Molina Clinical Policy
Transarterial Chemoembolization (TACE) and Transarterial Embolization (TAE) for Liver Tumors: Policy No. 120

Last Approval: 4/13/2023
Next Review Due By: April 2024

DISCLAIMER

This Molina Clinical Policy (MCP) is intended to facilitate the Utilization Management process. Policies are not a supplementation or recommendation for treatment; Providers are solely responsible for the diagnosis, treatment, and clinical recommendations for the Member. It expresses Molina's determination as to whether certain services or supplies are medically necessary, experimental, investigational, or cosmetic for purposes of determining appropriateness of payment. The conclusion that a particular service or supply is medically necessary does not constitute a representation or warranty that this service or supply is covered (e.g., will be paid for by Molina) for a particular Member. The Member's benefit plan determines coverage – each benefit plan defines which services are covered, which are excluded, and which are subject to dollar caps or other limits. Members and their Providers will need to consult the Member's benefit plan to determine if there are any exclusion(s) or other benefit limitations applicable to this service or supply. If there is a discrepancy between this policy and a Member's plan of benefits, the benefits plan will govern. In addition, coverage may be mandated by applicable legal requirements of a State, the Federal government or CMS for Medicare and Medicaid Members. CMS's Coverage Database can be found on the CMS website. The coverage directive(s) and criteria from an existing National Coverage Determination (NCD) or Local Coverage Determination (LCD) will supersede the contents of this MCP and provide the directive for all Medicare members. References included were accurate at the time of policy approval and publication.

OVERVIEW

Transarterial chemoembolization (TACE) and transarterial embolization (TAE) are catheter-based embolization procedures used to treat primary hepatocellular carcinoma and certain hepatic metastases or as a bridge to liver transplantation. The TACE procedure entails injection of a chemotherapeutic agent into the artery directly supplying the tumor followed by the administration of embolizing agents. TAE, also known as bland embolization, involves injection of embolizing agents not combined with a chemotherapeutic agent. The aim of either procedure is to cause ischemia of the tumor by blockage of the nutrient supply, resulting in delayed progression or in some cases destruction of the tumor. TACE with drug-eluting beads (DEB-TACE) is an adaptation of TACE in which drug-eluting beads are loaded with a chemotherapy drug and delivered to the artery feeding the tumor. Once in place, the beads slowly release chemotherapy to target the tumor, theoretically reducing systemic exposure and decreasing side effects. The beads remain within the arteries causing embolization. TACE and TAE can be used as standalone treatments or in combination with surgery, ablation, chemotherapy, or radiation therapy. The most used drug in TACE is doxorubicin, followed by cisplatin, epirubicin, mitoxantrone, and mitomycin C (Curley et al., 2021; Song & Kim, 2017).

TACE and TAE require hospitalization and multiple treatments may be required to treat all lesions as well as recurrences, however, the benefit of repetition needs to be balanced against the progressive liver damage associated with the treatment. In cases of disease involving both lobes, tumor areas are treated in separate procedures at intervals of approximately 4 weeks. Patients are generally hospitalized for 1 to 2 days following the procedure. Post-procedure care includes aggressive hydration, antiemetics, analgesics as needed, and monitoring of electrolytes and liver function tests. The most common adverse effect of TACE and TAE is post-embolization syndrome, which consists of varying degrees of right upper quadrant pain, nausea, a moderate degree of ileus, fatigue, fever, and transient elevation of AST, ALT and bilirubin values. Symptoms are usually self-limited, lasting three to four days; full recovery is typical within 7 to 10 days (Curley et al., 2021).

Hepatocellular carcinoma (HCC) is a primary tumor of the liver that usually develops in the setting of chronic liver disease, particularly in patients with chronic hepatitis B and C. TACE is an appropriate option for patients with a large, unresectable, or multifocal HCC without main or lobar branch portal vein thrombus that is not amenable to local ablation. TACE is also commonly used as a bridging maneuver in patients awaiting liver transplantation. Preoperative TACE is not indicated for most patients who are candidates for resection. (Curly et al., 2021; NCCN, V5.2021).

Neuroendocrine tumors (NETs) are a heterogeneous group of neoplasms that are thought to arise from neuroendocrine cells and their precursors located throughout the body. TACE is applied as a palliative technique in patients with a hepatic-predominant metastatic NET who are not candidates for surgical resection (NCCN, V2.2021).

Uveal melanoma is a rare malignancy that arises from melanocytes within the uveal tract of the eye, which includes the iris, ciliary body, and choroid. Uveal melanoma comprises approximately 95 percent of melanomas arising from the eye, with the remainder arising from the conjunctiva. Among patients with hepatic metastases, TACE directed specifically toward the liver metastases has been associated with responses that may have clinical utility (Carvajal & Harbour, 2021).

Colorectal cancer (CRC) resection is the gold standard in the management of colon cancer metastatic to the liver. Most patients, however, are not surgical candidates due to disease bulk or the presence of extrahepatic metastases. Arterial therapies such as TACE and SIRT, either as monotherapy or in combination with other therapeutic regimens, have shown benefit in cases of chemorefractory CRC liver metastases (Venook, 2022).

COVERAGE POLICY

Transarterial chemoembolization (TACE) or Transarterial embolization (TAE) **is considered medically necessary** for any of the following conditions:

1. Treatment of unresectable primary hepatocellular liver carcinoma (HCC) when **ALL** the following criteria are met:
   a. Preserved liver function defined as Childs-Turcotte-Pugh Class A or B; **AND**
   b. No evidence of extra-hepatic metastases; **AND**
   c. No evidence of severe renal function impairment; **AND**
   d. No evidence of portal vein occlusion.

OR

2. Treatment of unresectable primary HCC in individuals who may become eligible for liver transplantation when the following criteria are met:
   a. One lesion greater than 5 cm and less than or equal to 8 cm; **OR**
   b. Two or three lesions each greater than 3 cm and less than or equal to 5 cm and total diameter of all lesions less than or equal to 8 cm; **OR**
   c. Four to five lesions each less than 3 cm, and a total diameter of all lesions less than or equal to 8 cm.

OR

3. Treatment of liver metastasis in symptomatic patients with metastatic neuroendocrine tumors whose symptoms persist despite systemic treatment and who are not candidates for surgical resection; **OR**

4. Treatment of liver metastasis in patients with liver-dominant metastatic uveal melanoma; **OR**

5. Treatment of liver metastasis in select patients with colorectal cancer whose symptoms persist despite systemic treatment and who are not candidates for surgical resection.

***** The Child-Turcote-Pugh (CPT) score determines short-term prognosis among groups of patients awaiting liver transplantation and has been widely adopted for risk-stratifying patients before transplantation.
Child-Turcote-Pugh Score of Severity of Liver Disease

Points	**1**	**2**	**3**
Encephalopathy	None	Grade 1 – 2	Grade 3 – 4
Ascites	Absent	Slight	Moderate
Bilirubin (mg/dL)	< 2	2 – 3	> 3
Albumin (g/dL)	> 3.5	2.8 – 3.5	< 2.8
INR*	< 1.7	1.7 – 2.3	> 2.3
PT* (seconds prolonged)	< 4	4 - 6	> 6

The individual scores are summed and then grouped as a classification: < 7 = A, 7-9 = B, > 9 = C (forecasts a survival of less than 12 months).
*INR = International Normalized Ratio; PT = prothrombin time.

Continuation of Therapy

TACE may be repeated after the first two sessions if there is a partial but incomplete response.

- Multiple courses of TACE, especially if spaced too closely together, can increase deaths from liver failure despite successful tumor shrinkage, and these excess deaths from deterioration of liver function may outweigh any prolongation of survival that results from improved tumor control.
- TACE may cause hepatic artery damage, the likelihood of which is higher in patients with impaired liver function.
- Hepatic artery interruption by repeated TACE or arterial dissection also leads to the development of extrahepatic collateralization, which may create an alternative blood supply to the tumor and contribute to treatment failure.

Limitations and Exclusions

1. TACE utilizing chemotherapy-loaded microspheres (e.g., drug-loaded microspheres, drug-eluting beads, and doxorubicin drug-eluting bead transarterial chemoembolization [DEB-TACE] and Embozene Microspheres) **are considered experimental, investigational, and unproven** for all liver-related conditions.

2. TACE is contraindicated for **ANY** of the following conditions:
   - Absent or severely reduced portal vein flow (e.g., tumoral or nontumoral portal vein occlusion, or hepatofugal blood flow); **AND**
   - Decompensated cirrhosis (Child-Turcotte-Pugh C, or Child-Turcotte-Pugh B score >8 including jaundice, clinical hepatic encephalopathy, refractory ascites, and/or hepatorenal syndrome).

3. Relative contraindications include **ANY** of the following:
   - Serum bilirubin >2 mg/dL; **OR**
   - Lactate dehydrogenase >425 units/L; **OR**
   - Aspartate aminotransferase >100 units/L; **OR**
   - Tumor burden involving >50 percent of the liver; **OR**
   - Severe comorbidities; **OR**
   - Untreated esophageal varices at high risk of bleeding; **OR**
   - Prior transjugular intrahepatic portosystemic shunting (TIPS).

DOCUMENTATION REQUIREMENTS. Molina Healthcare reserves the right to require that additional documentation be made available as part of its coverage determination; quality improvement; and fraud; waste and abuse prevention processes. Documentation required may include, but is not limited to, patient records, test results and credentials of the provider ordering or performing a drug or service. Molina Healthcare may deny reimbursement or take additional appropriate action if the documentation provided does not support the initial determination that the drugs or services were medically necessary, not investigational, or experimental, and otherwise within the scope of benefits afforded to the member, and/or the documentation demonstrates a pattern of billing or other practice that is inappropriate or excessive.

SUMMARY OF MEDICAL EVIDENCE

The available evidence on the efficacy and safety of TACE or TAE to treat unresectable HCC is from randomized controlled trials (RCTs), systematic reviews, retrospective reviews, and prospective studies. Data from two early RCTs and a systematic review of RCTs demonstrate that TACE provides a survival benefit for the treatment of unresectable primary HCC when compared with supportive care alone or when added as an additional therapy versus supportive care or systemic chemotherapy alone in the management of unresectable HCC (Lo et al., 2002; Llovet et al., 2002; Llovet & Bruix, 2003). Consensus opinion from professional organizations is that TACE remains a treatment option for unresectable HCC.

The available evidence on TACE performed using DEB-TACE consists of RCTs comparing the efficacy and safety of treatment with DEB-TACE with conventional TACE (cTACE) or with bland embolization with inert beads, controlled retrospective trials, prospective trials, comparative studies, and systematic reviews. The overall quality of the evidence is low due to study size, the limitations of the uncontrolled studies, and the small number of RCTs. The available evidence suggests that DEB-TACE is a safe and efficacious treatment for unresectable HCC, however there is insufficient evidence to draw conclusions regarding the superiority of DEB-TACE over conventional TACE. Additional trials are necessary to compare the efficacy and safety of DEB-TACE with conventional TACE, assess quality of life, and assess a consistent imaging method to monitor the tumor response to DEB-TACE (Xie et al., 2015; Facciorusso et al., 2016a; Facciorusso et al., 2016b; Baur et al., 2016; Massani et al., 2017; Wang et al., 2020; Ikeda et al., 2020).

The available evidence on the efficacy and safety of TACE for unresectable hepatic metastases from uveal (ocular) melanoma and neuroendocrine tumors includes retrospective studies and case series of treated patients who have reported that tumor response and survival are improved compared to historical controls. Treatment with TACE conferred a survival advantage. There are limited treatment options, and this condition is rare, making the performance of high-quality RCTs difficult or impossible. These reports conclude that TACE improves outcomes for patients with hepatic metastases from uveal melanoma and neuroendocrine tumors (Schuster et al., 2010; Grozensky et al., 2018; de Mestier et al., 2017; Do et al., 2017; Kennedy et al., 2015; Valpione et al., 2015; Shibayama et al., 2017).

The available evidence on the efficacy and safety of TACE or TAE as a bridge to liver transplantation consists of a number of uncontrolled studies that report that TACE is associated with low rates of dropout from the transplant list and is likely to reduce dropouts from the list. As a result, TACE has become an accepted component of care for patients with HCC on the waiting list for a liver transplant. Studies continue to evaluate whether TACE prior to transplantation is associated with post-transplant complications (Li et al., 2015; Sneiders et al., 2021).

Organ Procurement and Transplantation Network (OPTN). According to OPTN Policy, lesions eligible for downstaging protocols to qualify for liver transplantation must meet one of the following criteria: One lesion greater than 5 cm and less than or equal to 8 cm; two or three lesions with at least one lesion greater than 3 cm and all lesions less than or equal to 5 cm, and a total diameter of all lesions less than or equal to 8 cm; or four to five lesions, each less than 3 cm, and a total diameter of all lesions less than or equal to 8 cm (OPTN, 2022).

The **European Association for the Study of the Liver (EASL)** Clinical Practice Guideline on management of hepatocellular carcinoma notes that the best candidates for treatment with TACE are those with unresectable unifocal or multifocal nodules without vascular invasion or metastases, are asymptomatic, and have a Child-Pugh score no greater than B7. TACE is contraindicated in patients with impaired portal vein blood flow or microvascular invasion of the main portal branches or main portal vein. The risk of hepatic decompensation after TACE is increased for patients with inadequate hepatic function (such as bilirubin >2mg/dL) and a tumor burden of greater than 50% of total liver volume (EASL, 2018).

A consensus statement on the clinical practice of TACE for HCC from an **International Society of Multidisciplinary Interventional Oncology (ISMIO)** expert panel states that TACE is indicated for those patients with Child-Pugh A and B. TACE is an appropriate bridge therapy prior to liver transplantation when the wait time for transplant is longer than 6 months, and it can also be used as a downstaging treatment in select patients to meet the indications for transplant. Repeat TACE should be performed “on demand” and not according to a schedule. The combination of TACE with other therapies such as ablation, radiotherapy, or systemic therapy may improve therapeutic outcomes (Lu et al., 2021).

American Hepato-Pancreato-Biliary Association; Society of Surgical Oncology; Society of Surgery of the Alimentary Tract. The organizations published an expert consensus statement regarding treatment options for unresectable HCC. The guideline notes that although surgical resection and liver transplantation are the only treatment options for HCC, resulting in a chance of long-term survival, TACE is indicated in intermediate or advanced stage unresectable HCC and is also a treatment option used as a bridge to transplantation (Schwarz et al., 2010).

American Association for the Study of Liver Disease (AASLD). *Practice Guidelines: Treatment of Hepatocellular Carcinoma* published in 2018 suggests bridging to transplant with liver-directed therapy (LRT) in patients listed for liver transplantation within OPTN T2 (Milan) criteria to decrease the progression of disease and subsequent dropout from the waiting list. The AASLD does not recommend one form of LRT over another for the purposes of bridging to liver transplantation for patients within OPTN T2 (Milan) criteria. The guidelines also suggest that patients beyond the Milan criteria (T3) may be treated with LRT to downstage into the Milan criteria and become eligible for transplant. Additionally, for adults with cirrhosis and HCC not amenable to resection, the AASLD guidelines recommend treatment with LRT over no treatment, with a moderate certainty of evidence designated specifically to treatment with TACE (Heimbach et al., 2018).

National Comprehensive Cancer Network (NCCN). *Clinical Practice Guidelines in Oncology* (NCCN Guidelines)

- The NCCN Guidelines for hepatocellular carcinoma (V1.2023) includes the following:
  - Lesions 3 cm to 5 cm may be treated to prolong survival using arterially directed therapies, or with combination of an arterially directed therapy and ablation if tumor location is accessible for ablation.
  - Unresectable/inoperable lesions >5 cm should be considered for treatment using arterially directed or systemic therapy.
  - For bridge therapy to transplant arterially directed therapy is used to decrease tumor progression and the dropout rate from the liver transplant list and may be considered for patients who meet the transplant criteria.
  - All tumors irrespective of location may be amenable to arterially directed therapies provided that the arterial blood supply to the tumor may be isolated without excessive non-target treatment.
  - Relative contraindications include bilirubin > 3 mg/dL unless segmental treatment can be performed.

- The NCCN Guidelines for neuroendocrine tumors of the gastrointestinal tract and/or distant metastases (V2.2022) includes a recommendation to consider hepatic-directed therapy for hepatic-predominant disease including arterial embolization and TACE for individuals with locoregional unresectable disease and/or distant (liver) metastases (symptomatic, clinically significant tumor burden, or clinically significant progressive disease).
- The NCCN Guidelines for biliary tract cancers (V1.2023) includes the following recommendation: Locoregional therapy (i.e. TACE, DEB-TACE, TARE) may be considered for patients with unresectable disease or metastatic cancer without extrahepatic disease.
- The NCCN Guidelines for uveal melanoma (V2.2022) includes the following recommendation: In general, uveal melanomas may have lower response rates to drug-based therapies than cutaneous melanoma, but efficacy has in general been more limited; however, individual patients on occasion may derive substantial benefit. Regionally directed therapies such as hepatic chemoembolization or radioembolization should be considered.
- The NCCN Guidelines for colorectal cancer (V3.2022) state that arterially directed treatment (which includes TACE) is an option in highly selected patients with chemotherapy resistant refractive disease with predominant hepatic metastases.

For additional sources used in the development and update of this policy, please see the *References* section.

CODING & BILLING INFORMATION

CPT Codes

CPT	Description
37243	Vascular embolization or occlusion, inclusive of all radiological supervision and interpretation, intraprocedural roadmapping, and imaging guidance necessary to complete the intervention; for tumors, organ ischemia, or infarction
75894	Transcatheter therapy, embolization, any method, radiological supervision and interpretation

HCPCS Codes – N/A

CODING DISCLAIMER. Codes listed in this policy are for reference purposes only and may not be all-inclusive. Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement. Listing of a service or device code in this policy does not guarantee coverage. Coverage is determined by the benefit document. Molina adheres to Current Procedural Terminology (CPT®), a registered trademark of the American Medical Association (AMA). All CPT codes and descriptions are copyrighted by the AMA; this information is included for informational purposes only. Providers and facilities are expected to utilize industry standard coding practices for all submissions. When improper billing and coding is not followed, Molina has the right to reject/deny the claim and recover claim payment(s). Due to changing industry practices, Molina reserves the right to revise this policy as needed.

APPROVAL HISTORY

4/13/2023	Policy reviewed. No changes in coverage criteria. Updated references.
4/13/2022	Policy reviewed, updated references and Summary of Evidence. Criteria updated to remove limit of 5 cm tumor size from the indications of TACE for HCC as well as the coverage of continued TACE for tumors showing partial but incomplete response. IRO Peer Review. Policy reviewed on March 24, 2022 by an practicing, board-certified physician in the area of Gastroenterology.
4/5/2021	Policy reviewed. No changes. Updated references.
4/23/2020	Policy reviewed. No changes. Updated references.
9/18/2019	Policy reviewed. No changes. Updated references.
7/10/2018	Policy reviewed and updated with revisions to criteria. For TACE and the addition of TAE for conditions including metastatic colorectal cancer, neuroendocrine tumors, uveal melanoma, as a bridge to liver transplant and in individuals who may become eligible for liver transplantation. Updated contraindications to TACE with additional recommendations Updated sections for General Information, Summary of Medical Evidence, Coding and References.
6/22/2017	Policy reviewed, no changes.
12/14/2016	Policy reviewed, no changes.
7/16/2015	Policy reviewed and updated with revisions to criteria (TACE utilizing chemotherapy-loaded microspheres [e.g., drug-loaded microspheres, drug-eluting beads, and doxorubicin drug-eluting bead transarterial chemoembolization (DEB-TACE)]; added Embozene Microspheres are considered experimental, investigational, and unproven for all liver-related conditions.
10/31/2012	New policy.

REFERENCES

Government Agency

1. Centers for Medicare and Medicaid Services (CMS). Medicare coverage database. National coverage determination for therapeutic embolization (20.28). Effective December 15, 1978. Accessed March 2, 2023. https://www.cms.gov/medicare-coverage-database/search.aspx.

Peer Reviewed Publications

1. Baur J, Ritter CO, Germer CT, et al. Transarterial chemoembolization with drug-eluting beads versus conventional transarterial chemoembolization in locally advanced hepatocellular carcinoma. Hepat Med. 2016 Jun 20;8:69-74. doi: 10.2147/HMER.S105395.
2. de Mestier L, Zappa M, et al. Liver transarterial embolizations in metastatic neuroendocrine tumors. Rev Endocr Metab Disord. 2017 Dec;18(4):459-471. doi: 10.1007/s11154-017-9431-2.
3. Do Minh D, Chapiro J, et al. Intra-arterial therapy of neuroendocrine tumour liver metastases: Comparing conventional TACE, drug-eluting beads TACE and yttrium-90 radioembolisation as treatment options using a propensity score analysis model. Eur Radiol. 2017 Dec;27(12):4995-5005. doi: 10.1007/s00330-017-4856-2.
4. Facciorusso A, Di Maso M, Muscatiello N. Drug-eluting beads versus conventional chemoembolization for the treatment of unresectable hepatocellular carcinoma: A meta-analysis. Dig Liver Dis. 2016a Jun;48(6):571-7. doi: 10.1016/j.dld.2016.02.005.
5. Facciorusso A, Mariani L, Sposito C, et al. Drug-eluting beads versus conventional chemoembolization for the treatment of unresectable hepatocellular carcinoma. J Gastroenterol Hepatol. 2016b Mar;31(3):645-53. doi: 10.1111/jgh.13147.
6. Ikeda M, Inaba Y, Tanaka T, et al. A prospective randomized controlled trial of selective transarterial chemoembolization using drug-eluting beads loaded with epirubicin versus selective conventional transarterial chemoembolization using epirubicin-lipiodol for hepatocellular carcinoma: The JIVROSG-1302 PRESIDENT study. Journal of Clinical Oncology. 2020;38(15)4518-4518. doi: 10.1200/JCO.2020.38.15_suppl.4518.
7. Kennedy A, Bester L, et al. Role of hepatic intra-arterial therapies in metastatic neuroendocrine tumours (NET): guidelines from the NET-Liver-Metastases Consensus Conference. HPB (Oxford). 2015 Jan;17(1):29-37. doi: 10.1111/hpb.12326.
8. Li H, Li B, Wei Y, et al. Preoperative transarterial chemoembolization does not increase hepatic artery complications after liver transplantation: A single center 12-year experience. Clin Res Hepatol Gastroenterol. 2015 Sep;39(4):451-7. doi: 10.1016/j.clinre.2014.12.004.
9. Llovet J, Bruix J. Systematic review of randomized trials for unresectable hepatocellular carcinoma: Chemoembolization improves survival. Hepatology. 2003 Feb;37(2):429-42. doi: 10.1053/jhep.2003.50047.
10. Llovet J, Real M, Montanya X, et al. Arterial embolization, chemoembolization versus symptomatic treatment in patients with unresectable hepatocellular carcinoma. A randomized controlled trial. Lancet. 2002 May 18;359(9319):1734-9. doi: 10.1016/S0140-6736(02)08649-X.
11. Lo CM, Ngan H, Tso WK, et al. Randomized controlled trial of transarterial lipiodol chemoembolization for unresectable hepatocellular carcinoma. Hepatology. 2002 May;35(5):1164-71. doi: 10.1053/jhep.2002.33156.
12. Sneiders D, Boteon APCS, Lerut J, et al. Transarterial chemoembolization of hepatocellular carcinoma before liver transplantation and risk of post-transplant vascular complications: a multicentre observational cohort and propensity score-matched analysis. Br J Surg. 2021 Nov 11;108(11):1323-1331. doi: 10.1093/bjs/znab268.
13. Massani M, Stecca T, Ruffolo C, Bassi N. Should we routinely use DEBTACE for unresectable HCC? cTACE versus DEBTACE: a single-center survival analysis. 2017 Mar;69(1):67-73. doi: 10.1007/s13304-017-0414-3.
14. Schuster R, Lindner M, Wacker F, et al. Transarterial chemoembolization of liver metastases from uveal melanoma after failure of systemic therapy: toxicity and outcome. Melanoma Res. 2010 Jun;20(3):191-6. doi: 10.1097/CMR.0b013e328334c36e.
15. Shibayama Y, Namikawa K, et al. Efficacy and toxicity of transarterial chemoembolization therapy using cisplatin and gelatin sponge in patients with liver metastases from uveal melanoma in an Asian population. Int J Clin Oncol. 2017 Jun;22(3):577-584. doi: 10.1007/s10147-017-1095-0.
16. Sneiders D, Boteon APCS, Lerut J, et al. Transarterial chemoembolization of hepatocellular carcinoma before liver transplantation and risk of post-transplant vascular complications: a multicentre observational cohort and propensity score-matched analysis. Br J Surg. 2021 Nov 11;108(11):1323-1331. doi: 10.1093/bjs/znab268.
17. Song JE, Kim DO. Conventional vs drug-eluting beads transarterial chemoembolization for hepatocellular carcinoma. World J Hepatol. 2017 Jun 28;9(18):808-814. doi: 10.4254/wjh.v9.i18.808.
18. Song MJ, Park CH, Kim JD, et al. Drug-eluting bead loaded with doxorubicin versus conventional Lipiodol-based transarterial chemoembolization in the treatment of hepatocellular carcinoma: a case-control study of Asian patients. Eur J Gastroenterol Hepatol. 2011;23(6):521-527. doi: 10.1097/MEG.0b013e328346d505.
19. Valpione S, Aliberti C, Parrozzani R, et al. A retrospective analysis of 141 patients with liver metastases from uveal melanoma: a two-cohort study comparing transarterial chemoembolization with CPT-11 charged microbeads and historical treatments. Melanoma Res. 2015 Apr;25(2):164-8. doi: 10.1097/CMR.0000000000000129.

National and Specialty Organizations

1. American College of Radiology (ACR). ACR appropriateness criteria radiologic management of hepatic malignancy. Updated 2015. Revised 2022. Accessed March 2023. https://acsearch.acr.org/docs/69379/Narrative/.
2. American Association for the Study of Liver Disease (AASLD). Clinical practice guidelines. Accessed March 2023. http://www.aasld.org/publications/practice-guidelines.
   - Heimbach JK, Kulik LM, et al. Treatment of hepatocellular carcinoma. Hepatology. 2018. 67(1):358-380.
   - Kulik L, Heimbach JK, et al. Therapies for patients with hepatocellular carcinoma awaiting liver transplantation: A systematic review and meta-analysis. Hepatology. 2018;67:381-400.
   - Martin P, et al. Liver transplantation: Evaluation of the adult patient. Hepatology. 2014 Mar;59(3):1144-65.

3. EASL Clinical Practice Guidelines. Management of hepatocellular carcinoma. J Hepatol. 2018; 69: 182-236. doi.org/10.1016/j.jhep.2018.03.019.
4. Gaba RC, Lokken P, Hickey RM, et al. Society of Interventional Radiology: Quality improvement guidelines for transarterial chemoembolization and embolization of hepatic malignancy. 2017; (9):1210-1223. doi: 10.1016/j.jvir.2017.04.025.
5. Lu J, Zhao M, Arai Y, et al. Clinical practice of transarterial chemoembolization for hepatocellular carcinoma: consensus statement from an international expert panel of International Society of Multidisciplinary Interventional Oncology (ISMIO). Hepatobiliary Surg Nutr. 2021 Oct; 10(5): 661–671. doi: 10.21037/hbsn-21-260.
6. National Cancer Institute (NCI). Childhood liver cancer treatment PDQ®. Updated 2021. https://www.cancer.gov/types/liver/hp/child-liver-treatment-pdq.
7. National Cancer Institute (NCI). Adult primary liver cancer treatment PDQ®. Updated 2021. https://www.cancer.gov/types/liver/hp/adult-liver-treatment-pdq.
8. National Comprehensive Cancer Network (NCCN). Accessed March 2023. Clinical practice guidelines in oncology:
   a. Biliary tract cancers (ver. 1.2023). Published March 10, 2023.
   b. Colon cancer (ver. 3.2022). Published January 25, 2023.
   c. Hepatocellular carcinoma (ver. 1.2023). Published March 10, 2023.
   d. Melanoma: Uveal (ver. 2.2022). Published April 5, 2022.
   e. Neuroendocrine and adrenal tumors (ver. 2.2022). Published December 21, 2022.
9. Organ Procurement and Transplantation Network (OPTN). Organ distribution: Policy 9: allocation of livers and liver-intestines. Effective February 10, 2022. https://optn.transplant.hrsa.gov/.
10. Schwarz RE, Abou-Alfa GK, Geschwind JF, et al.; American Hepato-Pancreato-Biliary Association; Society of Surgical Oncology; Society for Surgery of the Alimentary Tract. Nonoperative therapies for combined modality treatment of hepatocellular cancer: expert consensus statement. HPB (Oxford). 2010 Jun;12(5):313-20. doi: 10.1111/j.1477-2574.2010.00183.x.

Other Authoritative Publications

1. Carvajal R, Harbour JW. Metastatic uveal melanoma. Updated December 06, 2022. Accessed March 2023. http://www.uptodate.com.
2. Curley SA, Stuart KE, Schwartz JM. Localized hepatocellular carcinoma: Liver-directed therapies for nonsurgical candidates not eligible for local thermal ablation. Updated December 6, 2022. Accessed March 2023. http://www.uptodate.com.
3. DynaMed. Hepatocellular carcinoma. EBSCO Publishing. Updated December 13, 2022. http://www.dynamed.com.
4. Venook AP. Nonsurgical local treatment strategies for colorectal cancer liver metastases. Updated January 27, 2022. Accessed March 2023. http://www.uptodate.com.

Other Peer Reviewed Publications (not cited)

1. Butcher DA, Brandis KJ, Wang H, et al. Long-term survival and postoperative complications of pre-liver transplantation transarterial chemoembolisation in hepatocellular carcinoma: A systematic review and meta-analysis. Eur J Surg Oncol. 2021 Sep 24:S0748-7983(21)00743-5. doi: 10.1016/j.ejso.2021.09.017.
2. Katsanos K, Kitrou P, et al. Comparative effectiveness of different transarterial embolization therapies alone or in combination with local ablative or adjuvant systemic treatments for unresectable hepatocellular carcinoma: A network meta-analysis of randomized controlled trials. PLoS One. 2017 Sep 21;12(9):e0184597. doi: 10.1371/journal.pone.0184597.
3. Malagari K, Alexopoulou E, Chatzimichael K, et al. Transcatheter chemoembolization in the treatment of HCC in patients not eligible for curative treatments: midterm results of doxorubicin-loaded DC bead. Abdom Imaging. 2008a;33(5):512-519. doi: 10.1007/s00261-007-9334-x.
4. Malagari K, Chatzimichael K, Alexopoulou E, et al. Transarterial chemoembolization of unresectable hepatocellular carcinoma with drug eluting beads: results of an open-label study of 62 patients. Cardiovasc Intervent Radiol. 2008b;31(2):269-280. doi: 10.1007/s00270-007-9226-z.
5. Massani M, Stecca T, Ruffolo C, Bassi N. Should we routinely use DEBTACE for unresectable HCC? cTACE versus DEBTACE: a single-center survival analysis. 2017 Mar;69(1):67-73. doi: 10.1007/s13304-017-0414-3.
6. Marelli L, Stigliano R, Triantos C, et al. Transarterial therapy for hepatocellular carcinoma: Which technique is more effective? A systematic review of cohort and randomized studies. Cardiovasc Intervent Radiol. 2007;30(1):6-25. doi: 10.1007/s00270-006-0062-3.
7. Morimoto M, Numata K, Kondou M, et al. Midterm outcomes in patients with intermediate-sized hepatocellular carcinoma: a randomized controlled trial for determining the efficacy of radiofrequency ablation combined with transcatheter arterial chemoembolization. Cancer. 2010 Dec 1;116(23):5452-60. doi: 10.1002/cncr.25314.
8. Oliveri RS, Wetterslev J, Gluud C. Transarterial (chemo) embolisation for unresectable hepatocellular carcinoma. Cochrane Database of Systematic Reviews 2011, Issue 3. Art. No.: CD004787. doi: 10.1002/14651858.CD004787.pub2
9. Ren Y, Chen L, Huang S, et al. Transarterial chemoembolization of unresectable systemic chemotherapy refractory liver metastases: a retrospective single-center analysis. Abdom Radiol (NY). 2020;45(9):2862. Abdom Radiol (NY). 2020;45(9):2862.
10. Samuel M, Chow PKH, Chan Shih-Yen E, Machin D, Soo K-C. Neoadjuvant and adjuvant therapy for surgical resection of hepatocellular carcinoma. World J Gastroenterol. 2019 Jul 28;25(28):3704-3721. doi: 10.3748/wjg.v25.i28.3704.
11. Shao G, Liu R, Ding W, et al. Efficacy and safety of raltitrexed-based transarterial chemoembolization for colorectal cancer liver metastases. Anticancer Drugs. 2018 Nov;29(10):1021-1025. doi: 10.1097/CAD.0000000000000690.
12. Swierz MJ, Storman D, Riemsma RP, et al. Transarterial (chemo)embolisation versus no intervention or placebo for liver metastases. Cochrane Database Syst Rev. 2020 Mar 12;3(3):CD009498. doi: 10.1002/14651858.CD009498.pub4.
13. Takayasu K. Transarterial chemoembolization for hepatocellular carcinoma over three decades: current progress and perspective. Jpn J Clin Oncol. 2012 Apr;42(4):247-55. doi: 10.1093/jjco/hys020.
14. van Malenstein H, Maleux G, Vandecaveye V, et al. A randomized phase II study of drug-eluting beads versus transarterial chemoembolization for unresectable hepatocellular carcinoma. Onkologie. 2011;34(7):368-376. doi: 10.1159/000329602.
15. Vogl TJ, Lammer J, Lencioni R, et al. Liver, gastrointestinal, and cardiac toxicity in intermediate hepatocellular carcinoma treated with PRECISION TACE with drug-eluting beads: results from the PRECISION V randomized trial. AJR Am J Roentgenol. 2011 Oct;197(4):W562-70. doi: 10.2214/AJR.10.4379.

16. Zhong JH, Li LQ. Postoperative adjuvant transarterial chemoembolization for participants with hepatocellular carcinoma: A meta-analysis. Hepatol Res. 2010;40(10):943-953. doi: 10.1111/j.1872-034X.2010.00710.x.
17. Zhou WP, Lai EC, Li AJ, et al. A prospective, randomized, controlled trial of preoperative transarterial chemoembolization for resectable large hepatocellular carcinoma. Ann Surg 2009; 249: 195–202. doi: 10.1097/SLA.0b013e3181961c16.