracer accumulation in yttrium-90 selective internal radiation therapy: implications for pretherapeutic planning and posttreatment monitoring.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
40673285	Portal Venous Gas After Trans-arterial Radioembolization in Hepatocellular Carcinoma: A Rare but Critical Imaging Finding.	Case report or series ≤ 10
40647551	Transarterial Chemoembolization Outperforms Radioembolization in Early- and Intermediate-Stage Hepatocellular Carcinoma: A Multicenter Retrospective Study.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)

40591174	Sequential surgery following Yttrium-90 resin microspheres combined with targeted therapy and immunotherapy for primary hepatocellular carcinoma: a case report.	Case report or series ≤10
40527741	Optimizing Yttrium-90 Radioembolization Dosimetry for Hepatocellular Carcinoma: A Korean Perspective.	Review/guidance; not original incidence data
39494134	Yttrium-90 radioembolization treatment strategies for management of hepatocellular carcinoma.	Review/guidance; not original incidence data
38919523	Safety and efficacy of Holmium-166 selective internal radiotherapy of primary and secondary liver cancer confirmed by real-world data.	Wrong isotope/intervention or non-human population
38779252	Gastric Ulcer With Yttrium-90 Microsphere Selective Internal Radiation Therapy.	Case report or series ≤10
38407790	Selective Internal Radiation Therapy Using Y-90 Resin Microspheres for Metastatic Colorectal Cancer: An Updated Systematic Review and Network Meta-Analysis.	Review/guidance; not original incidence data
38321223	Factors Impacting Survival After Transarterial Radioembolization in Patients with Unresectable Intrahepatic Cholangiocarcinoma: A Combined Analysis of the Prospective CIRT Studies.	Duplicate/overlapping cohort
37835485	Holmium-166 Transarterial Radioembolization for the Treatment of Intrahepatic Cholangiocarcinoma: A Case Series.	Wrong isotope/intervention or non-human population
37190173	188 Re-SSS Lipiodol Radioembolization in HCC Patients: Results of a Phase 1 Trial (Lip-Re-01 Study).	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
37179793	Selective internal radiotherapy in Germany: a review of indications and hospital mortality from 2012 to 2019.	Review/guidance; not original incidence data
37038587	Post-embolization Syndrome Following Yttrium-90 Radiation Segmentectomy.	Case report or series ≤10
36927302	Update of the Bologna Experience in Radioembolization of Intrahepatic cholangiocarcinoma.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
36593888	Factors impacting survival after transarterial radioembolization in patients with hepatocellular carcinoma: Results from the prospective CIRT study.	Duplicate/overlapping cohort
36547167	Temporary Reversal of Hepatoenteric Collaterals during 90 Y Radioembolization Planning and Administration.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
36505832	Selective internal radiation therapy of metastatic breast cancer to the liver: A meta-analysis.	Review/guidance; not original incidence data
36290830	Hepatic Abscess following Yttrium-90 Radioembolization in Patients with Surgical Bilioenteric Anastomosis or Compromised Sphincter of Oddi: A Tertiary Cancer Center Experience.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
35229168	Pure laparoscopic major liver resection after yttrium 90 radioembolization: a case-matched series analysis of feasibility and outcomes.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
37383534	Radioembolization for hepatocellular carcinoma: what clinicians need to know.	Review/guidance; not original incidence data
34898592	Selective Internal Radiation Combined with Chemotherapy Maintains the Quality of Life in Intrahepatic Cholangiocarcinomas.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
34585259	Lung shunt fraction calculation using 99m Tc-MAA SPECT/CT imaging for 90 Y microsphere selective internal radiation therapy of liver tumors.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
33604708	Yttrium-90 radioembolization of isolated hepatic adrenocortical carcinoma metastases with negative surgical pathology.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)

32959085	Clinical Application of Trans-Arterial Radioembolization in Hepatic Malignancies in Europe: First Results from the Prospective Multicentre Observational Study CIRSE Registry for SIR-Spheres Therapy (CIRT).	Duplicate/overlapping cohort
32272656	Comparison between Y90 Radioembolization Plus Sorafenib and Y90 Radioembolization alone in the Treatment of Hepatocellular Carcinoma: A Propensity Score Analysis.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
31933552	Software development for hepatopulmonary shunt estimation by gamma camera method in transarterial radioembolization.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
31830831	Yttrium-90 Microsphere Selective Internal Radiation Therapy-Induced Cholecystitis.	Case report or series ≤10
31705243	Catheter-Directed Computed Tomography Hepatic Angiography for Yttrium-90 Selective Internal Radiotherapy of Hepatocellular Carcinoma Reduces Prophylactic Embolization of Extrahepatic Vessels.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
30911980	Liver Resection After Selective Internal Radiation Therapy with Yttrium-90: Safety and Outcomes.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
29849654	A Woman with Black Beads in Her Stomach: Severe Gastric Ulceration Caused by Yttrium-90 Radioembolization.	Case report or series ≤10
29520178	Imaging Evaluation Following 90 Y Radioembolization of Liver Tumors: What Radiologists Should Know.	Review/guidance; not original incidence data
29496075	Yttrium-90 radioembolization for unresectable metastatic neuroendocrine liver tumor: A systematic review.	Review/guidance; not original incidence data
29416432	Radioembolization treatment for liver metastases.	Review/guidance; not original incidence data
29344714	Angiographic Anatomy and Relevance of 3 and 9 O'clock Arteries During Radioembolization.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
29167951	Radioembolization Versus Bland Embolization for Hepatic Metastases from Small Intestinal Neuroendocrine Tumors: Short-Term Results of a Randomized Clinical Trial.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
28781171	First-line selective internal radiotherapy plus chemotherapy versus chemotherapy alone in patients with liver metastases from colorectal cancer (FOXFIRE, SIFLOX, and FOXFIRE-Global): a combined analysis of three multicentre, randomised, phase 3 trials.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
28500460	Prophylactic Temporary Occlusion of the Cystic Artery Using a Fibered Detachable Coil During 90 Y Radioembolization.	Case series ≤10 (n=9)
28407278	Prevention and treatment of complications of selective internal radiation therapy: Expert guidance and systematic review.	Review/guidance; not original incidence data
27039186	Transarterial Radioembolization with Yttrium-90 for the Treatment of Hepatocellular Carcinoma.	Review/guidance; not original incidence data
26335790	Radioembolization with Y-90 Glass Microspheres: Do We Really Need SPECT-CT to Identify Extrahepatic Shunts?	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
26089551	Intraarterial Hepatic SPECT/CT Imaging Using 99mTc-Macroaggregated Albumin in Preparation for Radioembolization.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
25353006	Determination of Radiation Absorbed Dose to Primary Liver Tumors and Normal Liver Tissue Using Post-Radioembolization (90Y) PET.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
25320734	Gastrectomy for the treatment of refractory gastric ulceration after radioembolization with 90Y microspheres.	Case report or series ≤10
25191640	Radioembolization of hepatic lesions from a radiobiology and dosimetric perspective.	Review/guidance; not original incidence data

25156827	Yttrium-90 radioembolization stops progression of targeted breast cancer liver metastases after failed chemotherapy.	Duplicate/overlapping cohort
25120955	Side effects of yttrium-90 radioembolization.	Review/guidance; not original incidence data
24551594	Non-Target Activity Detection by Post-Radioembolization Yttrium-90 PET/CT: Image Assessment Technique and Case Examples.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
24434228	Yttrium-90 radioembolization of liver tumors: what do the images tell us?	Review/guidance; not original incidence data
27508185	Transarterial radioembolization using yttrium-90 microspheres in the treatment of hepatocellular carcinoma: a review on clinical utility and developments.	Review/guidance; not original incidence data
23894481	Clinical and laboratory toxicity after intra-arterial radioembolization with (90)Y-microspheres for unresectable liver metastases.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
23883566	Post-radioembolization yttrium-90 PET/CT - part 1: diagnostic reporting.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
23602420	Yttrium-90 radioembolization for intrahepatic cholangiocarcinoma: safety, response, and survival analysis.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
23229892	Temporary arterial balloon occlusion as an adjunct to Yttrium-90 radioembolization.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
22913492	Transarterial radioembolization versus chemoembolization for the treatment of hepatocellular carcinoma (TRACE): study protocol for a randomized controlled trial.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
22654269	Hepatic radioembolization complicated by radiation cholecystitis.	Case report or series ≤10
22546235	Clinical practice in radioembolization of hepatic malignancies: a survey among interventional centers in Europe.	Review/guidance; not original incidence data
22137020	Radioembolization for neuroendocrine liver metastases: safety, imaging, and long-term outcomes.	Duplicate/overlapping cohort
22079516	Radioembolization versus standard care of hepatic metastases: comparative retrospective cohort study of survival outcomes and adverse events in salvage patients.	Duplicate/overlapping cohort
21939859	Radioembolization for primary and metastatic liver cancer.	Review/guidance; not original incidence data
21567273	Practical vascular anatomy in the preparation of radioembolization.	Review/guidance; not original incidence data
21191588	Technical solutions to ensure safe yttrium-90 radioembolization in patients with initial extrahepatic deposition of (99m)technetium-albumin macroaggregates.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
20550679	Holmium-166 radioembolization for the treatment of patients with liver metastases: design of the phase I HEPAR trial.	Wrong isotope/intervention or non-human population
19820932	First experience of hepatic radioembolization using microspheres labelled with yttrium-90 (TheraSphere): practical aspects concerning its implementation.	No extractable symptomatic cholecystitis numerator/denominator (often imaging-only)
19680720	Selective internal radiation therapy with SIR-spheres for the treatment of unresectable colorectal hepatic metastases.	Duplicate/overlapping cohort
19546555	Treatment of hepatocellular carcinoma by radioembolization using 90Y microspheres.	Review/guidance; not original incidence data
18656012	Hepatic yttrium-90 radioembolization of chemotherapy-refractory colorectal cancer liver metastases.	Duplicate/overlapping cohort
18203932	Multimodality imaging following 90Y radioembolization: a comprehensive review and pictorial essay.	Review/guidance; not original incidence data

17312068	Response of liver metastases after treatment with yttrium-90 microspheres: role of size, necrosis, and PET.	Duplicate/overlapping cohort
17159545	Management and prevention of adverse effects related to treatment of liver tumours with 90Y microspheres.	Duplicate/overlapping cohort

Appendix C Included-study extraction

Forty-four reports met the review eligibility criteria. Atassi et al. 2008 was retained for qualitative synthesis but excluded from the primary independent-cohort model because of likely overlap with the 2003-2006 multicenter or Northwestern cohort. Blank or unreported fields are shown as NR. All extracted values remain subject to independent source verification before submission.

Table S2A Study design, population, and treatment characteristics

Study	PMID	N	Design and cohort type	Population	Microspheres	Treatment technique and dose
Carr 2004	14762849	65	Prospective single-center safety cohort; General cohort	HCC	Glass (TheraSphere)	Hepatic arterial/lobar TARE
Jiao 2007	17433608	21	Prospective observational cohort; General cohort	Unresectable primary/metastatic liver tumors	Resin	21 patients; one retreated
Atassi 2008	18440457	327	Retrospective imaging/toxicity cohort; General cohort	HCC (190) and liver metastases (137)	Mixed/NR	569 standard lobar infusions
Kennedy 2009	19157721	515	Retrospective multicenter registry; General cohort	Primary and metastatic hepatic tumors	Resin	680 treatments in 515 patients
Cianni 2010	20091135	110	Observational single-center cohort; General cohort	Unresectable hepatic metastases	Resin	TARE after angiographic work-up
McWilliams 2011	21063871	46	Retrospective technical cohort; Anatomy/management-enriched	Hepatic malignancies requiring right-lobar TARE	NR	Sequential lobar TARE
Lenoir 2012	22237844	89	Prospective/retrospective imaging-planning cohort; General mapping cohort	Primary and metastatic hepatic tumors	NR	103 mapped; 89 treated
Peterson 2013	23953810	112	Two-center consecutive cohort; General cohort	Unresectable hepatic tumors	Mixed/NR	Y90 TARE
Theysohn 2013	22983697	295	Retrospective consecutive cohort; General mapping cohort	Primary and metastatic hepatic tumors	NR	Tailored intervention when gallbladder wall uptake was significant
Bester 2014	23388564	427	Retrospective comparative cohort; General cohort	Unresectable liver tumors with/without prior hepatectomy	Resin/NR	TARE
Geisel 2014	25075065	143	Retrospective cohort; General cohort	Hepatic malignancies; 9 with biliodigestive anastomosis	NR	Y90 TARE
Sag 2014	24758670	133	Retrospective consecutive gallbladder-effects cohort; General cohort	Primary (34) and metastatic (99) hepatic tumors; gallbladder in situ	Resin 95; glass 38	Lobar TARE
Lee 2015	26640386	30	Retrospective cohort; General cohort	Advanced inoperable HCC	NR	Y90 TARE
Powerski 2015	25823575	105	Retrospective comparative technical cohort; Anatomy/management-enriched	Liver malignancies with CA management data	NR	TARE with or without CA coil occlusion
Damm 2016	27439702	106	Retrospective cohort; General cohort	Chemo-refractory liver-dominant metastatic colorectal cancer	Resin	178 TARE procedures in 106 patients
Kim 2016	27430276	16	Retrospective single-center cohort; General cohort	Liver-dominant metastatic pancreatic adenocarcinoma	NR	TARE incorporated with systemic chemotherapy
Mosconi 2016	27336601	23	Retrospective cohort with prospectively acquired follow-up data; General cohort	Unresectable/recurrent intrahepatic cholangiocarcinoma	NR	Y90 TARE
Parakh 2016	26116405	74	Retrospective cohort; General cohort	Hepatic malignancies	Resin	Y90 resin TARE
Pieper 2016	27461588	44	Retrospective single-center cohort; General cohort	Advanced breast cancer liver metastases	56 resin and 13 glass treatment sessions	69 TARE sessions; 42/44 bilobar disease; Dose: Mean activity 1.35±0.71 GBq
Pieper 2016	27462163	21	Retrospective imaging/outcomes cohort; General cohort	Breast cancer liver metastases	Resin	Resin-based TARE
Klompenerhouwer 2017	28685382	30	Retrospective cohort; General cohort	Intermediate/advanced HCC refractory to DEB-TACE	NR	Y90 TARE after DEB-TACE

Piasecki 2019	31554288	64	Quantitative anatomic/imaging cohort; Anatomy/management-enriched	Hepatic malignancies	NR	85 patients/98 workups; 64 treated
Topcuoglu 2019	30635753	29	Retrospective technical cohort; Anatomy/management-enriched	Hepatic malignancies with CA near treatment territory	Glass	34 TARE procedures without CA occlusion; Dose: Mean tumor dose 204.9 Gy; healthy liver 70.5 Gy; gallbladder 96.4±53.4 Gy
Ebadi 2020	32033166	101	Retrospective consecutive cohort; General cohort	HCC	NR	Y90 SIRT
Padia 2020	33187861	17	Retrospective multi-institutional feasibility cohort; Anatomy/management-enriched	HCC supplied by the cystic artery	NR	Ablative/direct cystic-artery infusion; Dose: Median target dose 340 Gy (200-720)
Teyateeti 2020	32984089	155	Retrospective HCC cohort; General cohort	Unresectable HCC	Glass	175 procedures in 155 patients; TARE alone/with sorafenib/alternative
Yammine 2020	32399360	23	Retrospective single-center cohort; General cohort	HCC 8, cholangiocarcinoma 4, other metastases 11	NR	Y90 SIRT
Loffroy 2021	32975600	200	Prospective multicenter observational registry (CIRT-FR); General cohort	HCC 114; mCRC 38; ICC 33; other 15	Resin	Real-world TARE
Mulcahy 2021	34541864	187	Randomized open-label international phase III trial (TARE arm safety cohort); General cohort	Second-line colorectal liver metastases	Resin	TARE plus systemic chemotherapy
Paprottka 2021	34771563	73	Retrospective cohort; General cohort	Unresectable intrahepatic cholangiocarcinoma	Resin	103 TARE procedures in 73 patients
Paz-Fumagalli 2021	34611481	28	Retrospective ablative cohort; General cohort	Unresectable intrahepatic cholangiocarcinoma	Glass	37 radioembolizations; single-compartment dose ≥190 Gy; Dose: Median highest patient dose 256.8 Gy (195.7-807.8)
Pellegrinelli 2021	33466706	70	Retrospective single-center cohort; General cohort	HCC 44; mCRC 20; cholangiocarcinoma 6	Resin or glass	Real-world TARE; Dose: Median activity 1.6 GBq
Chaikajornwat 2022	39959806	52	Retrospective single-center cohort; General cohort	Unresectable HCC	NR	66 Y90 SIRT sessions
Minor 2022	35021863	26	Prospective pilot trial; General cohort	Metastatic uveal melanoma	Resin	Sequential bilobar Y90 followed by ipilimumab/nivolumab
Mosconi 2022	36556085	253	Retrospective longitudinal cohort; General cohort	HCC	NR	TARE across early and modern eras
Yim 2022	35053546	149	Retrospective real-world cohort; General cohort	Unresectable HCC	NR	Y90 TARE
Carrión 2023	37920686	63	Retrospective consecutive cohort; General cohort	HCC	NR	Unilobar or bilobar Y90 TARE
Choi 2023	37364731	24	Retrospective direct-CA treatment cohort; Anatomy/management-enriched	HCC with parasitized cystic-artery supply	NR	Infusion via main CA 6, deep CA 9, small CA feeders 9; Dose: Median CA activity 0.19 GBq; median total 4.1 GBq
Damm 2023	37525508	130	Prospective consecutive management-algorithm cohort; Anatomy/management-enriched	Advanced liver tumors receiving right-lobe Y90 with gallbladder at risk	NR	197 total patients; 130 at-risk right-lobe treatments
Maleux 2023	36914788	1027	Prospective multicenter observational CIRT registry; General cohort	HCC 422; ICC 120; mCRC 237; other metastases 248	Resin	1197 real-world treatments
Alexander 2024	37923172	57	Retrospective cohort; General cohort	Primary lung cancer metastases to liver	Resin 34 patients; glass 23	79 TARE treatments in 57 patients
Karaoğullarından 2024	39128104	146	Retrospective single-center age-comparison cohort; General cohort	HCC; 90 younger and 56 elderly patients	NR	Y90 TARE
Kim 2026	41941922	37	Retrospective flow-redistribution cohort; Other technique-enriched	HCC requiring inferior phrenic artery flow redistribution	NR	TARE after inferior phrenic artery glue embolization
di Gaeta 2026	42047802	64	Retrospective two-center dosimetry cohort; General cohort	HCC	Resin	Personalized-dosimetry TARE; Dose: Tumor mean-dose response threshold 296.74 Gy

Table S2B Cystic-artery, mapping, and outcome ascertainment

Study	Cystic-artery information	Mapping	Gallbladder uptake	Clinical outcome definition	Follow-up
Carr 2004	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Clinical acute cholecystitis	All patients ≥6 months
Jiao 2007	NR	Angiography plus 99mTc-MAA	NR	Clinical post-TARE cholecystitis	6 weeks, then every 3 months
Atassi 2008	NR	CT/MRI before and 3-6 months after TARE	NR	Imaging diagnosis with clinically significant cases requiring surgery	3-6 months
Kennedy 2009	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Explicitly reported no cholecystitis in toxicity assessment	NR
Cianni 2010	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE grade 2 cholecystitis	3-month effectiveness assessment
McWilliams 2011	Prophylactic CA embolization: Gelfoam 35; coils 11	Angiography plus planar 99mTc-MAA SPECT	NR	RUQ pain plus positive Murphy sign	Inpatient clinical observation; angiography at 1 month
Lenoir 2012	NR	99mTc-MAA SPECT/CT plus post-Y90 imaging	Gallbladder uptake on 17/139 mapping scans; reproduced after Y90 in 2	Gallbladder pain plus ultrasound sludge (alithiasic cholecystitis)	≥6 months
Peterson 2013	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE v3 symptomatic cholecystitis (5 grade 2; 2 grade 3)	Early ≤30 days; late thereafter; late toxicity assessed to 12 months
Theysohn 2013	Among 20 uptake-positive: Gelfoam 5, coil 1, vasospasm 4, catheter repositioning 10	DSA plus 99mTc-HSA SPECT/CT	Significant gallbladder-wall uptake 20/295	Clinical pain/fever/positive Murphy sign	NR
Bester 2014	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE grade 2 cholecystitis	Complications assessed to 3 months
Geisel 2014	NR	Contrast-enhanced MRI/CT pre-treatment and 6-8 weeks	NR	Cholecystitis listed as a clinical complication	6-8 week imaging
Sag 2014	CA embolized in 4/133	Serial CT/MRI in 85 patients	Imaging abnormalities 84/85 but only one clinical event	Clinically significant radiation cholecystitis requiring cholecystectomy	NR; 85 had serial imaging
Lee 2015	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE v4 symptomatic cholecystitis	Median 18.3 months
Powerski 2015	No coil 37; permanent coil 68	Clinical/laboratory/imaging assessment to 6 weeks	NR	Treatment-requiring clinical cholecystitis	6 weeks
Damm 2016	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE v4.03 grade 3/4 radiation-induced cholecystitis	Followed to death/last assessment
Kim 2016	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Transient radiation cholecystitis	Clinical/laboratory follow-up; enzymes returned to baseline by 1 month
Mosconi 2016	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Late clinically symptomatic cholecystitis	1 and 3 months, then every 3 months; median 16 months (2-52)
Parakh 2016	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Symptomatic post-TARE cholecystitis	All events occurred >4 weeks
Pieper 2016	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE grade 2 clinical cholecystitis	Median clinical follow-up 121 days (26-870)
Pieper 2016	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Explicitly no procedure-related cholecystitis	Median 163 days (46-1638)

Klompenshouwer 2017	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE grade 3 cholecystitis	Median survival follow-up 14.8 months
Piasecki 2019	CA coiled in 54/65 evaluable arteries	DSA plus 99mTc-MAA and post-Y90 imaging	MAA gallbladder leak 16; post-Y90 leak 2, both asymptomatic	CTCAE/clinical assessment through 3 months; no symptomatic cholecystitis	3 months
Topcuoglu 2019	No CA occlusion	Post-treatment SPECT/CT	Gallbladder radioactivity 11/34 procedures	No CTCAE grade ≥ 2 clinical event	Mean 14 $\pm$ 5.2 months
Ebadi 2020	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Acute cholecystitis categorized as a serious adverse event	Median 14 months
Padia 2020	Y90 delivered via CA supply; no prophylactic CA embolization	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	No acute cholecystitis warranting invasive intervention	Median 9 months (3-72)
Teyateeti 2020	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Grade 3-4 cholecystitis	To death, last follow-up, or treatment change
Yammine 2020	CA occluded in 2; event occurred after CA coiling in a patient with gallstones	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Clinical cholecystitis likely ischemic	Median survival follow-up 12 months
Loffroy 2021	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE v4.03; no radiation cholecystitis reported	30 days and first follow-up (mean 13 weeks)
Mulcahy 2021	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	TARE-specific CTCAE grade ≥ 3 cholecystitis	Median approximately 36 months
Paprottka 2021	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE acute/late table explicitly reported no grade 1-5 cholecystitis	Toxicity tracked to 3 months
Paz-Fumagalli 2021	NR	Post-Y90 Bremsstrahlung SPECT/CT	No gallbladder activity in the case	Grade 4 perforated cholecystitis; causation uncertain	Median 13.4 months (5.4-39.4)
Pellegrinelli 2021	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE grade 3 radiation-induced cholecystitis from nontarget distribution	Median 32.1 months
Chaikajornwat 2022	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Explicitly no cholecystitis reported	Mean 12.5 months
Minor 2022	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Cholecystitis attributed to Y90 with severe persistent symptoms	On-study follow-up; median survival 15 months
Mosconi 2022	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Grade III-IV acute cholecystitis within 1 month	2005-2020 cohort; outcome within 1 month
Yim 2022	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE v4.03 grade 3 cholecystitis	Median 16.9 months; imaging at 1 and 3 months then every 2-3 months
Carrión 2023	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Grade 3 radiation-induced cholecystitis	Assessments at 6 and 12 weeks
Choi 2023	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	No symptomatic cholecystitis requiring invasive intervention	1-month CT plus oncologic follow-up
Damm 2023	Algorithm scheduled prophylaxis in 22 patients	99mTc-MAA SPECT/CT plus angiography	Gallbladder enhancement in 16 patients	Clinical presentation plus imaging/laboratory criteria (Tokyo Guidelines)	Prospective clinical follow-up; exact median NR
Maleux 2023	Prophylactic embolization yes 412/no 477; outcome-specific comparison not reported	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	CTCAE v4.03 radiation cholecystitis prospectively included in case-report form	Up to 24 months
Alexander 2024	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Severe acalculous/aseptic cholecystitis within 30 days	Within 30 days and longer-term oncologic follow-up
Karaoğullarından 2024	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Radiation cholecystitis in adverse-event table; grading not reported	Median survival 9.0 vs 8.5 months; event-specific follow-up NR

Kim 2026	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Severe cholecystitis	Median survival/local progression follow-up 31.7 months
di Gaeta 2026	NR	Angiography/99mTc-MAA per standard TARE workflow; study-specific detail NR	NR	Grade 3 cholecystitis	Median 15.0 months (IQR 8.0-24.3)

Table S2C Clinical events, timing, management, and imaging-only findings

Study	Symptomatic events	Timing	Management	Cholecystitis-related mortality	Imaging-only findings
Carr 2004	2/65 (3.08%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 2 (100% of cases)	0 reported/NR	NR
Jiao 2007	1/21 (4.76%)	NR	Hospitalization: NR; Conservative: 1 (100% of cases); Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 0	0 reported/NR	NR
Atassi 2008	2/327 (0.61%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 2 (100% of cases)	0 reported/NR	Gallbladder enhancement 6/327; wall rent/disruption 3/327
Kennedy 2009	0/515 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Cianni 2010	2/110 (1.82%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
McWilliams 2011	3/46 (6.52%)	Immediate/early after right-lobar treatment	Hospitalization: NR; Conservative: 2/3 cases; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 1/3 cases	0 reported/NR	NR
Lenoir 2012	2/89 (2.25%)	NR	Hospitalization: NR; Conservative: 2/2 cases resolved medically; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Peterson 2013	7/112 (6.25%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Theysohn 2013	1/295 (0.34%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: 1/1 case; Cholecystostomy: NR; Cholecystectomy: 0	0 reported/NR	NR
Bester 2014	2/427 (0.47%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Geisel 2014	1/143 (0.70%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Sag 2014	1/133 (0.75%)	Day 8 in the clinical case	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 1/1 case	0 reported/NR	84/85 with ≥1 gallbladder imaging abnormality
Lee 2015	1/30 (3.33%)	NR	Hospitalization: NR; Conservative: 1 self-limited; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Powerski 2015	3/105 (2.86%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Damm 2016	1/106 (0.94%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 1/1 case	0 reported/NR	NR
Kim 2016	1/16 (6.25%)	Immediately after TARE	Hospitalization: NR; Conservative: 1/1 case; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Mosconi 2016	1/23 (4.35%)	NR	Hospitalization: NR; Conservative: 1 medical management; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Parakh 2016	4/74 (5.41%)	>4 weeks for all cases	Hospitalization: NR; Conservative: 4 initially; all failed; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: 4/4 cases	0 reported/NR	NR
Pieper 2016	1/44 (2.27%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Pieper 2016	0/21 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Klompenhouwer 2017	1/30 (3.33%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR

Piasecki 2019	0/64 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	MAA leak 16/65; post-Y90 leak 2/64
Topcuoglu 2019	0/29 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	11/34 procedures with gallbladder uptake
Ebadi 2020	1/101 (0.99%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Padia 2020	0/17 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	Gallbladder wall edema 6/17
Teyateeti 2020	1/155 (0.65%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Yamine 2020	1/23 (4.35%)	NR	Hospitalization: NR; Conservative: 1/1 case; no surgery; Antibiotics: 1/1 case; Cholecystostomy: NR; Cholecystectomy: 0	0 reported/NR	NR
Loffroy 2021	0/200 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Mulcahy 2021	2/187 (1.07%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Paprottka 2021	0/73 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Paz-Fumagalli 2021	1/28 (3.57%)	Day 33	Hospitalization: 1/1 case; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Pellegrinelli 2021	1/70 (1.43%)	NR	Hospitalization: NR; Conservative: Responded to medical/radiologic therapy; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Chaikajornwat 2022	0/52 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Minor 2022	1/26 (3.85%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Mosconi 2022	3/253 (1.19%)	Within 1 month	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Yim 2022	1/149 (0.67%)	NR	Hospitalization: NR; Conservative: Resolved without sequelae; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Carrión 2023	1/63 (1.59%)	NR	Hospitalization: NR; Conservative: Resolved; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Choi 2023	0/24 (0.00%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	Gallbladder wall thickening 12/24
Damm 2023	4/130 (3.08%)	2 within 48 h (embolic); 2 late (radiogenic)	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Maleux 2023	4/1027 (0.39%)	3 cases at 1-4 months; 1 after 4 months	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 cholecystitis-related deaths reported	NR
Alexander 2024	2/57 (3.51%)	Within 30 days	Hospitalization: 2 severe events requiring prolonged admission/escalated care; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Karaoğullarından 2024	6/146 (4.11%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
Kim 2026	2/37 (5.41%)	NR	Hospitalization: NR; Conservative: Both severe events reversible with treatment; details NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR
di Gaeta 2026	1/64 (1.56%)	NR	Hospitalization: NR; Conservative: NR; Antibiotics: NR; Cholecystostomy: NR; Cholecystectomy: NR	0 reported/NR	NR

Table S2D Analysis classification and overall appraisal

Study	Cohort type	All-grade ascertainment	Etiology compatible	Primary model	Quantitative handling	Overall appraisal
Carr 2004	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Jiao 2007	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Atassi 2008	General cohort	No	Yes	No	Likely overlap with 2003-2006 multicenter/Northwestern data	Some concerns
Kennedy 2009	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Cianni 2010	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
McWilliams 2011	Anatomy/management-enriched	Yes	No	Yes	Included in independent-cohort model	Some concerns
Lenoir 2012	General mapping cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Peterson 2013	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Theysohn 2013	General mapping cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Bester 2014	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Geisel 2014	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Sag 2014	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Lee 2015	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Powerski 2015	Anatomy/management-enriched	No	Yes	Yes	Included in independent-cohort model	Some concerns
Damm 2016	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Kim 2016	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Mosconi 2016	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Parakh 2016	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Pieper 2016	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Pieper 2016	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Klompenhouwer 2017	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Piasecki 2019	Anatomy/management-enriched	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Topcuoglu 2019	Anatomy/management-enriched	No	Yes	Yes	Included in independent-cohort model	Some concerns
Ebadi 2020	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Padia 2020	Anatomy/management-enriched	No	Yes	Yes	Included in independent-cohort model	Some concerns
Teyateeti 2020	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Yammine 2020	General cohort	Yes	No	Yes	Included in independent-cohort model	Some concerns
Loffroy 2021	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Low risk
Mulcahy 2021	General cohort	No	Yes	Yes	Included in independent-cohort model	Low risk
Paprottka 2021	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Paz-Fumagalli 2021	General cohort	No	No	Yes	Included in independent-cohort model	Some concerns
Pellegrinelli 2021	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Chaikajornwat 2022	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Minor 2022	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Mosconi 2022	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Yim 2022	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Carrión 2023	General cohort	No	Yes	Yes	Included in independent-cohort model	Some concerns
Choi 2023	Anatomy/management-enriched	No	Yes	Yes	Included in independent-cohort model	Some concerns
Damm 2023	Anatomy/management-enriched	Yes	Yes	Yes	Included in independent-cohort model	Some concerns

Maleux 2023	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Low risk
Alexander 2024	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Karaogullarından 2024	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns
Kim 2026	Other technique-enriched	No	Yes	Yes	Included in independent-cohort model	Some concerns
di Gaeta 2026	General cohort	Yes	Yes	Yes	Included in independent-cohort model	Some concerns

Appendix D Procedure-specific effects

Procedural comparisons were not pooled because exposure definitions, clinical indications, outcome measures, and adjustment approaches were not sufficiently compatible. Surrogate mapping endpoints and imaging-only abnormalities are kept distinct from clinical symptomatic cholecystitis.

Table S3 Evidence on procedural factors and preventive strategies

Study	Factor	Comparison	Result	Interpretation
Damm 2023	Algorithm-guided prophylaxis	2.9% algorithm vs 4.7% standard care	P=.53; no demonstrated reduction	Selective algorithm is feasible; benefit remains uncertain
Powerski 2015	Permanent CA coil embolization	2/68 coiled vs 1/37 uncoiled	2.9% vs 2.7%; no significant difference	Routine permanent coil embolization is unsupported
McWilliams 2011	Coil vs temporary Gelfoam CA embolization	2/11 coil vs 1/35 Gelfoam	One coil patient required cholecystectomy	Small nonrandomized cohort; ischemic injury/collateralization are concerns
Piasecki 2019	Catheter position relative to CA	MAA leak 12/34 proximal vs 4/31 distal	P=.039; reported RR ≈2.5 (95% CI 1.2-5.4)	Distal catheter positioning is the clearest quantitative procedural signal
Sag 2014	Imaging abnormality / microsphere type	84/85 imaging abnormalities vs 1/133 clinical event	Clinical event followed glass infusion proximal to CA origin	Imaging findings are highly nonspecific; product inference is not possible
Topcuoglu 2019	Gallbladder uptake/dose without CA occlusion	11/34 procedures with uptake; 0/29 grade ≥2 clinical events	Mean gallbladder dose 96.4±53.4 Gy	Uptake/dose alone did not predict symptoms
Padia 2020	Direct/ablative infusion via CA	0/17 invasive cholecystitis; RUQ pain 4/17	Median target dose 340 Gy	Feasible in selected expert-center cases; not evidence about inadvertent reflux
Choi 2023	Direct CA infusion branch	0/24 invasive cholecystitis; wall thickening 12/24	Main/deep/small feeder infusion	Selected direct-CA treatment can be clinically tolerated despite imaging changes
Walker 2023	Prophylactic CA embolization	4/22 treatment-requiring cholecystitis	2 presumed ischemic; all 4 events after coils	Selected cohort without control; permanent coils may themselves injure the gallbladder

Appendix E Cohort-overlap map

Only one included-report overlap was explicit in the retained extraction dataset. Ten additional database records were excluded during detailed assessment as duplicate or overlapping reports.

Table S4 Explicit included-report cohort linkage

Cohort cluster	Reports	Handling	Rule
Northwestern and multicenter 2003-2006 treatment experience	Atassi 2008 (PMID 18440457); Kennedy 2009 (PMID 19157721)	Kennedy 2009 contributes to the primary model. Atassi 2008 is retained in the qualitative review but excluded from quantitative pooling because cohort overlap is likely.	One event numerator and denominator from an independent cohort may enter a given analysis.

Appendix F JBI-informed risk-of-bias and applicability judgments

Initial overall judgments were 3 low risk, 40 with some concerns, and 1 high risk. Domains reflect participant selection, denominator validity, clinical outcome definition, follow-up, cohort independence, and applicability. These are provisional single-reviewer judgments and require independent verification and documented resolution before journal submission.

Table S5 Study-level JBI-informed judgments

Study	Selection	Denominator	Outcome definition	Follow-up	Independence	Applicability	Overall
Carr 2004	Low	Low	Low	Low	Low	Low	Some concerns
Jiao 2007	Low	Low	Low	Low	Low	Low	Some concerns
Atassi 2008	Some concerns	Low	Some concerns	Low	High	Low	High risk
Kennedy 2009	Some concerns	Low	Low	Some concerns	Low	Low	Some concerns
Cianni 2010	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
McWilliams 2011	Some concerns	Low	Low	Low	Low	Some concerns	Some concerns
Lenoir 2012	Low	Low	Low	Low	Low	Low	Some concerns
Peterson 2013	Low	Low	Some concerns	Low	Low	Low	Some concerns
Theysohn 2013	Low	Low	Low	Some concerns	Low	Low	Some concerns
Bester 2014	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Geisel 2014	Some concerns	Low	Low	Low	Low	Low	Some concerns
Sag 2014	Low	Low	Some concerns	Low	Low	Low	Some concerns
Lee 2015	Some concerns	Low	Low	Low	Low	Low	Some concerns
Powerski 2015	Some concerns	Low	Some concerns	Low	Low	Some concerns	Some concerns
Damm 2016	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Kim 2016	Some concerns	Low	Low	Low	Low	Low	Some concerns
Mosconi 2016	Low	Low	Low	Low	Low	Low	Some concerns
Parakh 2016	Some concerns	Low	Low	Low	Low	Low	Some concerns
Pieper 2016	Some concerns	Low	Low	Low	Low	Low	Some concerns
Pieper 2016	Some concerns	Low	Low	Low	Low	Low	Some concerns
Klompshouwer 2017	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Piasecki 2019	Some concerns	Low	Low	Low	Low	Some concerns	Some concerns
Topcuoglu 2019	Some concerns	Low	Some concerns	Low	Low	Some concerns	Some concerns
Ebadi 2020	Low	Low	Some concerns	Low	Low	Low	Some concerns
Padia 2020	Some concerns	Low	Some concerns	Low	Low	Some concerns	Some concerns
Teyateeti 2020	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Yammine 2020	Some concerns	Low	Low	Low	Low	Low	Some concerns
Loffroy 2021	Low	Low	Low	Low	Low	Low	Low risk
Mulcahy 2021	Low	Low	Some concerns	Low	Low	Low	Low risk
Paprottka 2021	Some concerns	Low	Low	Low	Low	Low	Some concerns
Paz-Fumagalli 2021	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Pellegrinelli 2021	Some concerns	Low	Low	Low	Low	Low	Some concerns
Chaikajornwat 2022	Some concerns	Low	Low	Low	Low	Low	Some concerns
Minor 2022	Low	Low	Low	Low	Low	Low	Some concerns

Mosconi 2022	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Yim 2022	Some concerns	Low	Some concerns	Low	Low	Low	Some concerns
Carrión 2023	Low	Low	Some concerns	Low	Low	Low	Some concerns
Choi 2023	Some concerns	Low	Some concerns	Low	Low	Some concerns	Some concerns
Damm 2023	Low	Low	Low	Low	Low	Some concerns	Some concerns
Maleux 2023	Low	Low	Low	Low	Low	Low	Low risk
Alexander 2024	Some concerns	Low	Low	Low	Low	Low	Some concerns
Karaoğullarından 2024	Some concerns	Low	Low	Low	Low	Low	Some concerns
Kim 2026	Some concerns	Low	Some concerns	Low	Low	Some concerns	Some concerns
di Gaeta 2026	Some concerns	Low	Low	Low	Low	Low	Some concerns

Appendix G Protocol access and deviations

PROSPERO record: [CRD420261499367](#)

Full protocol: [registered protocol PDF](#)

Date of first submission to PROSPERO: Sep 21, 2026 . Date of registration: Sep 22, 2026 .