MASSACHUSETTS

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Medical Policy

Radiofrequency Ablation of Primary or Metastatic Liver Tumors

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Policy Number: 286

BCBSA Reference Number: 7.01.91 (For Plans internal use only)
NCD/LCD: NA

Related Policies

- Radiofrequency Ablation of Miscellaneous Solid Tumors Excluding Liver Tumors, #259
- Radioembolization for Primary and Metastatic Tumors of the Liver, #292
- Cryosurgical Ablation of Primary or Metastatic Liver Tumors, #633
- Transcatheter Arterial Chemoembolization (TACE) to Treat Primary or Metastatic Liver Malignancies, #634

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity Medicare HMO Blue℠ and Medicare PPO Blue℠ Members

Radiofrequency ablation of primary, inoperable (eg, due to location of lesion[s] and/or comorbid conditions) hepatocellular carcinoma may be considered **MEDICALLY NECESSARY** under the following conditions:

- As a primary treatment of hepatocellular carcinoma meeting the Milan criteria (a single tumor of ≤5 cm or up to 3 nodules <3 cm).
- As a bridge to transplant, where the intent is to prevent further tumor growth and to maintain a individual's candidacy for liver transplant.

Radiofrequency ablation as a primary treatment of inoperable hepatic metastases may be considered **MEDICALLY NECESSARY** under the following conditions:

- Metastases are of colorectal origin and meet the Milan criteria (a single tumor of ≤5 cm or up to 3 nodules <3 cm).
- Metastases are of neuroendocrine in origin and systemic therapy has failed to control symptoms.

Radiofrequency ablation of primary, inoperable, hepatocellular carcinoma is considered **INVESTIGATIONAL** under the following conditions:

- When there are more than 3 nodules or when not all sites of tumor foci can be adequately treated.
- When used to downstage (downsize) hepatocellular carcinoma in individuals being considered for liver transplant.

Radiofrequency ablation of primary, operable hepatocellular carcinoma is **INVESTIGATIONAL**.

Radiofrequency ablation for hepatic metastasis is considered **INVESTIGATIONAL** for:

- Hepatic metastases from colorectal cancer or neuroendocrine tumors that do not meet the criteria above; and
- For hepatic metastases from other types of cancer except colorectal cancer or neuroendocrine tumors.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is **not required**.
Commercial PPO and Indemnity	Prior authorization is **not required**.
Medicare HMO Blue℠	Prior authorization is **not required**.
Medicare PPO Blue℠	Prior authorization is **not required**.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

CPT Codes

CPT codes:	Code Description
47370	Laparoscopy, surgical, ablation of one or more liver tumor(s); radiofrequency
47380	Ablation, open, of one or more liver tumor(s); radiofrequency
47382	Ablation, 1 or more liver tumor(s), percutaneous, radiofrequency

Description

Hepatic and Neuroendocrine Tumors

Hepatic tumors can arise as primary liver cancer (hepatocellular cancer) or by metastasis to the liver from other tissues. Local therapy for hepatic metastasis may be indicated when there is no extrahepatic disease, which rarely occurs for patients with primary cancers other than colorectal carcinoma or certain neuroendocrine malignancies. A study from 2016 determined that the incidence of liver cancer was higher among White individuals, Black individuals, and Hispanic individuals born after 1938.[1] The incidence of hepatocellular carcinoma was twice as high for US-born Hispanic men compared to Hispanic men born outside of the US. This may be due to the increased risk of smoking, hepatitis B or C infection, and diabetes among US-born Hispanic individuals.

Neuroendocrine tumors are tumors of cells that possess secretory granules and originate from the neuroectoderm. Neuroendocrine cells have roles both in the endocrine system and in the nervous system. They produce and secrete a variety of regulatory hormones, or neuropeptides, which include neurotransmitters and growth factors. Overproduction of the specific neuropeptides produced by the cancerous cells causes various symptoms, depending on the hormone produced. They are rare, with an incidence of 2 to 4 per 100,000 per year.

Treatment
Treatment options for hepatocellular carcinoma (HCC) range from potentially curative treatments, such as resection or liver transplantation, to nonsurgical options, which include ablative therapies (radiofrequency ablation [RFA], cryoablation, microwave ablation, percutaneous ethanol, or acetic acid injection), transarterial chemoembolization, radiation therapy, and systemic therapy. Choice of therapy depends on the severity of the underlying liver disease, size, and distribution of tumors, vascular supply, and patient overall health. Treatment of liver metastases is undertaken to prolong survival and reduce endocrine-related symptoms and hepatic mass-related symptoms.

At present, surgical resection with adequate margins or liver transplantation constitutes the only treatments available with demonstrated curative potential for hepatic tumors. However, most hepatic tumors are unresectable at diagnosis, due either to their anatomic location, size, number of lesions, or underlying liver reserve. Comorbid conditions may also make patients unqualified for surgical resection.

Radiofrequency Ablation
Radiofrequency ablation is a procedure in which a needle electrode is inserted into a tumor either percutaneously, through a laparoscope, or through an open incision. The electrode is heated by a high-frequency, alternating current, which destroys tissue in a 3 to 5 cm sphere of the electrode. The cells killed by RFA are not removed but are gradually replaced by fibrosis and scar tissue. If there is a local recurrence, it occurs at the edge of the treated tissue and, in some cases, is retreated. Radiofrequency ablation has been investigated as a treatment for unresectable hepatic tumors, both as a primary intervention and as a bridge to a liver transplant. In the latter setting, RFA is being tested to determine whether it can reduce the incidence of tumor progression in patients awaiting transplantation and thus maintain patients' candidacy for liver ablation, transhepatic arterial chemoembolization, microwave coagulation, percutaneous ethanol injection, and radioembolization (yttrium-90 microspheres).

Note that RFA of extrahepatic tumors is addressed policy #259

Summary
Description
Radiofrequency ablation (RFA) is a procedure in which a probe is inserted into the center of a tumor and heated locally by a high-frequency, alternating current that flows from electrodes. The local heat treats the tissue adjacent to the probe, resulting in a 3 to 5 cm sphere of dead tissue. The cells killed by RFA are not removed but are gradually replaced by fibrosis and scar tissue. If there is a local recurrence, it occurs at the edge of the treated tissue and, in some cases, is retreated. Radiofrequency ablation may be performed percutaneously, laparoscopically, or as an open procedure.

Summary of Evidence
For individuals who have primary, operable hepatocellular carcinoma (HCC) who receive RFA, the evidence includes meta-analyses of randomized controlled trials (RCTs) and/or retrospective observational studies and additional observational studies. Relevant outcomes are overall survival (OS), disease-specific survival, change in disease status, and morbid events. The majority of data found that patients undergoing surgical resection experienced longer survival outcomes and lower recurrence rates than patients receiving RFA, though complication rates were higher with surgical resection. Some meta-analyses of specifically selected populations (eg, small tumor sizes or Child-Pugh Class A liver function or HCC within the Milan criteria) found that OS and disease-free survival (DFS) rates were not significantly different between RFA and surgical resection. Results from observational studies have suggested that RFA alone or RFA plus percutaneous ethanol injection (PEI) could be as effective as a resection for small HCC tumors, as OS and

DFS rates were not significantly different between RFA and surgical resection. An exact tumor cutoff size has not been established. Some studies found that OS was similar in patients receiving RFA or resection when tumor size was 3 cm or less; however, OS was significantly longer in patients undergoing resection if the tumor size was between 3.1 cm and 5 cm. Further study in a multicenter RCT would permit greater certainty whether RFA, with or without other ablative or arterial directed therapies, is as effective as surgical resection in treating HCC tumors 3 cm or smaller. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have inoperable HCC who receive RFA, the evidence includes RCTs and several systematic reviews and meta-analyses. Relevant outcomes are OS, disease-specific survival, change in disease status, and morbid events. When resection is not an option, nonsurgical options include RFA, PEI, transarterial chemoembolization (TACE), cryoablation, microwave ablation, and systemic therapy. Meta-analyses comparing RFA to other local ablative therapies have found that RFA and microwave ablation are similarly effective, that RFA is more effective than PEI, and that RFA may be better than cryoablation. The evidence comparing RFA with TACE is limited, and no conclusions can be drawn. RFA has also been shown to improve survival in patients with unresectable HCC as an adjunct to chemotherapy. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have inoperable HCC awaiting liver transplant who receive RFA, the evidence includes small case series. Relevant outcomes are OS, disease-specific survival, and change in disease status. A number of approaches are used in this patient population, including RFA and other locoregional therapies, particularly TACE. Locoregional therapy has reduced the dropout rate of patients with HCC awaiting a liver transplant. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have inoperable hepatic metastases of colorectal origin who receive RFA, the evidence includes RCTs and several systematic reviews and meta-analyses. Relevant outcomes are OS, disease-specific survival, symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. There are no RCTs comparing RFA with alternative treatments for patients who have unresectable colorectal liver metastases. However, an RCT assessing RFA plus chemotherapy found improved survival at 8 years compared with chemotherapy alone. In addition, prospective studies have demonstrated that OS following RFA is at least equivalent to and likely better than currently accepted systemic chemotherapy in well-matched patients with unresectable hepatic metastatic colorectal cancer who do not have extrahepatic disease. Results from a number of uncontrolled case series also have suggested that RFA of hepatic colorectal cancer metastases produces long-term survival that is at a minimum equivalent to but likely superior to historical outcomes achieved with systemic chemotherapy. Evidence from a comparative study has indicated that RFA has fewer deleterious effects on quality of life than chemotherapy and that RFA patients recover their quality of life significantly faster than chemotherapy recipients. It should be noted that patients treated with RFA in different series might have had better prognoses than those who had chemotherapy, suggesting patient selection bias might at least partially explain the better outcomes observed following RFA. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have inoperable hepatic metastases of neuroendocrine origin who receive RFA, the evidence includes case series and a systematic review of case series. Relevant outcomes are OS, disease-specific survival, symptoms, change in disease status, morbid events, quality of life, and treatment-related morbidity. Most reports of RFA treatment for neuroendocrine liver metastases have assessed small numbers of patients or subsets of patients in reports of multiple ablative methods or very small subsets of larger case series of patients with various diagnoses. The available evidence has indicated that durable tumor and symptom control of neuroendocrine liver metastases can be achieved using RFA in individuals whose symptoms are not controlled by systemic therapy or who are ineligible for resection. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have hepatic metastases not of colorectal or neuroendocrine origin who receive RFA, the evidence includes small nonrandomized comparative studies and small case series. Relevant outcomes are OS, disease-specific survival, symptoms, change in disease status, morbid events, quality of life, and

treatment-related morbidity. Similar to primary HCC, resection appears to have the most favorable outcomes. For patients who are ineligible for resection, RFA may provide a survival benefit. However, the evidence is limited by study designs with a high-risk of bias and small sample sizes. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Policy History

Date	Action
9/2022	Annual policy review. Reference added and additional references updated. Minor editorial refinements to policy statements; intent unchanged.
8/2021	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
9/2020	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
9/2019	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
9/2018	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
1/2018	Annual policy review. Policy statements reformatted and edited for clarity and specificity, including the distinction between operable and non-operable tumors and the Milan criteria. The intent of the statements is unchanged. A statement has been added that RFA for operable HCC is considered investigational. Clarified coding information.
10/2016	Annual policy review. New references added.
11/2015	Annual policy review. New references added.
9/2014	Annual policy review. New references added.
6/2014	Updated Coding section with ICD10 procedure and diagnosis codes, effective 10/2015.
11/2013	Removed ICD diagnosis code 155.2 as it does not meet the intent of the policy.
10/2013	Annual policy review. New references added.
11/2011-4/2012	Medical policy ICD10 remediation: Formatting, editing and coding updates. No changes to policy statements.
7/2011	Reviewed - Medical Policy Group – Hematology and Oncology. No changes to policy statements.
3/2011	New policy describing covered and non-covered indications. Effective 3/2011.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:
Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines
Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Singh SK, Singh R. Liver cancer incidence and mortality: Disparities based on age, ethnicity, health and nutrition, molecular factors, and geography. Cancer Health Disparities. Mar 2020; 4: e1-e10. PMID 34164612
2. Jia Z, Zhang H, Li N. Evaluation of clinical outcomes of radiofrequency ablation and surgical resection for hepatocellular carcinoma conforming to the Milan criteria: A systematic review and meta-analysis of recent randomized controlled trials. J Gastroenterol Hepatol. Jul 2021; 36(7): 1769-1777. PMID 33569810
3. Shin SW, Ahn KS, Kim SW, et al. Liver Resection Versus Local Ablation Therapies for Hepatocellular Carcinoma Within the Milan Criteria: A Systematic Review and Meta-analysis. Ann Surg. Apr 01 2021; 273(4): 656-666. PMID 33074898

4. Li JK, Liu XH, Cui H, et al. Radiofrequency ablation vs. surgical resection for resectable hepatocellular carcinoma: A systematic review and meta-analysis. Mol Clin Oncol. Jan 2020; 12(1): 15-22. PMID 31814972
5. Zhu GQ, Sun M, Liao WT, et al. Comparative efficacy and safety between ablative therapies or surgery for small hepatocellular carcinoma: a network meta-analysis. Expert Rev Gastroenterol Hepatol. Sep 2018; 12(9): 935-945. PMID 30025486
6. Jia JB, Zhang D, Ludwig JM, et al. Radiofrequency ablation versus resection for hepatocellular carcinoma in patients with Child-Pugh A liver cirrhosis: a meta-analysis. Clin Radiol. Dec 2017; 72(12): 1066-1075. PMID 28851491
7. Feng Q, Chi Y, Liu Y, et al. Efficacy and safety of percutaneous radiofrequency ablation versus surgical resection for small hepatocellular carcinoma: a meta-analysis of 23 studies. J Cancer Res Clin Oncol. Jan 2015; 141(1): 1-9. PMID 24889505
8. Chen S, Peng Z, Lin M, et al. Combined percutaneous radiofrequency ablation and ethanol injection versus hepatic resection for 2.1-5.0 cm solitary hepatocellular carcinoma: a retrospective comparative multicentre study. Eur Radiol. Sep 2018; 28(9): 3651-3660. PMID 29600474
9. Zhao WJ, Zhu GQ, Wu YM, et al. Comparative Effectiveness of Radiofrequency Ablation, Surgical Resection and Transplantation for Early Hepatocellular Carcinoma by Cancer Risk Groups: Results of Propensity Score-Weighted Analysis. Onco Targets Ther. 2019; 12: 10389-10400. PMID 31819521
10. Lee HJ, Kim JW, Hur YH, et al. Combined Therapy of Transcatheter Arterial Chemoembolization and Radiofrequency Ablation versus Surgical Resection for Single 2-3 cm Hepatocellular Carcinoma: A Propensity-Score Matching Analysis. J Vasc Interv Radiol. Sep 2017; 28(9): 1240-1247.e3. PMID 28688816
11. Cucchetti A, Mazzaferro V, Pinna AD, et al. Average treatment effect of hepatic resection versus locoregional therapies for hepatocellular carcinoma. Br J Surg. Nov 2017; 104(12): 1704-1712. PMID 28745399
12. Conticchio M, Inchingolo R, Delvecchio A, et al. Radiofrequency ablation vs surgical resection in elderly patients with hepatocellular carcinoma in Milan criteria. World J Gastroenterol. May 14 2021; 27(18): 2205-2218. PMID 34025074
13. Lee SH, Jin YJ, Lee JW. Survival benefit of radiofrequency ablation for solitary (3-5 cm) hepatocellular carcinoma: An analysis for nationwide cancer registry. Medicine (Baltimore). Nov 2017; 96(44): e8486. PMID 29095307
14. Min JH, Kang TW, Cha DI, et al. Radiofrequency ablation versus surgical resection for multiple HCCs meeting the Milan criteria: propensity score analyses of 10-year therapeutic outcomes. Clin Radiol. Jul 2018; 73(7): 676.e15-676.e24. PMID 29709236
15. Lin Y, Pan XB. Differences in Survival Between First-Line Radiofrequency Ablation versus Surgery for Early-Stage Hepatocellular Carcinoma: A Population Study Using the Surveillance, Epidemiology, and End Results Database. Med Sci Monit. May 28 2020; 26: e921782. PMID 32461542
16. Zheng L, Zhang CH, Lin JY, et al. Comparative Effectiveness of Radiofrequency Ablation vs. Surgical Resection for Patients With Solitary Hepatocellular Carcinoma Smaller Than 5 cm. Front Oncol. 2020; 10: 399. PMID 32296638
17. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Radiofrequency ablation of unresectable hepatic tumors. TEC Assessments. 2003;Volume 18:Tab 13.
18. Yu Q, Liu C, Navuluri R, et al. Percutaneous microwave ablation versus radiofrequency ablation of hepatocellular carcinoma: a meta-analysis of randomized controlled trials. Abdom Radiol (NY). Sep 2021; 46(9): 4467-4475. PMID 33870454
19. Han J, Fan YC, Wang K. Radiofrequency ablation versus microwave ablation for early stage hepatocellular carcinoma: A PRISMA-compliant systematic review and meta-analysis. Medicine (Baltimore). Oct 23 2020; 99(43): e22703. PMID 33120763
20. Majumdar A, Roccarina D, Thorburn D, et al. Management of people with early- or very early-stage hepatocellular carcinoma: an attempted network meta-analysis. Cochrane Database Syst Rev. Mar 28 2017; 3: CD011650. PMID 28351116
21. Shen A, Zhang H, Tang C, et al. Systematic review of radiofrequency ablation versus percutaneous ethanol injection for small hepatocellular carcinoma up to 3 cm. J Gastroenterol Hepatol. May 2013; 28(5): 793-800. PMID 23432154

22. Tiong L, Maddern GJ. Systematic review and meta-analysis of survival and disease recurrence after radiofrequency ablation for hepatocellular carcinoma. Br J Surg. Sep 2011; 98(9): 1210-24. PMID 21766289
23. Huang YZ, Zhou SC, Zhou H, et al. Radiofrequency ablation versus cryosurgery ablation for hepatocellular carcinoma: a meta-analysis. Hepatogastroenterology. Jul-Aug 2013; 60(125): 1131-5. PMID 23321123
24. Giorgio A, Merola MG, Montesarchio L, et al. Sorafenib Combined with Radio-frequency Ablation Compared with Sorafenib Alone in Treatment of Hepatocellular Carcinoma Invading Portal Vein: A Western Randomized Controlled Trial. Anticancer Res. Nov 2016; 36(11): 6179-6183. PMID 27793949
25. Organ Procurement and Transplant Network. Policy 9: Allocation of Livers and Liver-Intestines. Updated April 28, 2022; https://optn.transplant.hrsa.gov/media/1200/optn_policies.pdf#nameddest=Policy_09. Accessed June 8, 2022.
26. Mazzaferro V, Regalia E, Doci R, et al. Liver transplantation for the treatment of small hepatocellular carcinomas in patients with cirrhosis. N Engl J Med. Mar 14 1996; 334(11): 693-9. PMID 8594428
27. Pomfret EA, Washburn K, Wald C, et al. Report of a national conference on liver allocation in patients with hepatocellular carcinoma in the United States. Liver Transpl. Mar 2010; 16(3): 262-78. PMID 20209641
28. Lee MW, Raman SS, Asvadi NH, et al. Radiofrequency ablation of hepatocellular carcinoma as bridge therapy to liver transplantation: A 10-year intention-to-treat analysis. Hepatology. Jun 2017; 65(6): 1979-1990. PMID 28170115
29. Mazzaferro V, Battiston C, Perrone S, et al. Radiofrequency ablation of small hepatocellular carcinoma in cirrhotic patients awaiting liver transplantation: a prospective study. Ann Surg. Nov 2004; 240(5): 900-9. PMID 15492574
30. Lu DS, Yu NC, Raman SS, et al. Percutaneous radiofrequency ablation of hepatocellular carcinoma as a bridge to liver transplantation. Hepatology. May 2005; 41(5): 1130-7. PMID 15841454
31. Porrett PM, Peterman H, Rosen M, et al. Lack of benefit of pre-transplant locoregional hepatic therapy for hepatocellular cancer in the current MELD era. Liver Transpl. Apr 2006; 12(4): 665-73. PMID 16482577
32. Yao FY, Kerlan RK, Hirose R, et al. Excellent outcome following down-staging of hepatocellular carcinoma prior to liver transplantation: an intention-to-treat analysis. Hepatology. Sep 2008; 48(3): 819-27. PMID 18688876
33. Yao FY, Hirose R, LaBerge JM, et al. A prospective study on downstaging of hepatocellular carcinoma prior to liver transplantation. Liver Transpl. Dec 2005; 11(12): 1505-14. PMID 16315294
34. Sauer P, Kraus TW, Schemmer P, et al. Liver transplantation for hepatocellular carcinoma: is there evidence for expanding the selection criteria?. Transplantation. Sep 27 2005; 80(1 Suppl): S105-8. PMID 16286885
35. Fernandez JA, Robles R, Marin C, et al. Can we expand the indications for liver transplantation among hepatocellular carcinoma patients with increased tumor size?. Transplant Proc. Aug 2003; 35(5): 1818-20. PMID 12962807
36. Yao FY, Ferrell L, Bass NM, et al. Liver transplantation for hepatocellular carcinoma: comparison of the proposed UCSF criteria with the Milan criteria and the Pittsburgh modified TNM criteria. Liver Transpl. Sep 2002; 8(9): 765-74. PMID 12200775
37. Yao FY, Ferrell L, Bass NM, et al. Liver transplantation for hepatocellular carcinoma: expansion of the tumor size limits does not adversely impact survival. Hepatology. Jun 2001; 33(6): 1394-403. PMID 11391528
38. Merli M, Nicolini G, Gentili F, et al. Predictive factors of outcome after liver transplantation in patients with cirrhosis and hepatocellular carcinoma. Transplant Proc. Jul-Aug 2005; 37(6): 2535-40. PMID 16182736
39. Kemeny N. Management of liver metastases from colorectal cancer. Oncology (Williston Park). Sep 2006; 20(10): 1161-76, 1179; discussion 1179-80, 1185-6. PMID 17024869
40. McKay A, Dixon E, Taylor M. Current role of radiofrequency ablation for the treatment of colorectal liver metastases. Br J Surg. Oct 2006; 93(10): 1192-201. PMID 16983740
41. Lencioni R, Crocetti L, Cioni D, et al. Percutaneous radiofrequency ablation of hepatic colorectal metastases: technique, indications, results, and new promises. Invest Radiol. Nov 2004; 39(11): 689-97. PMID 15486530

42. Meijerink MR, Puijk RS, van Tilborg AAJM, et al. Radiofrequency and Microwave Ablation Compared to Systemic Chemotherapy and to Partial Hepatectomy in the Treatment of Colorectal Liver Metastases: A Systematic Review and Meta-Analysis. Cardiovasc Intervent Radiol. Aug 2018; 41(8): 1189-1204. PMID 29666906
43. Loveman E, Jones J, Clegg AJ, et al. The clinical effectiveness and cost-effectiveness of ablative therapies in the management of liver metastases: systematic review and economic evaluation. Health Technol Assess. Jan 2014; 18(7): vii-viii, 1-283. PMID 24484609
44. Weng M, Zhang Y, Zhou D, et al. Radiofrequency ablation versus resection for colorectal cancer liver metastases: a meta-analysis. PLoS One. 2012; 7(9): e45493. PMID 23029051
45. Pathak S, Jones R, Tang JM, et al. Ablative therapies for colorectal liver metastases: a systematic review. Colorectal Dis. Sep 2011; 13(9): e252-65. PMID 21689362
46. Guenette JP, Dupuy DE. Radiofrequency ablation of colorectal hepatic metastases. J Surg Oncol. Dec 15 2010; 102(8): 978-87. PMID 21166002
47. Ruers T, Punt C, Van Coevorden F, et al. Radiofrequency ablation combined with systemic treatment versus systemic treatment alone in patients with non-resectable colorectal liver metastases: a randomized EORTC Intergroup phase II study (EORTC 40004). Ann Oncol. Oct 2012; 23(10): 2619-2626. PMID 22431703
48. Ruers T, Van Coevorden F, Punt CJ, et al. Local Treatment of Unresectable Colorectal Liver Metastases: Results of a Randomized Phase II Trial. J Natl Cancer Inst. Sep 01 2017; 109(9). PMID 28376151
49. Hof J, Wertenbroek MW, Peeters PM, et al. Outcomes after resection and/or radiofrequency ablation for recurrence after treatment of colorectal liver metastases. Br J Surg. Jul 2016; 103(8): 1055-62. PMID 27193207
50. Abdalla EK, Vauthey JN, Ellis LM, et al. Recurrence and outcomes following hepatic resection, radiofrequency ablation, and combined resection/ablation for colorectal liver metastases. Ann Surg. Jun 2004; 239(6): 818-25; discussion 825-7. PMID 15166961
51. Ruers TJ, Joosten JJ, Wiering B, et al. Comparison between local ablative therapy and chemotherapy for non-resectable colorectal liver metastases: a prospective study. Ann Surg Oncol. Mar 2007; 14(3): 1161-9. PMID 17195903
52. Van Tilborg AA, Meijerink MR, Sietses C, et al. Long-term results of radiofrequency ablation for unresectable colorectal liver metastases: a potentially curative intervention. Br J Radiol. Jun 2011; 84(1002): 556-65. PMID 21159807
53. Mohan H, Nicholson P, Winter DC, et al. Radiofrequency ablation for neuroendocrine liver metastases: a systematic review. J Vasc Interv Radiol. Jul 2015; 26(7): 935-942.e1. PMID 25840836
54. Fairweather M, Swanson R, Wang J, et al. Management of Neuroendocrine Tumor Liver Metastases: Long-Term Outcomes and Prognostic Factors from a Large Prospective Database. Ann Surg Oncol. Aug 2017; 24(8): 2319-2325. PMID 28303430
55. Berber E, Siperstein A. Local recurrence after laparoscopic radiofrequency ablation of liver tumors: an analysis of 1032 tumors. Ann Surg Oncol. Oct 2008; 15(10): 2757-64. PMID 18618182
56. Mazzaglia PJ, Berber E, Milas M, et al. Laparoscopic radiofrequency ablation of neuroendocrine liver metastases: a 10-year experience evaluating predictors of survival. Surgery. Jul 2007; 142(1): 10-9. PMID 17629995
57. Schullian P, Johnston E, Laimer G, et al. Stereotactic Radiofrequency Ablation of Breast Cancer Liver Metastases: Short- and Long-Term Results with Predicting Factors for Survival. Cardiovasc Intervent Radiol. Aug 2021; 44(8): 1184-1193. PMID 33825059
58. Veltri A, Gazzera C, Barrera M, et al. Radiofrequency thermal ablation (RFA) of hepatic metastases (METS) from breast cancer (BC): an adjunctive tool in the multimodal treatment of advanced disease. Radiol Med. May 2014; 119(5): 327-33. PMID 24297589
59. Meloni MF, Andreano A, Laeseke PF, et al. Breast cancer liver metastases: US-guided percutaneous radiofrequency ablation--intermediate and long-term survival rates. Radiology. Dec 2009; 253(3): 861-9. PMID 19709994
60. Jakobs TF, Hoffmann RT, Schrader A, et al. CT-guided radiofrequency ablation in patients with hepatic metastases from breast cancer. Cardiovasc Intervent Radiol. Jan 2009; 32(1): 38-46. PMID 18575933
61. Li J, Zhang K, Gao Y, et al. Evaluation of hepatectomy and palliative local treatments for gastric cancer patients with liver metastases: a propensity score matching analysis. Oncotarget. Sep 22 2017; 8(37): 61861-61875. PMID 28977910

62. Li W, Bai Y, Wu M, et al. Combined CT-guided radiofrequency ablation with systemic chemotherapy improves the survival for nasopharyngeal carcinoma with oligometastasis in liver: Propensity score matching analysis. Oncotarget. Aug 08 2017; 8(32): 52132-52141. PMID 28881719
63. Liu B, Huang G, Jiang C, et al. Ultrasound-Guided Percutaneous Radiofrequency Ablation of Liver Metastasis From Ovarian Cancer: A Single-Center Initial Experience. Int J Gynecol Cancer. Jul 2017; 27(6): 1261-1267. PMID 28640176
64. Hua YQ, Wang P, Zhu XY, et al. Radiofrequency ablation for hepatic oligometastatic pancreatic cancer: An analysis of safety and efficacy. Pancreatology. Nov 2017; 17(6): 967-973. PMID 29129384
65. Jones RL, McCall J, Adam A, et al. Radiofrequency ablation is a feasible therapeutic option in the multi modality management of sarcoma. Eur J Surg Oncol. May 2010; 36(5): 477-82. PMID 20060679
66. Pawlik TM, Vauthey JN, Abdalla EK, et al. Results of a single-center experience with resection and ablation for sarcoma metastatic to the liver. Arch Surg. Jun 2006; 141(6): 537-43; discussion 543-4. PMID 16785353
67. Heimbach JK, Kulik LM, Finn RS, et al. AASLD guidelines for the treatment of hepatocellular carcinoma. Hepatology. Jan 2018; 67(1): 358-380. PMID 28130846
68. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Hepatobiliary Cancers, Version 1.2022. Updated March 29, 2022. https://www.nccn.org/professionals/physician_gls/pdf/hepatobiliary.pdf. Accessed June 9, 2022.
69. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Colon Cancer. Version 1.2022. Updated February 25, 2022. https://www.nccn.org/professionals/physician_gls/pdf/colon.pdf. Accessed June 8, 2022.
70. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Neuroendocrine and Adrenal Tumors. Version 1.2022. Updated May 23, 2022. https://www.nccn.org/professionals/physician_gls/pdf/neuroendocrine.pdf. Accessed June 10, 2022.
71. Gervais DA, Goldberg SN, Brown DB, et al. Society of Interventional Radiology position statement on percutaneous radiofrequency ablation for the treatment of liver tumors. J Vasc Interv Radiol. Jul 2009; 20(7 Suppl): S342-7. PMID 19560023