BlueCross BlueShield of Alabama

Name of Blue Advantage Policy:

Locoregional Therapies for Hepatocellular Carcinoma and Metastatic Liver Carcinoma and Metastatic Carcinoid Tumors of the Liver

Policy #: 070
Latest Review Date: September 2024
Category: Surgical

BACKGROUND:

Blue Advantage *medical policy does not conflict with Local Coverage Determinations (LCDs), Local Medical Review Policies (LMRPs) or National Coverage Determinations (NCDs) or with coverage provisions in Medicare manuals, instructions or operational policy letters. In order to be covered by Blue Advantage the service shall be reasonable and necessary under Title XVIII of the Social Security Act, Section 1862(a)(1)(A). The service is considered reasonable and necessary if it is determined that the service is:*

1. *Safe and effective;*
2. *Not experimental or investigational*;*
3. *Appropriate, including duration and frequency that is considered appropriate for the service, in terms of whether it is:*

    - *Furnished in accordance with accepted standards of medical practice for the diagnosis or treatment of the patient's condition or to improve the function of a malformed body member;*
    - *Furnished in a setting appropriate to the patient's medical needs and condition;*
    - *Ordered and furnished by qualified personnel;*
    - *One that meets, but does not exceed, the patient's medical need; and*
    - *At least as beneficial as an existing and available medically appropriate alternative.*

Routine costs of qualifying clinical trial services with dates of service on or after September 19, 2000, which meet the requirements of the Clinical Trials NCD are considered reasonable and necessary by Medicare. Providers should bill* ***Original Medicare* *for covered services that are related to* ***clinical trials*** *that meet Medicare requirements (Refer to Medicare National Coverage Determinations Manual, Chapter 1, Section 310 and Medicare Claims Processing Manual Chapter 32, Sections 69.0-69.11).*

POLICY:

Blue Advantage will treat **radiofrequency ablation (RFA)** as a **covered benefit** for individuals with one of the following indications:

- hepatocellular carcinoma (HCC)
- metastatic liver carcinoma

Blue Advantage will treat **percutaneous ethanol injection (PEI)** as a **covered benefit** for individuals with one of the following indications:

- hepatocellular carcinoma (HCC)
- metastatic liver carcinoma

Please refer to Policy #178 "MRI-Guided Focused Ultrasound (MRgFUS)" for coverage information on ultrasound ablation of the bone.

Please refer to Policy #119 "Radiofrequency Ablation of Solid Tumors Excluding Liver Tumors" for coverage information on radiofrequency ablation of solid tumors excluding liver.

Please refer to NCD (230.9) for Cryosurgery of Prostate.

Please refer to Policy #429 "Cryosurgical Ablation of Miscellaneous Solid Tumors Other than Liver, Prostate, or Dermatologic Tumors" for coverage information on cryosurgical ablation of these tumors.

Please refer to Policy #512 "Microwave Tumor Ablation" for coverage information on microwave tumor ablation.

Please refer to Policy MP# 737 "Transcatheter Arterial Chemoembolization to Treat Primary or Metastatic Liver" for coverage information on Transcatheter Arterial Chemoembolization.

Blue Advantage does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Advantage administers benefits based on the members' contract and medical policies. Physicians should always exercise their best medical judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.

DESCRIPTION OF PROCEDURE OR SERVICE:

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. 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 embolization, 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 (RFA)

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).

Percutaneous Ethanol Injection (PEI)
PEI induces tumor necrosis by cellular dehydration, protein denaturation, and thrombosis of small vessels. HCC is softer than the surrounding cirrhotic liver and is often encapsulated, allowing selective diffusion of ethanol within the tumor mass. The hypervascularization of HCC also favors ethanol injection therapy by enhancing the distribution of ethanol within the network of the tumor vessels. A fine needle is inserted into the tumor under ultrasonographic guidance, and absolute ethanol is then injected slowly into the tumor until the whole area of tumor appears hypoechogenic on the ultrasound. PEI may be performed under CT guidance for tumors not visualized by ultrasounds. The injection is repeated once or twice a week for up to six to eight sessions, depending on the tumor size. PEI can be done as an outpatient procedure under local anesthesia.

Histotripsy
Histotripsy, a nonthermal focal ablative therapy, has been proposed as an alternative treatment of liver lesions. Histotripsy utilizes short, high-pressure bursts of high-intensity focused ultrasound to induce tissue destruction via acoustic cavitation, rendering the target into acellular debris. The material in the histotripsy ablation zone is absorbed by the body within 1–2 months, leaving a minimal remnant scar. Histotripsy has also been shown to stimulate an immune response and induce abscopal effects in animal models, which may have positive implications for future cancer treatment. Histotripsy has been investigated for a wide range of applications in preclinical studies, including the treatment of cancer, neurological diseases, and cardiovascular diseases. The benefits of non-thermal focal ablative therapy include avoidance of any heat sink effects which is theorized to allow histotripsy to be used in highly vascular areas.

KEY POINTS:
The most recent literature update was performed through May 20, 2024.

Summary of Evidence
For individuals who have primary, operable hepatocellular carcinoma (HCC) who receive radiofrequency ablation (RFA), the evidence includes meta-analyses of randomized controlled trials (RCTs) and/or retrospective observational studies, an RCT 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 and an RCT 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, hepatocellular carcinoma (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 with hepatic metastases of colorectal origin who receive RFA, the evidence includes an RCT, systematic reviews and meta-analyses, prospective cohort series, and retrospective case series. Relevant outcomes are overall survival, disease-specific survival, symptoms, changes in disease status, morbid events, quality of life, and treatment-related morbidity. There are no RCTs comparing RFA with alternative treatments for patients with unresectable colorectal liver metastases. However, an RCT assessing RFA combined with chemotherapy found improved survival at 8 years compared with chemotherapy alone. In addition, prospective studies have demonstrated that overall survival following RFA is at least equivalent and likely better than that obtained with currently accepted systemic chemotherapy in well-matched patients with unresectable hepatic metastatic colorectal cancer (CRC) who do not have extrahepatic disease. Results from a number of uncontrolled case series also suggest RFA of hepatic CRC metastases produces long-term survival that is at minimum equivalent but likely superior to historical outcomes achieved with systemic chemotherapy. Evidence from one comparative study suggests RFA has less deleterious effect on quality of life than chemotherapy and that RFA patients recover quality of life significantly faster than chemotherapy recipients. It should be noted, however, that patients treated with RFA in different series may have better prognosis than those who undergo chemotherapy, suggesting patient selection bias may at least partially explain the apparent 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 more than 1 ablative method or very small subsets of larger case series of patients with various diagnoses. The available evidence indicates 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 a systematic review, 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. Complete ablation of tumors was seen in >/= 90% of tumors in most studies; however, there was tumor recurrence. Although there are only small case series available, OS was documented as being at least 90% at 1year in 2 studies. The available evidence indicates that symptom control may be achieved using RFA, therefore the evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

Percutaneous Ethanol Injection
For patients who have inoperable hepatocellular carcinoma, PEI can be considered. The evidence includes several RCTs, non- randomized trials and a comparative analysis. It has been noted that to achieve complete necrosis of liver tumors using PEI, multiple treatment sessions are usually needed.

Histotripsy
There are U.S. clinical trials underway to evaluate the safety and technical efficacy of histotripsy in patients with primary and secondary liver tumors. A phase I trial provided the initial safety and efficacy data regarding the use of hepatic histotripsy in individuals with hepatocellular carcinoma and hepatic metastasis. A total of 8 individuals with multifocal liver tumors were followed for 8 weeks post-procedure. There were no significant procedure related events. The study focused on technical safety and did not address cancer follow-up. The HistoSonics System for Treatment of Primary and Metastatic Liver Tumors Using Histotripsy trial is a single arm, non-randomized prospective trial where following histotripsy treatment of liver tumor(s), subjects will undergo imaging < 36 hours post-index procedure to determine technical success then will be followed for 30 days. Participants will be evaluated at 6 months and followed annually for up to 5 years post-procedure. There are no published studies evaluating the treatment effects of histotripsy. The current evidence regarding the histotripsy procedure does not support that this form of locally ablative therapy is a clinically appropriate treatment of hepatic malignancies.

Practice Guidelines and Position Statements
RFA:

American Association for the Study of Liver Diseases
The American Association for the Study of Liver Diseases (AASLD) published a guideline in 2018 on the treatment of hepatocellular carcinoma (HCC), which was subsequently updated in 2023. Relevant guidance statements related to radiofrequency ablation (RFA) are listed below:.

- "Thermal ablation (radiofrequency or microwave ablation) should be considered the treatment of choice for patients with early-stage HCC ≤3 cm who are ineligible for or decline surgery (Level 1, Strong Recommendation).
    - AASLD does not advise 1 thermal ablative modality over another."

Society of American Gastrointestinal and Endoscopic Surgeons

The Society of American Gastrointestinal and Endoscopic Surgeons with the Americas Hepato-Pancreato-Biliary Association developed guidelines (2023) for the use of microwave and radiofrequency liver ablation for the surgical treatment of hepatocellular carcinoma or colorectal liver metastases less than 5 cm. A systematic review was conducted to address key questions and GRADE methodology was used to provide evidence-based recommendations. All guideline recommendations were assigned "conditional" recommendations based on the weak evidence found. The key questions and subsequent recommendations related to RFA addressed by the guideline are summarized in Table 1.

Table 1. SAGES/AHPBA recommendations for use of ablative therapy

Key questions addressed by the guideline	Recommendations
Should MWA (laparoscopic or open) vs. RFA (laparoscopic or open) be used for HCC or CRLM less than 5 cm ineligible for other therapies?	The panel suggests MWA and RFA are both safe and feasible. There was insufficient evidence to recommend one modality over another in terms of oncologic outcomes (conditional recommendation, very low certainty of evidence).

AHPBA: Americas Hepato-Pancreato-Biliary Association; MWA: microwave ablation; RFA: radiofrequency ablation; SAGES: Society of American Gastrointestinal and Endoscopic Surgeons.

Society of Interventional Radiology

The Society of Interventional Radiology published a position statement on percutaneous radiofrequency ablation for the treatment of liver tumors in 2009. It is the position of the Society that “percutaneous RFA of hepatic tumors is a safe and effective treatment for selected patients with HCC and colorectal carcinoma metastases” and that the current literature is insufficient to support any recommendations supporting or refuting the use of RFA in other diseases.

National Comprehensive Cancer Network

Several National Comprehensive Cancer Network (NCCN) guidelines are relevant to this review.

The NCCN guidelines recommend:

- The NCCN (v.1.2024) guidelines on HCC note that "locoregional therapy should be considered in patients who are not candidates for surgical curative treatments, or as part of a strategy to bridge patients for other curative therapies." The guideline further states that "ablation alone may be curative in treating tumors ≤ 3 cm. In well-selected patients with small, properly located tumors, ablation should be considered as definitive treatment

in the context of a multidisciplinary review. Lesions 3 to 5 cm may be treated to prolong survival using arterially directed therapies, or with the combination of an arterially directed therapy and ablation as long as the tumor is accessible for ablation".

- The NCCN (v.2.2024) guidelines on colon cancer metastatic to the liver state that "[a]blative techniques may be considered alone or in conjunction with resection. All original sites of disease need to be amenable to ablation or resection". Of all ablative techniques, the guidelines note that RFA has the most supporting evidence.
- The NCCN (v.1.2023) guidelines for neuroendocrine and adrenal tumors state that "percutaneous thermal ablation, often using microwave energy (radiofrequency and cryoablation are also acceptable), can be considered for oligometastatic liver disease, generally up to 4 lesions each smaller than 3 cm. Feasibility considerations include safe percutaneous imaging-guided approach to the target lesions, and proximity to vessels, bile ducts, or adjacent non-target structures that may require hydro- or aero-dissection for displacement [category 2B]." Additionally, "cytoreductive surgery or ablative therapies such as RFA or cryoablation may be considered if near-complete treatment of tumor burden can be achieved. Ablative therapy in this setting is non-curative. For unresectable liver metastases, hepatic regional therapy (arterial embolization, chemoembolization, or radioembolization [category 2B]) is recommended."

Percutaneous Ethanol Injection:
National Comprehensive Cancer Network
The 2018 NCCN guidelines (v2.2018) state that “locoregional therapy should be considered in patients who are not candidates for surgical curative treatments, or as a part of a strategy to bridge patients for other curative therapies.” PEI is included in the locoregional therapies.

- Tumors should be amenable to ablation, but a margin is not expected following PEI
- Tumors should be accessible for ablation

U.S. Preventive Services Task Force Recommendations
RFA of tumors is not a preventive service.

KEY WORDS:

Locoregional liver therapy, Locoregional liver treatment, Radiofrequency Ablation (RFA), Percutaneous Ethanol Injection (PEI), liver cryotherapy, cryotherapy, histotripsy, HistoSonics

APPROVED BY GOVERNING BODIES:

Chemoembolization for hepatic tumors is a medical procedure, and as such is not subject to FDA regulations. However, the embolizing agents and drugs are subject to FDA approval.

Radiofrequency ablation devices have been cleared through the U.S. Food and Drug Administration (FDA) 510(k) process.

Several cryosurgical devices have clearance by the U.S. Food and Drug Administration (FDA). For example, the ENDOcare™ CRYOcare Cryosurgical System (Endocare, Inc., Irvine, CA) was

cleared for marketing through the 510(k) process in December 1996 for "use in general surgery, dermatology, neurology, thoracic surgery, ENT, gynecology, oncology, proctology and urology for the ablation of tissue, including liver metastases, skin lesions, warts, and removal of prostate tissue."

TheraSphere® has been granted Humanitarian Device Exception status by the FDA on December 10, 1999

SIR-Spheres was given a 510(k) PMA, March 5, 2002

In October 2023, the U.S. Food and Drug Administration (FDA) authorized marketing of the HistoSonics® Inc. Edison® Histotripsy System. It is the first histotripsy platform available in the United States for the non-invasive destruction of liver tumors, including unresectable liver tumors. The FDA cautioned that non-thermal focused ultrasound should only be considered in patients with a sufficient amount of functional liver reserve to withstand the destruction of the planned volume of liver tissue.

BENEFIT APPLICATION:

Coverage is subject to member's specific benefits. Group-specific policy will supersede this policy when applicable.

CURRENT CODING:

CPT:

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, open, of one or more liver tumor(s); percutaneous, radiofrequency
47399	Unlisted procedure, liver
76940	Ultrasound guidance for, and monitoring of, parenchymal tissue ablation
77013	Computerized tomography guidance for, and monitoring of, parenchymal tissue ablation
77022	Magnetic resonance guidance for, and monitoring of, parenchymal tissue ablation
0686T	Histotripsy (ie, non-thermal ablation via acoustic energy delivery) of malignant hepatocellular tissue, including image guidance

REFERENCES:

1. American Cancer Society. Liver Cancer. Available at www.cancer.org/cancer/livercancer/detailedguide/liver-cancer-what-is-liver-cancer.
2. Bala MM, Riemsma RP, Wolff R et al. Cryotherapy for liver metastases. Cochrane Database Syst Rev 2013 Jun 5; 6:CD009058.
3. Bertot LC, Sato M, Tateishi R et al. Mortality and complication rates of percutaneous ablative techniques for the treatment of liver tumors: a systematic review. Eur Radiol Dec 2011; 21(12):2584-96.
4. Biederman DM, Titano JJ, Korff RA, et al. Radiation Segmentectomy versus Selective Chemoembolization in the Treatment of Early-Stage Hepatocellular Carcinoma. J Vasc Interv Radiol. Jan 2018;29(1):30-37 e32.
5. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Radiofrequency ablation of unresectable hepatic tumors. TEC Assessments. 2003;Volume 18:Tab 13.
6. Boehm LM, Jayakrishnan TT, Miura JT, et al. Comparative effectiveness of hepatic artery based therapies for unresectable intrahepatic cholangiocarcinoma. J Surg Oncol. Sep 1 2014.
7. Bush DA, Smith JC, Slater JD, et al. Randomized clinical trial comparing proton beam radiation therapy with transarterial chemoembolization for hepatocellular carcinoma: results of an interim analysis. Int J Radiat Oncol Biol Phys. May 1 2016; 95(1):477-482.
8. Ceppa EP, Collings AT, Abdalla M, et al. SAGES/AHPBA guidelines for the use of microwave and radiofrequency liver ablation for the surgical treatment of hepatocellular carcinoma or colorectal liver metastases less than 5 cm. Surg Endosc. Dec 2023; 37(12): 8991-9000.
9. 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.
10. Cheng PL, Wu PH, Kao WY, et al. Comparison of local ablative therapies, including radiofrequency ablation, microwave ablation, stereotactic ablative radiotherapy, and particle radiotherapy, for inoperable hepatocellular carcinoma: a systematic review and meta-analysis. Exp Hematol Oncol. Apr 12 2023; 12(1): 37.
11. Chu HH, Kim JH, Kim PN, et al. Surgical resection versus radiofrequency ablation very early-stage HCC (2 cm Single HCC): A propensity score analysis. Liver Int. Dec 2019; 39(12): 2397-2407.
12. Cianni R, Pelle G, Notarianni E et al. Radioembolization with (90) Y-labelled resin microspheres in the treatment of liver metastasis from breast cancer. Eur Radiol 2013 Jan; 23(1):182-9.
13. Cirocchi R, Trastulli S, Boselli C et al. Radiofrequency ablation in the treatment of liver metastases from colorectal cancer. Cochrane Database Syst Rev 2012 Jun 13; 6:CD006317.
14. 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.

15. 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.
16. Ding J, Jing X, Liu J et al. Comparison of two different thermal techniques for the treatment of hepatocellular carcinoma. Eur J Radiol 2013 Sep; 82(9):1379-84.
17. Ding J, Jing X, Liu J et al. Complications of thermal ablation of hepatic tumours: comparison of radiofrequency and microwave ablative techniques. Clin Radiol 2013 Jun; 68(6):608-15.
18. Duan C, Liu M, Zhang Z et al. Radiofrequency ablation versus hepatic resection for the treatment of early-stage hepatocellular carcinoma meeting Milan criteria: a systematic review and meta-analysis. World J Surg Oncol 2013 Aug 13; 11(1):190.
19. Dunne RM, Shyn PB, Sung JC, et al. Percutaneous treatment of hepatocellular carcinoma in patients with cirrhosis: a comparison of the safety of cryoablation and radiofrequency ablation. Eur J Radiol. Apr 2014; 83(4):632-638.
20. Ei S, Hibi T, Tanabe M, et al. Cryoablation provides superior local control of primary hepatocellular carcinomas of >2 cm compared with radiofrequency ablation and microwave coagulation therapy: an underestimated tool in the toolbox. Ann Surg Oncol. Apr 2015; 22(4):1294-1300.
21. 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.
22. Feng K, Yan J, Li X et al. A randomized controlled trial of radiofrequency ablation and surgical resection in the treatment of small hepatocellular carcinoma. J Hepatol 2012 Oct; 57(4):794-802.
23. 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.
24. Fiorentini G, Aliberti C, Tilli M et al. Intra-arterial infusion of irinotecan-loaded drug-eluting beads (DEBIRI) versus intravenous therapy (FOLFIRI) for hepatic metastases from colorectal cancer: final results of a phase III study. Anticancer Res 2012 Apr; 32(4):1387-95.
25. Giorgio A, Di Sarno A, De Stefano G, et al. Percutaneous radiofrequency ablation of hepatocellular carcinoma compared to percutaneous ethanol injection in treatment of cirrhotic patients: an Italian randomized controlled trial. Anticancer Res. 2012 Mar; 32(3):1117.
26. 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.
27. Gonsalves CF, Eschelman DJ, Sullivan KL et al. Radioembolization as salvage therapy for hepatic metastasis of uveal melanoma: a single-institution experience. AJR Am J Roentgenol 2011 Feb; 196(2):468-73.
28. Han J, Fan YC, Wang K. Radiofrequency ablation versus microwave ablation for early stage hepatocellular carcinoma: APRISMA-compliant systematic review and meta-analysis. Medicine (Baltimore). Oct 23 2020; 99(43): e22703.

29. Haug AR, Heinemann V, Bruns CJ et al. 18F-FDG PET independently predicts survival in patients with cholangiocellular carcinoma treated with 90Y microspheres. Eur J Nucl Med Mol Imaging 2011 Jun; 38(6):1037-45.
30. Haug AR, Tiega Donfack BP, Trumm C et al. 18F-FDG PET/CT predicts survival after radioembolization of hepatic metastases from breast cancer. J Nucl Med 2012 Mar; 53(3):371-7.
31. Heimbach JK, Kulik LM, Finn RS, et al. AASLD guidelines for the treatment of hepatocellular carcinoma. Hepatology. Jan2018; 67(1): 358-380.
32. Hendricks-Wenger A, Weber P, Simon A, et al. Histotripsy for the treatment of cholangiocarcinoma liver tumors: in vivo feasibility and ex vivo dosimetry study. IEEE Trans Ultrason Ferroelectr Freq Control. 2021 Sep; 68(9):2953-2964.
33. 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):1055-1062.
34. Hoffmann RT, Paprottka PM, Schon A et al. Transarterial hepatic yttrium-90 radioembolization in patients with unresectable intrahepatic cholangiocarcinoma: factors associated with prolonged survival. Cardiovasc Intervent Radiol 2012 Feb; 35(1):105-16.
35. Hua YQ, Wang P, Zhu XY, et al. Radiofrequency ablation for hepatic oligometastatic pancreatic cancer: An analysis of safety and efficacy. Pancreatology. Nov - Dec 2017;17(6):967-973
36. Huang C, Zhuang W, Feng H, et al. Analysis of therapeutic effectiveness and prognostic factor on argon-helium cryoablation combined with transcatheter arterial chemoembolization for the treatment of advanced hepatocellular carcinoma. J Cancer Res Ther. Dec 2016; 12(Supplement):C148-c152.
37. Huang YZ, Zhou SC, Zhou H et al. Radiofrequency ablation versus cryosurgery ablation for hepatocellular carcinoma: a meta-analysis. Hepatogastroenterology 2013 Jul-Aug; 60(125): 1131-5.
38. IOM (Institute of Medicine). 2011. Clinical Practice Guidelines We Can Trust. Washington, DC: The National Academies Press.
39. 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.
40. 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.
41. Kaibori M, Tanigawa N, Kariya S, et al. A prospective randomized controlled trial of preoperative whole-liver chemolipiodolization for hepatocellular carcinoma. Dig Dis Sci. May 2012; 57(5):1404-1412.
42. Klingenstein A, Haug AR, Zech CJ et al. Radioembolization as locoregional therapy of hepatic metastases in uveal melanoma patients. Cardiovasc Intervent Radiol 2013 Feb; 36(1):158-65.
43. Knuppel M, Kubicka S, Vogel A et al. Combination of conservative and interventional therapy strategies for intra- and extrahepatic cholangiocellular carcinoma: a retrospective survival analysis. Gastroenterol Res Pract 2012; 2012:190708.

44. Kutlu OC, Chan JA, Aloia TA, et al. Comparative effectiveness of first-line radiofrequency ablation versus surgical resection and transplantation for patients with early hepatocellular carcinoma. Cancer. May 15 2017; 123(10):1817-1827.
45. Lan T, Chang L, Mn R, et al. Comparative efficacy of interventional therapies for early-stage hepatocellular carcinoma: A PRISMA-compliant systematic review and network meta-analysis. Medicine (Baltimore). Apr 2016; 95(15):e3185.
46. 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 e1243.
47. 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.
48. 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.
49. 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.
50. 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.
51. 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 8 2017;8(32):52132-52141.
52. Li Z, Fu Y, Li Q, et al. Cryoablation plus chemotherapy in colorectal cancer patients with liver metastases. Tumour Biol. Nov 2014; 35(11):10841-10848.
53. Liao M, Zhu Z, Wang H, et al. Adjuvant transarterial chemoembolization for patients after curative resection of hepatocellular carcinoma: a meta-analysis. Scand J Gastroenterol. Jun - Jul 2017; 52(6-7):624-634.
54. 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.
55. 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.
56. Liu H, Wang ZG, Fu SY, et al. Randomized clinical trial of chemoembolization plus radiofrequency ablation versus partial hepatectomy for hepatocellular carcinoma within the Milan criteria. Br J Surg. Mar 2016; 103(4):348-356.
57. Liu Y, Li S, Wan X et al. Efficacy and safety of thermal ablation in patients with liver metastases. Eur J Gastroenterol Hepatol 2013 Apr; 25(4):442-6.
58. 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.

59. 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(3):CD011650.
60. Martin RC, Scoggins CR, Schreeder M, et al. Randomized controlled trial of irinotecan drug-eluting beads with simultaneous FOLFOX and bevacizumab for patients with unresectable colorectal liver-limited metastasis. Cancer. Oct 15 2015; 121(20):3649-3658.
61. 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. 2018 Aug;41(8):1189-1204.
62. Memon K, Lewandowski RJ, Mulcahy MF et al. Radioembolization for neuroendocrine liver metastases: safety, imaging, and long-term outcomes. Int J Radiat Oncol Biol Phys 2012 Jul 1; 83(3):887-94.
63. Michl M, Haug AR, Jakobs TF et al. Radioembolization with Yttrium-90 Microspheres (SIRT) in Pancreatic Cancer Patients with Liver Metastases: Efficacy, Safety and Prognostic Factors. Oncology 2014; 86(1):24-32.
64. 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 e615-676 e624.
65. 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.
66. Mouli S, Memon K, Baker T et al. Yttrium-90 radioembolization for intrahepatic cholangiocarcinoma: safety, response, and survival analysis. J Vasc Interv Radiol 2013 Aug; 24(8):1227-34.
67. National Cancer Institute, Surveillance Epidemiology and End Results Program. Cancer Stat Facts: Liver and Intrahepatic Bile Duct Cancer. n.d.; seer.cancer.gov/statfacts/html/livibd.html.
68. National Comprehensive Cancer Network Clinical Practice Guidelines in Oncology. Available online at: www.nccn.org/professionals/physician_gls/f_guidelines.asp#site.
69. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Breast cancer. Version 1.2024. www.nccn.org/professionals/physician_gls/pdf/breast.pdf.
70. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Hepatocellular Carcinoma. v1.2024. www.nccn.org/professionals/physician_gls/pdf/hcc.pdf.
71. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Colon Cancer.Version 1.2024. www.nccn.org/professionals/physician_gls/pdf/colon.pdf.
72. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Neuroendocrine and Adrenal Tumors. Version 2.2024. www.nccn.org/professionals/physician_gls/pdf/neuroendocrine.pdf.
73. Ng KKC, Chok KSH, Chan ACY, et al. Randomized clinical trial of hepatic resection versus radiofrequency ablation for early-stage hepatocellular carcinoma. Br J Surg. Dec 2017;104(13):1775-1784.

74. Ng KM, Chua TC, Saxena A et al. Two decades of experience with hepatic cryotherapy for advanced colorectal metastases. Ann Surg Oncol 2012; 19(4):1276-83.
75. Oliveri RS, Wetterslev J, Gluud C. Transarterial (chemo) embolisation for unresectable hepatocellular carcinoma. Cochrane Database Syst Rev 2011 Mar 16; (3):CD004787.
76. Organ Procurement and Transplant Network. Policy 9: Allocation of Livers and Liver-Intestines. 2023; optn.transplant.hrsa.gov/media/1200/optn_policies.pdf#nameddest=Policy_09.
77. Paprottka PM, Hoffmann RT, Haug A et al. Radioembolization of symptomatic, unresectable neuroendocrine hepatic metastases using yttrium-90 microspheres. Cardiovasc Intervent Radiol 2012 Apr; 35(2):334-42.
78. Park SY, Kim JH, Yoon HJ et al. Transarterial chemoembolization versus supportive therapy in the palliative treatment of unresectable intrahepatic cholangiocarcinoma. Clin Radiol 2011 Apr; 66(4):322-8.
79. Pathak S, Jones R, Tand JMF, et al. Ablative therapies for colorectal liver metastases: a systematic review. Colorectal Dis Sep 2011; 13(9):e252-65.
80. Peng ZW, Zhang YJ, Liang HH, et al. Recurrent hepatocellular carcinoma treated with sequential transcatheter arterial chemoembolization and RF ablation versus RF ablation alone: a prospective randomized trial. Radiology. Feb 2012; 262(2):689-700.
81. Piduru SM, Schuster DM, Barron BJ et al. Prognostic value of 18f-fluorodeoxyglucose positron emission tomography-computed tomography in predicting survival in patients with unresectable metastatic melanoma to the liver undergoing yttrium-90 radioembolization. J Vasc Interv Radiol 2012 Jul; 23(7):943-8.
82. 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.
83. Qi X, Tang Y, An D et al. Radiofrequency ablation versus hepatic resection for small hepatocellular carcinoma: a meta-analysis of randomized controlled trials. J Clin Gastroenterol 2014 May-Jun; 48(5):450-7.
84. Qi X, Wang D, Su C, et al. Hepatic resection versus transarterial chemoembolization for the initial treatment of hepatocellular carcinoma: A systematic review and meta-analysis. Oncotarget. Jul 30 2015; 6(21):18715-18733.
85. Rangarajan K, Lazzereschi L, Votano D, et al. Breast cancer liver metastases: systematic review and time to event meta-analysis with comparison between available treatments. Ann R Coll Surg Engl. Apr 2023; 105(4): 293-305.
86. Riaz A, Gates VL, Atassi B, et al. Radiation segmentectomy: A novel approach to increase safety and efficacy of radioembolization. Int J Radiation Oncology Biol Phys 2011 Jan 1;79(1):163-71.
87. Richardson AJ, Laurence JM, Lam VW. Transarterial chemoembolization with irinotecan beads in the treatment of colorectal liver metastases: systematic review. J Vasc Interv Radiol 2013 Aug; 24(8):1209-17.
88. Riemsma RP, Bala MM, Wolff R, et al. Percutaneous ethanol injection for liver metastases. Cochrane Database Syst Rev. May 31 2013(5):CD008717.
89. Roberts WW. Development and translation of histotripsy: Current status and future directions. Curr Opin Urol. 2014 Jan;24(1):104-110.

90. Rong G, Bai W, Dong Z, et al. Long-term outcomes of percutaneous cryoablation for patients with hepatocellular carcinoma within Milan criteria. PLoS One. 2015 Apr 7; 10(4):e0123065.
91. Rosenbaum CE, Verkooijen HM, Lam MG et al. Radioembolization for treatment of salvage patients with colorectal cancer liver metastases: a systematic review. J Nucl Med 2013 Nov; 54(11):1890-5.
92. 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.
93. 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).
94. Saxena A, Bester L, Shan L et al. A systematic review on the safety and efficacy of yttrium-90 radioembolization for unresectable, chemorefractory colorectal cancer liver metastases. J Cancer Res Clin Oncol 2014 Apr;140(4):537-47.
95. Saxena A, Chua TC, Chu F et al. Optimizing the surgical effort in patients with advanced neuroendocrine neoplasm hepatic metastases: a critical analysis of 40 patients treated by hepatic resection and cryoablation. Am J Clin Oncol 2012 Oct; 35(5):439-45.
96. 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.
97. Seidensticker R, Denecke T, Kraus P, et al. Matched-pair comparison of radioembolization plus best supportive care versus best supportive care alone for chemotherapy refractory liver-dominant colorectal metastases. Cardiovasc Intervent Radiol 2012 Oct; 35(5):1066-73.
98. Shen A, Zhang H, Tang C et al. A 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.
99. Shen WF, Zhong W, Liu Q et al. Adjuvant transcatheter arterial chemoembolization for intrahepatic cholangiocarcinoma after curative surgery: retrospective control study. World J Surg 2011 Sep; 35(9):2083-91.
100. 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.
101. Si T, Chen Y, Ma D, et al. Preoperative transarterial chemoembolization for resectable hepatocellular carcinoma in Asia area: a meta-analysis of random controlled trials. Scand J Gastroenterol. Dec 2016; 51(12):1512-1519.
102. Singal AG, Llovet JM, Yarchoan M, et al. AASLD Practice Guidance on prevention, diagnosis, and treatment of hepatocellular carcinoma. Hepatology. Dec 01 2023; 78(6): 1922-1965.
103. 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.

104. Siperstein AE, Berber E. Cryoablation, percutaneous alcohol injection, and radiofrequency ablation treatment of neuroendocrine liver metastases. World J Surg 2001 Jun; 25(6):693-6.
105. Smits ML, Prince JF, Rosenbaum CE et al. Intra-arterial radioembolization of breast cancer liver metastases: a structured review. Eur J Pharmacol 2013 Jun 5; 709(1-3):37-42.
106. Solbiati, L. Humanitas Hospital. The HistoSonics System for Treatment of Primary and Metastatic Liver Tumors Using Histotripsy (#HOPE4LIVER). NCT04573881. Available at: clinicaltrials.gov/study/NCT04573881
107. Song J, Cao L, Ma K, et al. Laparoscopic liver resection versus radiofrequency ablation for small hepatocellular carcinoma: randomized clinical trial. Br J Surg. Apr 03 2024; 111(4).
108. TheraSphere. www.nordion.com/therasphere/home_us/index.asp.
109. Tian X, Dai Y, Wang DQ, et al. Transarterial chemoembolization versus hepatic resection in hepatocellular carcinoma treatment: a meta-analysis. Drug Des Devel Ther. 2015 Aug; 9:4431-4440.
110. Tice J. Selective internal radiation therapy or radioembolization for inoperable liver metastases from colorectal cancer. California Technology Assessment Forum 2010. Available online at: www.ctaf.org/assessments/selective-internal-radiation-therapy-or-radioembolization-inoperable-liver-metastases.
111. Tiong L and Maddern G.J. Systematic review and meta-analysis of survival and disease recurrence after radiofrequency ablation for hepatocellular carcinoma. Br J Surg 2011 Sep; 98(9):1210-24.
112. U.S. Food and Drug Administration. 510(k) Summary or 510(k) Statement. Valleylab Microwave Ablation Generator. www.fda.gov.
113. 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 2011 Jun; 84(1002):556-65.
114. 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.
115. Vidal-Jove J, Serres X, Vlaisavljevich E, et al. First-in-man histotripsy of hepatic tumors: the THERESA trial, a feasibility study. Int J Hyperthermia. 2022; 39(1):1115-1123.
116. Vietti Violi N, Duran R, Guiu B, et al. Efficacy of microwave ablation versus radiofrequency ablation for the treatment of hepatocellular carcinoma in patients with chronic liver disease: a randomised controlled phase 2 trial. Lancet Gastroenterol Hepatol. 2018 May;3(5):317-325.
117. Wang C, Wang H, Yang W, et al. A multicenter randomized controlled trial of percutaneous cryoablation versus radiofrequency ablation in hepatocellular carcinoma. Hepatology. Oct 6 2014.
118. Wang Y, Luo Q, Li Y et al. Radiofrequency ablation versus hepatic resection for small hepatocellular carcinomas: a meta-analysis of randomized and nonrandomized controlled trials. PLoS One 2014; 9(1):e84484.

119. Weis S, Franke A, Mossner J et al. Radiofrequency (thermal) ablation versus no intervention or other interventions for hepatocellular carcinoma. Cochrane Database Syst Rev 2013 Dec 19; 12:CD003046.
120. 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.
121. Xie F, Zang J, Guo X, et al. Comparison of transcatheter arterial chemoembolization and microsphere embolization for treatment of unresectable hepatocellular carcinoma: a meta-analysis. J Cancer Res Clin Oncol. Mar 2012; 138(3):455-462.
122. Xu G, Qi FZ, Zhang JH et al. Meta-analysis of surgical resection and radiofrequency ablation for early hepatocellular carcinoma. World J Surg Oncol 2012 Aug 16; 10:163.
123. Xu XL, Liu XD, Liang M, et al. Radiofrequency ablation versus hepatic resection for small hepatocellular carcinoma: systematic review of randomized controlled trials with meta-analysis and trial sequential analysis. Radiology. May 2018;287(2):461-472.
124. Xu Z, Hall TL, Vlaisavljevich E, Lee FT Jr. Histotripsy: the first noninvasive, non-ionizing, non-thermal ablation technique based on ultrasound. Int J Hyperthermia. 2021; 38(1):561-575.
125. Yang Y, Wang C, Lu Y et al. Outcomes of ultrasound-guided percutaneous argon-helium cryoablation of hepatocellular carcinoma. J Hepatobiliary Pancreat Sci 2012 Nov; 19(6):674-84.
126. Yeh ML, Huang CI, Huang CF, et al. Neoadjuvant transcatheter arterial chemoembolization does not provide survival benefit compared to curative therapy alone in single hepatocellular carcinoma. Kaohsiung J Med Sci. Feb 2015; 31(2):77-82.
127. Yin Z, Jin H, Ma T, et al. A meta-analysis of long-term survival outcomes between surgical resection and radiofrequency ablation in patients with single hepatocellular carcinoma </= 2cm (BCLC very early stage). Int J Surg. Aug 2018;56:61-67.
128. Yu C, Wu S, Zhao J, et al. Evaluation of efficacy, safety and treatment-related outcomes of percutaneous radiofrequency ablation versus partial hepatectomy for small primary liver cancer meeting the Milan criteria: A systematic review and meta-analysis of randomized controlled trials. Clin Res Hepatol Gastroenterol. 2020 Oct;44(5):718-732.
129. 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.
130. Yu SJ, Yoon JH, Lee JM, et al. Percutaneous ethanol injection therapy is comparable to radiofrequency ablation in hepatocellular carcinoma smaller than 1.5cm: A matched case-control comparative analysis. Medicine (Baltimore). 2016 Aug;95(35):e.4551
131. Zacharias AJ, Jayakrishnan TT, Rajeev R, et al. Comparative effectiveness of hepatic artery based therapies for unresectable colorectal liver metastases: a meta-analysis. PLoS One. 2015 Oct 8; 10(10):e0139940.
132. Zhang T, Hu H, Jia Y, et al. Efficacy and safety of radiofrequency ablation and surgery for hepatocellular carcinoma inpatients with cirrhosis: A meta-analysis. Medicine (Baltimore). Dec 30 2022; 101(52): e32470.
133. Zhang Y, Qin Y, Dong P, et al. Liver resection, radiofrequency ablation, and radiofrequency ablation combined with transcatheter arterial chemoembolization for very-early- and early-stage hepatocellular carcinoma: A systematic review and Bayesian network meta-analysis for comparison of efficacy. Front Oncol. 2022 Oct 28; 12: 991944.

134. Zhao WJ, Zhu GQ, Wu YM, et al. Comparative Effectiveness of Radiofrequency Ablation, Surgical Resection and Transplantationnfor Early Hepatocellular Carcinoma by Cancer Risk Groups: Results of Propensity Score-Weighted Analysis. Onco Targets Ther 2019 Nov 29; 12: 10389-10400.
135. 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 Mar 31; 10: 399.
136. Zhou Y, Zhang X, Wu L et al. Meta-analysis: preoperative transcatheter arterial chemoembolization does not improve prognosis of patients with resectable hepatocellular carcinoma. BMC Gastroenterol 2013 Mar 19; 13:51.
137. 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. 2018 Sep;12(9):935-945.
138. Ziemlewicz T, Cho C. The HistoSonics System for Treatment of Primary and Metastatic Liver Tumors Using Histotripsy (#HOPE4LIVER US). NCT04572633. Available at: clinicaltrials.gov/ct2/show/NCT04572633.

POLICY HISTORY:

Adopted for Blue Advantage, March 2005
Available for comment May 1-June 14, 2005
Medical Policy Group, September 2008
Medical Policy Group, October 2009
Available for comment October 20-December 3, 2009
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Medical Policy Group, August 2015
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Medical Policy Group, July 2018: Updates to Description, Key Points, Coding and References. No change to policy statement. Removed ICD 9 diagnosis codes from Current Coding. Removed radioembolization HCPCS code and CPT codes from Current Coding (77300, 77370, 77470, 77750, 77778, 77790, 79445, 79900, S2095). Removed CPT code 37204 (deleted 2014) from Previous Coding. Changed policy statement for microwave ablation (per 5) since it is referred to in the Blue Advantage policy #512. Also deleted Policy statements prior to November 2015.
Medical Policy Group, October 2019
Medical Policy Group, August 2020: Removed CPT codes 37243 and 75894. Policy statement updated to remove TACE. See medical policy #737 for TACE.
Medical Policy Group, September 2020
Medical Policy Group, July 2021
Medical Policy Group, July 2022
Medical Policy Group, July 2023
UM Committee, December 2023: Policy approved by UM Committee for use for Blue Advantage business.
Medical Policy Group, July 2024
Medical Policy Group, October 2024: Update to Current Coding removing 77261-77263 & adding 76940. No change to policy statement.
