



**BlueCross BlueShield
of Alabama**

Name of Blue Advantage Policy:
Microwave Tumor Ablation

Policy #: 512
Category: Surgery

Latest Review Date: October 2020
Policy Grade: B

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:

Effective for dates of service on or after December 11, 2012:

Blue Advantage will treat **microwave ablation** as a **covered benefit** for patients with one of the following indications:

- Hepatocellular carcinoma (HCC);
- Metastatic liver carcinoma.
- Primary or metastatic lung tumors

Blue Advantage will treat microwave ablation of primary and metastatic tumors, other than those listed above, as a non-covered service and as investigational.

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:

Microwave ablation (MWA) is a technique to destroy tumors and soft tissue by using microwave energy to create thermal coagulation and localized tissue necrosis. MWA is used to treat tumors considered to be inoperable, not amenable to resection, or to treat patients ineligible for surgery due to age, presence of comorbidities, or poor general health. MWA may be performed as an open procedure, laparoscopically, percutaneously or thoracoscopically under image guidance (e.g., ultrasound, computed tomography [CT] or magnetic resonance imaging [MRI]) with sedation, or local or general anesthesia. This technique may also be referred to as microwave coagulation therapy.

Microwave ablation (MWA) uses microwave energy induces an ultra-high speed, 915 MHz or 2450 MHz (2.45GHz), alternating electric field which causes water molecule rotation and the creation of heat. This results in thermal coagulation and localized tissue necrosis. In MWA, a single microwave antenna or multiple antennas connected to a generator are inserted directly into the tumor or tissue to be ablated; energy from the antennas generates friction and heat. The local heat coagulates the tissue adjacent to the probe, resulting in a small, approximately 2-3 cm elliptical area (5 x 3 cm) of tissue ablation. In tumors greater than 2 cm in diameter, 2-3 antennas may be used simultaneously to increase the targeted area of MWA and shorten operative time. Multiple antennas may also be used simultaneously to ablate multiple tumors. Tissue ablation occurs quickly, within one minute after a pulse of energy, and multiple pulses may be delivered within a treatment session depending on the size of the tumor. The cells killed by MWA are typically not removed but are gradually replaced by fibrosis and scar tissue. If there is local recurrence, it occurs at the edges. Treatment may be repeated as needed. MWA may be used to:

1) control local tumor growth and prevent recurrence; 2) palliate symptoms; and 3) extend survival duration.

MWA is an ablative technique similar to radiofrequency or cryosurgical ablation. However, MWA has some potential advantages over radiofrequency or cryosurgical ablation. In MWA, the heating process is active, which produces higher temperatures than the passive heating of radiofrequency ablation and should allow for more complete thermal ablation in a shorter period of time. The higher temperatures reached with MWA (over 100° C) can overcome the “heat sink” effect in which tissue cooling occurs from nearby blood flow in large vessels potentially resulting in incomplete tumor ablation. MWA does not rely on the conduction of electricity for heating, and therefore, does not have electrical current flow through patients and does not require grounding pads be used during the procedure since there is no risk of skin burns. Additionally, MWA does not produce electric noise, which allows ultrasound guidance to occur during the procedure without interference, unlike radiofrequency ablation. Finally, MWA can be completed in less time than radiofrequency ablation since multiple antennas can be used simultaneously.

Adverse Events

Complications from MWA may include pain and fever. Other potential complications associated with MWA include those caused by heat damage to normal tissue adjacent to the tumor (e.g., intestinal damage during MWA of the kidney or liver), structural damage along the probe track (e.g., pneumothorax as a consequence of procedures on the lung), liver enzyme elevation, liver abscess, ascites, pleural effusion, diaphragm injury or secondary tumors if cells seed during probe removal. MWA should be avoided in pregnant patients since potential risks to the patient and/or fetus have not been established and in patients with implanted electronic devices such as implantable pacemakers that may be adversely affected by microwave power output.

Applications

MWA was first used percutaneously in 1986 as an adjunct to liver biopsy. Since that time, MWA has been used for ablation of tumors and tissue for the treatment of many conditions including: hepatocellular carcinoma, colorectal cancer metastatic to the liver, renal cell carcinoma, renal hamartoma, adrenal malignant carcinoma, non-small cell lung cancer, intrahepatic primary cholangiocarcinoma, secondary splenomegaly and hypersplenism, abdominal tumors and other tumors not amenable to resection. Well-established local or systemic treatment alternatives are available for each of these malignancies. The hypothesized advantages of MWA for these cancers include improved local control and those common to any minimally invasive procedure (e.g., preserving normal organ tissue, decreasing morbidity, decreasing length of hospitalization). MWA has been investigated as a treatment for unresectable hepatic tumors, both as primary treatment, palliative treatment and as a bridge to liver transplant. In the latter setting, it is thought that MWA will reduce the incidence of tumor progression while awaiting transplantation and thus maintain a patient’s candidacy for liver transplant.

KEY POINTS:

The most recent literature update was performed through September 28, 2020.

Summary of Evidence

For individuals who have unresectable primary or metastatic breast cancer who receive MWA, the evidence includes case series and a systematic review of feasibility and pilot studies conducted prior to 2010. Relevant outcomes are overall survival (OS), disease-specific survival, symptoms, quality of life, and treatment-related mortality and morbidity. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have an unresectable primary or metastatic hepatic tumor who receive MWA, the evidence includes RCTs, comparative observational studies, and systematic reviews comparing MWA to RFA and to surgical resection. Relevant outcomes are overall survival, disease-specific survival, symptoms, quality of life, and treatment-related mortality and morbidity. The body of evidence indicates that MWA is an effective option in patients for whom resection is not an option. Although studies had methodological limitations, results consistently showed that MWA and RFA had similar survival outcomes with up to 5 years of followup in patients with a single tumor <5 cm or up to 3 nodules <3 cm each. In a meta-analysis of observational studies, patients receiving MWA had higher local recurrence rates and lower survival than those who received resection, but the patient populations were not limited to those who had unresectable tumors. MWA was associated with lower complications, intraoperative blood loss, and hospital length of stay. The evidence is sufficient to determine the effects of the technology on health outcomes.

For individuals who have an unresectable primary or metastatic lung tumor who receive MWA, the evidence includes one RCT, retrospective observational studies, and systematic reviews of these studies. Relevant outcomes are overall survival, disease-specific survival, symptoms, quality of life, and treatment-related mortality and morbidity. The body of evidence indicates that MWA is an effective option in patients for whom resection is not an option. In the RCT, direct comparison of MWA and RFA in patients with primary or metastatic lung cancer (mean tumor size, 1.90 cm [\pm 0.89] at baseline) found similar mortality rates up to 12 months of follow-up. In the first of three systematic reviews that included 12 retrospective observational studies, local recurrence rates were similar for MWA and RFA at a range of 9 to 47 months of follow-up. In the second systematic review with a meta-analysis, there was lower overall survival with MWA compared to RFA, but studies were not directly comparable due to clinical and methodological heterogeneity. However, the authors concluded that percutaneous RFA and MWA were both effective with a high safety profile. In the third systematic review using a network meta-analysis, the weighted average overall survival rates for MWA were 82.5%, 54.6%, 35.7%, 29.6%, and 16.6% at 1, 2, 3, 4, and 5 years, respectively. Limitations of the body of evidence included a lack of controlled studies and heterogeneity across studies. The RCT did not report results by tumor size or number of metastases. The observational studies included in the systematic reviews did not report sufficient information to assess effectiveness or safety of MWA in subgroups based on the presence of multiple tumors or total tumor burden. Therefore, conclusions about the evidence sufficiency can only be made about patients with single tumors. For this population, the evidence is sufficient to determine the effects of the technology on health outcomes.

For individuals who have an unresectable primary or metastatic renal tumor who receive MWA, the evidence includes one RCT that compared MWA to partial nephrectomy, retrospective reviews, systematic reviews and meta-analyses of the retrospective reviews (with or without the single RCT) and case series. Relevant outcomes are overall survival, disease-specific survival, symptoms, quality of life, and treatment-related mortality and morbidity. In the RCT, overall local recurrence-free survival at 3 years was 91.3% for MWA and 96.0% for partial nephrectomy (p=0.54). This positive outcome should be replicated in additional RCTs. There are also no controlled studies comparing MWA to other ablation techniques in patients with renal tumors. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have unresectable primary or metastatic solid tumors other than breast, hepatic, lung, or renal who receive MWA, the evidence includes systematic reviews and case series. Relevant outcomes are OS, disease-specific survival, symptoms, quality of life, and treatment-related mortality and morbidity. The evidence is insufficient to determine the effects of the technology on health outcomes.

Practice Guidelines and Position Statements

NCCN

The National Comprehensive Cancer Network (NCCN) guidelines on hepatobiliary cancers (v.4.2020) lists MWA (along with radiofrequency ablation, cryoablation and percutaneous alcohol injection) as a treatment option for hepatocellular carcinoma tumors in patients who are not candidates for potential curative treatments (e.g., resection and transplantation) and do not have large-volume extrahepatic disease. Ablation should only be considered when tumors are accessible by percutaneous, laparoscopic or open approaches. The guidelines indicate “ablative therapies are most effective for [HCC] tumors less than 3 cm...”. Hepatocellular carcinoma tumors between three to five centimeters may also be treated with ablation to prolong survival when used in combination with arterial embolization. Additionally, the tumor location must be accessible to permit ablation of the tumor and tumor margins without ablating major vessels, bile ducts, the diaphragm or other abdominal organs. However, only 1 RCT of MWA compared to RFA was cited in the guidelines to support recommendations for MWA. .

The guidelines on non-small cell lung cancer (v.6.2020) do not mention MWA and state, "for medically operative disease, resection is the preferred local treatment modality (other modalities include SABR, thermal ablation such as radiofrequency ablation, and cryotherapy)". Guidelines on small-cell lung cancer v.4.2020) state, "stereotactic ablative radiotherapy is an option for certain patients with medically inoperable stage I to IIA small-cell lung cancer.

The Network guidelines on neuroendocrine tumors (v.2.2020) state that: cytoreductive surgery or ablative therapies, (radiofrequency, cryotherapy, microwave) may be considered in patients with progressive hepatic-predominant metastatic disease to reduce tumor bulk and relieve symptoms of hormone hypersecretion (category 2B). Additionally, although prospective data for ablative therapy interventions are limited, the guideline notes that "percutaneous thermal ablation, often using microwave energy, can be considered for oligometastatic liver disease, generally up to 4 lesions each smaller than 3 cm.”

The guidelines on kidney cancer (v.1.2021) do not specifically address the role of MWA, but state that other thermal ablation techniques (RFA and cryotherapy) may be an option for T1 renal lesions, particularly for masses <3 cm.

NICE

The National Institute for Health and Care Excellence (2016) updated its guidance on MWA for treatment of metastases in the liver. The revised guidance states:

- Current evidence on MWA for treating liver metastases raises no major safety concerns and the evidence on efficacy is adequate in terms of tumor ablation. Therefore this procedure may be used provided that standard arrangements are in place for clinical governance, consent and audit.
- Patient selection should be carried out by a hepatobiliary cancer multidisciplinary team.
- Further research would be useful for guiding selection of patients for this procedure. This should document the site and type of the primary tumor being treated, the intention of treatment (palliative or curative), imaging techniques used to assess the efficacy of the procedure, long-term outcomes and survival.

The Institute also published guidance on MWA for HCC in 2007. This guidance indicated: “Current evidence on the safety and efficacy of MWA of hepatocellular carcinoma appears adequate to support the use of this procedure provided that the normal arrangements are in place for consent, audit and clinical governance.” The guidance also stated there are no major concerns about the efficacy of MWA, but noted that limited, long-term survival data are available.

The Institute (2013) has published guidance on MWA for lung tumors as well. This guidance indicated that "evidence that the procedure improves clinical outcomes and quality of life is limited in quantity and quality. There is a risk of complications, including pneumothorax, which may have serious implications for patients with already compromised lung function. Therefore this procedure should only be used with special arrangements for clinical governance, consent and audit." The guidance encourages further research.

American College of Chest Physicians

The 2013 American College of Chest Physicians (ACCP) evidence-based guidelines on the treatment of non-small cell lung cancer note that the role of ablative therapies in the treatment of high-risk patients with Stage I NSCLC is evolving. The guidelines deal mostly with radiofrequency ablation.

American Urological Association

The American Urological Association (2017) guidelines on renal mass and localized renal cancer note that MWA remains investigational for this indication due to the the limited number of published studies and the lack of long-term follow-up data. Cryoablation and RFA are recommended as options for thermal ablation in patients with T1a renal masses <3 cm in size.

U.S. Preventive Services Task Force Recommendations

Microwave tumor ablation is not a preventive service.

KEY WORDS:

Microwave tumor ablation, Microwave coagulation therapy, Tumor microwave ablation, MWA, breast microwave ablation, breast tumor, metastatic tumors, microwave coagulation therapy, primary tumors, pulmonary microwave ablation, pulmonary tumor, renal microwave ablation, renal tumor, secondary tumors, tumor microwave ablation, urinary system microwave ablation

APPROVED BY GOVERNING BODIES:

Multiple MWA devices have been cleared for marketing by the U.S. Food and Drug Administration through the 510(k) process. These devices are indicated for soft tissue ablation, including partial or complete ablation of nonresectable liver tumors. Some devices are specifically cleared for use in open surgical ablation, percutaneous ablation or laparoscopic procedures. Table 1 is a summary of selected MWA devices cleared by FDA.

The Food and Drug Administration used determinations of substantial equivalence to existing radiofrequency and MWA devices to clear these devices.

This evidence review does not address MWA for the treatment of splenomegaly or ulcers for cardiac applications, or as a surgical coagulation tool.

Table 1. Selected Microwave Ablation Devices Cleared by FDA

Device	Indication	Manufacturer	Date Cleared	510(k) No
VivaWave™ Microwave System	Coagulation of soft tissue	Vivant Medical, Inc.	6/2002	K011676
VivaWave™ Microwave Ablation System	Probe modification	ValleyLab	4/2006	K053535
Microsoulis Tissue Ablation System	Intraoperative coagulation of soft tissue	Microsoulis Americas, Inc	1/2006	K052919
MicroSurgeon Microwave Soft Tissue Ablation MTAD-100	Surgical ablation of soft tissue	MicroSurgeon, Inc.	8/2007	K070023
MicroSurgeon Microwave Tissue Ablation MTAD-200	Probe/design modifications		2/2009	K082565
MedWaves Microwave Coagulation/Ablation System	General surgery use in open procedures for the coagulation and ablation of soft tissues	MedWaves Incorporated	12/2007	K070356
Acculis Accu2i	Intraoperative	Microsoulis	8/2010	K094021

pMTA Microwave Tissue Ablation Applicator Acculis Accu2i pMTA Applicator and SulisV pMTA Generator	coagulation of soft tissue Software addition	Holdings, Ltd	11/2012	K122762
MicroThermX Microwave Ablation System	Coagulation (ablation) of soft tissue. M may be used in open surgical as well as percutaneous ablation procedures.	BSD Medical Corporation	8/2010	K100786
Emprint™ Ablation System Emprint™ Ablation System Emprint™ SX Ablation Platform with Thermosphere™ Technology Emprint™ Ablation Platform with Thermosphere™ Technology and Emprint™ SX Ablation Platform with Thermosphere™ Technology	percutaneous, laparoscopic, and intraoperative coagulation (ablation) of soft tissue, including partial or complete ablation of non-resectable liver tumors. Same with design modification of device antenna for percutaneous use 3-D navigation feature assists in the placement of antenna using real-time image guidance during intraoperative and laparoscopic ablation procedures. Antenna modification and	Covidien LLC	4/2014 12/2016 9/2017 2/2020	K133821 K163105 K171358 K193232

	update to instructions for use			
Certus 140 2.45 GHz Ablation System and Accessories Certus 140™ 2.45 GHz Ablation System and Accessories CertuSurgGT Surgical Tool Certus 140™ 2.45 GHz Ablation System and Accessories Certus 140 2.45GHz Ablation System	Ablation (coagulation) of soft tissue. Ablation (coagulation) of soft tissue in percutaneous, open surgical and in conjunction with laparoscopic surgical settings. Surgical coagulation (including Planar Coagulation) in open surgical settings. Same indication with probe redesign Ablation (coagulation) of soft tissue in percutaneous, open surgical and in conjunction with laparoscopic surgical settings, including the partial or complete ablation of nonresectable liver tumors.	NeuWave Medical, Inc.	10/2010 01/2012 7/2013 5/2016 10/2018	K100744 K113237 K130399 K160936 K173756
NEUWAVE Flex Microwave Ablation System (FLEX)	Ablation (coagulation) of soft tissue. Design evolution of Certus 140 2.45GHz	NeuWave Medical, Inc.	3/2017	K163118

	Ablation System (K160936)			
Solero Microwave Tissue Ablation (MTA) System and Accessories	Ablation of soft tissue during open procedures	Angiodynamics, Inc.	5/2017	K162449
Microwave Ablation System	Coagulation (ablation) of soft tissue	Surgnova Healthcare Technologies (Zhejiang) Co., Ltd	7/2019	K183153

BENEFIT APPLICATION:

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

CURRENT CODING:

CPT Codes:

As of 01/01/2018, there are no specific CPT codes for microwave ablation.

The unlisted CPT code for the anatomic area should be reported such as code **47399-** unlisted procedure liver; **53899-** unlisted procedure urinary system (for renal tumors); **32999-** unlisted procedure lung; **19499-** unlisted procedure breast.

This procedure may also be billed with radiofrequency ablation codes for the anatomic area, such as code **32998-** pulmonary, **47382-** liver, and **50592-** renal.

PREVIOUS CODING:

0301T-Destruction/reduction of malignant breast tumor with externally applied focused microwave, including interstitial placement of disposable catheter with combined temperature monitoring probe and microwave focusing sensocatheter under ultrasound thermotherapy guidance. **(Deleted 12/31/2017)**

REFERENCES:

1. Aarts BM, Prevoo W, Meier MAJ, et al. Percutaneous Microwave Ablation of Histologically Proven T1 Renal Cell Carcinoma. Cardiovasc Intervent Radiol. Jul 2020; 43(7): 1025-1033.
2. Abdelaziz AO, Nabeel MM, Elbaz TM, et al. Microwave ablation versus transarterial chemoembolization in large hepatocellular carcinoma: prospective analysis. Scand J Gastroenterol. Apr 2015; 50(4):479-484.

3. Acksteiner C, Steinke K. Percutaneous microwave ablation for early-stage non-small cell lung cancer (NSCLC) in the elderly: a promising outlook. *J Med Imaging Radiat Oncol.* Feb 2015; 59(1):82-90.
4. Bai J, Hu Z, Guan W et al. Initial experience with retroperitoneoscopic microwave ablation of clinical T (1a) renal tumors. *J Endourol* 2010; 24(12):2017-22.
5. Bala MM, Riemsma RP, Wolff R, et al. Microwave coagulation for liver metastases. *Cochrane Database Syst Rev.* 2013; 10: CD010163.
6. Belfiore G, Ronza F, Belfiore MP et al. Patients' survival in lung malignancies treated by microwave ablation: our experience on 56 patients. *Eur J Radiol* 2013; 82(1): 177-81.
7. 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* 2011; 21(12):2584-96.
8. Carberry GA, Smolock AR, Cristescu M et al. Safety and Efficacy of Percutaneous Microwave Hepatic Ablation Near the Heart.. *J Vasc Interv Radiol*, 2017 Feb 14;28(4).
9. Carrafiello G, Mangini M, Fontana F et al. Complications of microwave and radiofrequency lung ablation: personal experience and review of the literature. *Radiol Med* 2012; 117(2): 201-13.
10. Carrafiello G, Mangini M, Fontana F et al. Microwave ablation of lung tumours: single centre preliminary experience. *Radiol Med* 2014; 119: 75-82.
11. Castle SM, Salas N, Leveillee RJ. Initial experience using microwave ablation therapy for renal tumor treatment: 18-month follow-up. *Urology* 2011; 77(4):792-7.
12. Chiang J, Cristescu M, Lee MH et al. Effects of Microwave Ablation on Arterial and Venous Vasculature after Treatment of Hepatocellular Carcinoma.. *Radiology*, 2016 Oct 19;281(2).
13. Chinnaratha MA, Chuang MA, Fraser RJ, et al. Percutaneous thermal ablation for primary hepatocellular carcinoma: a systematic review and meta-analysis. *J Gastroenterol Hepatol.* Jun 25 2015.
14. Chong CCN, Lee KF, Cheung SYS, et al. Prospective double-blinded randomized controlled trial of Microwave versus RadioFrequency Ablation for hepatocellular carcinoma (McRFA trial). *HPB (Oxford)*. Aug 2020; 22(8): 1121-1127.
15. Chong CCN, Lee KF, Chu CM, et al. Microwave ablation provides better survival than liver resection for hepatocellular carcinoma in patients with borderline liver function: application of ALBI score to patient selection. *HPB (Oxford)*. Jun 2018; 20(6): 546-554.
16. Cui R, Yu J, Kuang M, et al. Microwave ablation versus other interventions for hepatocellular carcinoma: A systematic review and meta-analysis. *J Cancer Res Ther.* 2020; 16(2): 379-386.
17. Ding J, Jing X, Liu J et al. Comparison of two different thermal techniques for the treatment of hepatocellular carcinoma. *Eur J Radiol* 2013; 82(9):1379-84.
18. 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; 68(6):608-15.
19. Egashira Y, Singh S, Bandula S, et al. Percutaneous High-Energy Microwave Ablation for the Treatment of Pulmonary Tumors: A Retrospective Single-Center Experience. *J Vasc Interv Radiol.* Apr 2016; 27(4): 474-9.

20. Egorov AV, Vasilyev IA, Musayev GH, et al. The role of microwave ablation in management of functioning pancreatic neuroendocrine tumors. *Gland Surg.* Dec 2019; 8(6): 766-772.
21. Floridi C, De Bernardi I, et al. Microwave ablation of renal tumors: state of the art and development trends. *Radiol med* 2014; (119): 533-540.
22. Giorgio A, Gatti P, Montesarchio L et al. Microwave Ablation in Intermediate Hepatocellular Carcinoma in Cirrhosis: An Italian Multicenter Prospective Study.. *J Clin Transl Hepatol*, 2018 Oct 3;6(3).
23. Glassberg MB, Ghosh S, Clymer JW et al. Microwave ablation compared with hepatic resection for the treatment of hepatocellular carcinoma and liver metastases: a systematic review and meta-analysis.. *World J Surg Oncol*, 2019 Jun 12;17(1).
24. Groeschl RT, Pilgrim CH, Hanna EM et al. Microwave ablation for hepatic malignancies: a multiinstitutional analysis.. *Ann. Surg.*, 2013 Oct 8;259(6).
25. Guan W, Bai J, Hu Z et al. Retroperitoneoscopic microwave ablation of renal hamartoma: middle-term results. *J Huazhong Univ Sci Technolog Med Sci* 2010; 30(5):669-71.
26. Guan W, Bai J, Liu J et al. Microwave ablation versus partial nephrectomy for small renal tumors: intermediate-term results. *J Surg Oncol* 2012; 106(3):316-21.
27. Guideline for management of the clinical stage 1 renal mass. American Urological Association 2009.
28. Guo J, Arellano RS. Percutaneous Microwave Ablation of Stage T1a Renal Cell Carcinoma: Intermediate Results on Safety, Technical Feasibility and Clinical Outcomes of 119 Tumors. *AJR Am J Roentgenol.* Jun 29 2020.
29. He W, Hu XD, Wu DF et al. Ultrasonography-guided percutaneous microwave ablation of peripheral lung cancer. *Clin Imaging* 2006; 30(4):234-41.
30. Howington J, Blum M, Chang A, et al. Treatment of stage I and II non-small cell lung cancer: Diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest* May 2013; 143 (5 Suppl):e278S-313S.
31. Iannitti DA, Martin RC, Simon CJ et al. Hepatic tumor ablation with clustered microwave antennae: the US Phase II trial.. *HPB (Oxford)*, 2008 Mar 12;9(2).
32. Jagad RB, Koshariya M, et al. Laparoscopic microwave ablation of liver tumors: Our experience. *Hepatogastroenterology*, Jan-Feb 2008; 55(81): 27-32.
33. Jiang B, McClure MA, Chen T et al. Efficacy and safety of thermal ablation of lung malignancies: A Network meta-analysis.. *Ann Thorac Med*, 2018 Nov 13;13(4).
34. Katsanos K, Mailli L, Krokidis M, et al. Systematic review and meta-analysis of thermal ablation versus surgical nephrectomy for small renal tumours. *Cardiovasc Intervent Radiol.* Apr 2014; 37 (2):427-437.
35. Keane MG, Bramis K, Pereira SP, et al. Systematic review of novel ablative methods in locally advanced pancreatic cancer. *World J Gastroenterol.* Mar 7 2014; 20 (9):2267-2278.
36. Kitchin D, Lubner M, Ziemlewicz T et al. Microwave ablation of malignant hepatic tumours: intraperitoneal fluid instillation prevents collateral damage and allows more aggressive case selection.. *Int J Hyperthermia*, 2014 Aug 22;30(5).
37. Ko WC, Lee YF, Chen YC, et al. CT-guided percutaneous microwave ablation of pulmonary malignant tumors. *J Thorac Dis.* Oct 2016; 8(Suppl 9): S659-S665.

38. Li B, Wang Z, Zhou K, et al. Safety and feasibility within 24 h of discharge in patents with inoperable malignant lung nodules after percutaneous microwave ablation. *J Cancer Res Ther.* Dec 2016; 12(Supplement): C171-C175.
39. Li W, Zhou X, Huang Z, et al. Short-term and long-term outcomes of laparoscopic hepatectomy, microwave ablation, and open hepatectomy for small hepatocellular carcinoma: a 5-year experience in a single center. *Hepatol Res.* Jun 2017; 47(7): 650-657.
40. Li X, Fan W, Zhang L et al. CT-guided percutaneous microwave ablation of adrenal malignant carcinoma: preliminary results. *Cancer* 2011; 117(22):5182-8.
41. Liang P, Wang Y, Yu X et al. Malignant liver tumors: treatment with percutaneous microwave ablation--complications among cohort of 1136 patients. *Radiology* 2009; 251(3):933-40.
42. Lin Y, Liang P, et al. Percutaneous microwave ablation of renal cell carcinoma is safe in patients with a solitary kidney. *Urology* 2014; 83 (2): 357-363.
43. Liu Y, Li S, Wan X et al. Efficacy and safety of thermal ablation in patients with liver metastases. *Eur J Gastroenterol Hepatol* 2013; 25(4):442-6.
44. Lorentzen T, Skjoldbye BO, Nolsoe CP. Microwave ablation of liver metastases guided by contrast-enhanced ultrasound: experience with 125 metastases in 39 patients. *Ultraschall Med* 2011; 32(5):492-96.
45. 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.
46. Lu MD, Xu HX, Xie XY et al. Percutaneous microwave and radiofrequency ablation for hepatocellular carcinoma: a retrospective comparative study. *J Gastroenterol* 2005; 40(11):1054-60.
47. Lu Q, Cao W, Huang L et al. CT-guided percutaneous microwave ablation of pulmonary malignancies: results in 69 cases. *World J Surg Oncol* 2012; 10:80.
48. Lubner M, Brace C, et al. Microwave tumor ablation: mechanism of action, clinical results, and devices. *J Vasc Interv Radiol* 2010; (21): S192-S203.
49. Macchi M, Belfiore MP, Floridi C et al. Radiofrequency versus microwave ablation for treatment of the lung tumours: LUMIRA (lung microwave radiofrequency) randomized trial.. *Med. Oncol.*, 2017 Apr 19;34(5).
50. Martin J, Athreya S. Meta-analysis of cryoablation versus microwave ablation for small renal masses: is there a difference in outcome? *Diagn Interv Radiol.* Nov-Dec 2013; 19 (6):501-507.
51. Martin RC, Scoggins CR, McMasters KM. Safety and efficacy of microwave ablation of hepatic tumors: a prospective review of a 5-year experience. *Ann Surg Oncol* 2010; 17(1):171-8.
52. Maxwell AW, Healey TT, Dupuy DE. Percutaneous Thermal Ablation for Small-Cell Lung Cancer: Initial Experience with Ten Tumors in Nine Patients. *J Vasc Interv Radiol.* Dec 2016; 27(12): 1815-1821.
53. Moreland AJ, Ziemlewicz MD, Best SL, et al. High-powered microwave ablation of T1a renal cell carcinoma: safety and initial clinical evaluation. *Journal of Endourology* 2014; 28 (9): 1046-1052.
54. Muto G, Castelli E, Migliari R et al. Laparoscopic microwave ablation and enucleation of small renal masses: preliminary experience. *Eur Urol* 2011; 60(1):173-6.

55. National Comprehensive Cancer Network (NCCN). Hepatobiliary Cancers. Clinical practice guidelines in oncology, v.2.2018 Available online at: www.nccn.org/professionals/physician_gls/pdf/hepatobiliary.pdf. Accessed August 3, 2018.
56. National Comprehensive Cancer Network (NCCN). Kidney Cancer. Clinical practice guidelines in oncology, 2017. Available at: www.nccn.org/professionals/physician_gls/f_guidelines.asp#site.
57. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Non-Small Cell Lung Cancer. Version 6.2020. https://www.nccn.org/professionals/physician_gls/pdf/nscl.pdf. Accessed August 10, 2020.
58. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Small Cell Lung Cancer. Version 4.2020. https://www.nccn.org/professionals/physician_gls/pdf/sclc.pdf. Accessed August 6, 2020.
59. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Neuroendocrine and Adrenal Tumors. Version 2.2020. https://www.nccn.org/professionals/physician_gls/pdf/neuroendocrine.pdf. Accessed August 11, 2020.
60. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Kidney Cancer. Version 1.2021. https://www.nccn.org/professionals/physician_gls/pdf/kidney.pdf. Accessed August 5, 2020.
61. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Neuroendocrine and Adrenal Tumors. Version 2.2020. https://www.nccn.org/professionals/physician_gls/pdf/neuroendocrine.pdf. Accessed August 11, 2020.
62. National Comprehensive Cancer Network (NCCN). Neuroendocrine Tumors. Clinical practice guidelines in oncology, v.2.2018 Available online at: www.nccn.org/professionals/physician_gls/pdf/neuroendocrine.pdf. Accessed August 3, 2018.
63. National Comprehensive Cancer Network (NCCN). Non-small cell lung cancer. Clinical practice guidelines in oncology, 2017. Available at: www.nccn.org/professionals/physician_gls/f_guidelines.asp#site.
64. National Institute for Clinical Excellence (NICE). Microwave Ablation for the Treatment of Metastases in the Liver. 2017. Available online at: www.nice.org.uk/nicemedia/live/11333/56036/56036.pdf. Last Accessed: August 29, 2017.
65. National Institute for Clinical Excellence (NICE). Microwave ablation for the treatment of liver metastases.2016. Available online at: www.nice.org.uk/guidance/ipg406. Accessed August 3, 2018.
66. National Institute for Clinical Excellence (NICE). Microwave Ablation of Hepatocellular Carcinoma. 2007. Available online at: publications.nice.org.uk/microwave-ablation-of-hepatocellular-carcinoma-ipg214. Accessed August 3, 2018.
67. National Institute for Clinical Excellence (NICE). Microwave ablation for treating primary lung cancer and metastases in the lung. 2013.
68. National Institute for Health and Care Excellence (NICE). Microwave ablation for treating liver metastases [IPG553]. 2016; <https://www.nice.org.uk/guidance/ipg553> Accessed August 3, 2018.

69. National Institute for Health and Care Excellence (NICE). Microwave Ablation of Hepatocellular Carcinoma [IPG214]. 2007; <https://www.nice.org.uk/guidance/ipg214>. Accessed August 3, 2018.
70. National Institute for Health and Care Excellence (NICE). Microwave ablation for treating liver metastases [IPG553]. 2016; <https://www.nice.org.uk/guidance/ipg553> Accessed August 8, 2020.
71. National Institute for Health and Care Excellence (NICE). Microwave Ablation of Hepatocellular Carcinoma [IPG214]. 2007; <https://www.nice.org.uk/guidance/ipg214>. Accessed August 7, 2020.
72. National Institute for Health and Care Excellence (NICE). Microwave ablation for treating liver metastases [IPG553]. 2016; <https://www.nice.org.uk/guidance/ipg553> Accessed August 8, 2020.
73. National Institute for Health and Care Excellence (NICE). Microwave ablation for treating primary lung cancer and metastases in the lung [IPG469]. 2013; <https://www.nice.org.uk/guidance/ipg469>. Accessed August 9, 2020.
74. Nelson DB, Tam AL, Mitchell KG et al. Local Recurrence After Microwave Ablation of Lung Malignancies: A Systematic Review.. *Ann. Thorac. Surg.*, 2018 Dec 7;107(6).
75. Nelson DB, Tam AL, Mitchell KG, et al. Local Recurrence After Microwave Ablation of Lung Malignancies: A Systematic Review. *Ann Thorac Surg.* Jun 2019; 107(6): 1876-1883.
76. Nour-Eldin NA, Exner S, Al-Subhi M, et al. Ablation therapy of non-colorectal cancer lung metastases: retrospective analysis of tumour response post-laser-induced interstitial thermotherapy (LITT), radiofrequency ablation (RFA) and microwave ablation (MWA). *Int J Hyperthermia.* Nov 2017; 33(7): 820-829.
77. Ohmoto K, Yoshioka N, Tomiyama Y, et al. Comparison of therapeutic effects between radiofrequency ablation and percutaneous microwave coagulation therapy for small hepatocellular carcinomas. *J Gastroenterol Hepatol.* Feb 2009; 24(2): 223-7.
78. Ong SL, Gravante G, Metcalfe MS et al. Efficacy and safety of microwave ablation for primary and secondary liver malignancies: a systematic review. *Eur J Gastroenterol Hepatol* 2009; 21(6):599-605.
79. Pathak S, Jones R, Tang JM et al. Ablative therapies for colorectal liver metastases: a systematic review. *Colorectal Dis* 2011; 13(9):e252-65.
80. Philips P, Scoggins CR, Rostas JK, et al. Safety and advantages of combined resection and microwave ablation in patients with bilobar hepatic malignancies. *Int J Hyperthermia.* Feb 2017; 33(1): 43-50.
81. Potretzke TA, Ziemlewicz TJ, Hinshaw JL, et al. Microwave versus Radiofrequency Ablation Treatment for Hepatocellular Carcinoma: A Comparison of Efficacy at a Single Center. *J Vasc Interv Radiol.* May 2016; 27(5): 631-8.
82. Pusceddu C, Sotgia B, Fele RM et al. Treatment of bone metastases with microwave thermal ablation. *J Vasc Interv Radiol* 2013; 24(2):229-33.
83. Qin S, Liu GJ, Huang M et al. The local efficacy and influencing factors of ultrasound-guided percutaneous microwave ablation in colorectal liver metastases: a review of a 4-year experience at a single center.. *Int J Hyperthermia*, 2018 Nov 30;36(1).
84. Ryu T, Takami Y, Wada Y, et al. Oncological outcomes after hepatic resection and/or surgical microwave ablation for liver metastasis from gastric cancer. *Asian J Surg.* Jan 2019; 42(1): 100-105.

85. Scott WJ, Howington J, Feigenberg S et al. Treatment of non-small cell lung cancer stage I and stage II: ACCP evidence-based clinical practice guidelines (2nd edition). Chest 2007; 132(3 Suppl):234S-42S.
86. Seki T, Wakabayashi M, Nakagawa T, et al. Percutaneous microwave coagulation therapy for patients with small hepatocellular carcinoma: comparison with percutaneous ethanol injection therapy. Cancer. Apr 15 1999; 85(8): 1694-702.
87. Shen X, Ma S, Tang X et al. Clinical outcome in elderly Chinese patients with primary hepatocellular carcinoma treated with percutaneous microwave coagulation therapy (PMCT): A Strobe-compliant observational study.. Medicine (Baltimore), 2018 Sep 2;97(35).
88. Shi J, Sun Q, Wang Y, et al. Comparison of microwave ablation and surgical resection for treatment of hepatocellular carcinomas conforming to Milan criteria. J Gastroenterol Hepatol. 2014; 29(7): 1500-7.
89. Shibata T, Iimuro Y, Yamamoto Y et al. Small hepatocellular carcinoma: comparison of radio-frequency ablation and percutaneous microwave coagulation therapy. Radiology 2002; 223(2):331-7.
90. Shibata T, Niinobu T, Ogata N et al. Microwave coagulation therapy for multiple hepatic metastases from colorectal carcinoma. Cancer 2000; 89(2):276-84.
91. Simo KA, Sereika SE, Newton KN et al. Laparoscopic-assisted microwave ablation for hepatocellular carcinoma: Safety and efficacy in comparison with radiofrequency ablation. J Surg Oncol 2011; 104(7):822-9.
92. Smolock AR, Lubner MG, Ziemlewicz TJ et al. Microwave ablation of hepatic tumors abutting the diaphragm is safe and effective.. AJR Am J Roentgenol, 2014 Dec 30;204(1).
93. Soliman AF, Abouelkhair MM, Hasab Allah MS et al. Efficacy and Safety of Microwave Ablation (MWA) for Hepatocellular Carcinoma (HCC) in Difficult Anatomical Sites in Egyptian Patients with Liver Cirrhosis. Asian Pac. J. Cancer Prev., 2019 Jan 27;20(1).
94. Sun YH, Song PY, Guo Y, et al. Computed tomography-guided percutaneous microwave ablation therapy for lung cancer. Genet Mol Res. 2015; 14(2):4858-4864.
95. Swietlik JF, Longo KC, Knott EA et al. Percutaneous Microwave Tumor Ablation Is Safe in Patients with Cardiovascular Implantable Electronic Devices: A Single-Institutional Retrospective Review.. J Vasc Interv Radiol, 2019 Mar 2;30(3).
96. Takami Y, Ryu T, Wada Y et al. Evaluation of intraoperative microwave coagulo-necrotic therapy (MCN) for hepatocellular carcinoma: a single center experience of 719 consecutive cases. J Hepatobiliary Pancreat Sci 2012. [Epub ahead of print]
97. Tan K, DU X, Yin J, et al. Microwave tissue coagulation technique in anatomical liver resection. Biomed Rep. Mar 2014; 2(2): 177-182.
98. Tanaka K, Shimada H, Nagano Y, et al. Outcome after hepatic resection versus combined resection and microwave ablation for multiple bilobar colorectal metastases to the liver. Surgery. Feb 2006; 139(2): 263-73.
99. Taniai N, Yoshida H, Mamada Y et al. Is intraoperative adjuvant therapy effective for satellite lesions in patients undergoing reduction surgery for advanced hepatocellular carcinoma? Hepatogastroenterology 2006; 53(68):258-61.
100. Thamtorawat S, Hicks RM, Yu J et al. Preliminary Outcome of Microwave Ablation of Hepatocellular Carcinoma: Breaking the 3-cm Barrier?. J Vasc Interv Radiol, 2016 Mar 26;27(5).

101. Uhlig J, Strauss A, Rucker G, et al. Partial nephrectomy versus ablative techniques for small renal masses: a systematic review and network meta-analysis. *Eur Radiol*. Mar 2019; 29(3): 1293-1307.
102. 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 Mar 6;3(5).
103. Vogl TJ, Farshid P, Naguib NN, et al. Ablation therapy of hepatocellular carcinoma: a comparative study between radiofrequency and microwave ablation. *Abdom Imaging*. Aug 2015; 40(6):1829-1837.
104. Vogl TJ, Naguib NN, Gruber-Rouh T et al. Microwave ablation therapy: clinical utility in treatment of pulmonary metastases. *Radiology* 2011; 261(2):643-51.
105. Wei Z, Ye X, Yang X, et al. Microwave ablation in combination with chemotherapy for the treatment of advanced non-small cell lung cancer. *Cardiovasc Intervent Radiol*. Feb 2015; 38(1): 135-42.
106. Wolf FJ, Grand DJ, Machan JT et al. Microwave ablation of lung malignancies: effectiveness, CT findings, and safety in 50 patients. *Radiology* 2008; 247(3):871-9.
107. Xu HX, Xie XY, Lu MD, et al. Ultrasound-guided percutaneous thermal ablation of hepatocellular carcinoma using microwave and radiofrequency ablation. *Clin Radiol*. Jan 2004; 59(1): 53-61.
108. Xu J, Zhao Y. Comparison of percutaneous microwave ablation and laparoscopic resection in the prognosis of liver cancer.. *Int J Clin Exp Pathol*, 2015 Dec 1;8(9).
109. Yang X, Xin YE, Zheng A et al. Percutaneous microwave ablation of stage I medically inoperable non-small cell lung cancer: clinical evaluation of 47 cases. *Journal of Surgical Oncology* 2014.
110. Yu J, Liang P, et al. US-guided percutaneous microwave ablation versus open radical nephrectomy for small renal cell carcinoma: intermediate-term results. *Radiology* 2014; 270 (3): 880-887.
111. Yu J, Liang P, Yu XL et al. Needle track seeding after percutaneous microwave ablation of malignant liver tumors under ultrasound guidance: analysis of 14-year experience with 1462 patients at a single center. *Eur J Radiol* 2012; 81(10):2495-9.
112. Yu J, Liang P, Yu XL et al. US-guided percutaneous microwave ablation of renal cell carcinoma: intermediate-term results. *Radiology* 2012; 263(3):900-8.
113. Yu J, Yu XL, Han ZY et al. Percutaneous cooled-probe microwave versus radiofrequency ablation in early-stage hepatocellular carcinoma: a phase III randomised controlled trial.. *Gut*, 2016 Nov 26;66(6).
114. Yu MA, Liang P, Yu XL et al. Sonography-guided percutaneous microwave ablation of intrahepatic primary cholangiocarcinoma. *Eur J Radiol* 2011; 80(2):548-52.
115. Yuan Z, Wang Y, Zhang J et al. A Meta-Analysis of Clinical Outcomes After Radiofrequency Ablation and Microwave Ablation for Lung Cancer and Pulmonary Metastases.. *J Am Coll Radiol*, 2019 Jan 16;16(3).
116. Yue W, Wang S, Wang B et al. Ultrasound guided percutaneous microwave ablation of benign thyroid nodules: Safety and imaging follow-up in 222 patients. *Eur J Radiol* 2013 Jan; 82(1):e11-6.

117. Zhang X, Chen B, Hu S, et al. Microwave ablation with cooled-tip electrode for liver cancer: An analysis of 160 cases. *Hepatogastroenterology*, Nov-Dec 2008; 55(88): 2184-2187.
118. Zhao Z, Wu F. Minimally-invasive thermal ablation of early-stage breast cancer: a systemic review. *Eur J Surg Oncol* 2010; 36(12):1149-55.
119. Zhou P, Liang P, Dong B et al. Long-term results of a phase II clinical trial of superantigen therapy with staphylococcal enterotoxin C after microwave ablation in hepatocellular carcinoma. *Int J Hyperthermia* 2011; 27(2):132-9.
120. Zhou P, Liang P, Yu X et al. Percutaneous microwave ablation of liver cancer adjacent to the gastrointestinal tract. *J Gastrointest Surg* 2009; 13(2):318-24.
121. Zhou W, Zha X, Liu X et al. US-guided percutaneous microwave coagulation of small breast cancers: a clinical study. *Radiology* 2012; 263(2):364-73.
122. Ziemlewicz TJ, Hinshaw JL, Lubner MG et al. Percutaneous microwave ablation of hepatocellular carcinoma with a gas-cooled system: initial clinical results with 107 tumors.. *J Vasc Interv Radiol*, 2014 Dec 3;26(1).

POLICY HISTORY:

Adopted for Blue Advantage, October 2012

Available for comment October 24 through December 10, 2012

Medical Policy Group, June 2013

Medical Policy Group, October 2013

Medical Policy Group, January 2015

Medical Policy Group, March 2016

Medical Policy Group, September 2017

Medical Policy Group, December 2017

Medical Policy Group, September 2018 **(4)**: Updates to Key Points and Governing Bodies. No change to policy statement.

Medical Policy Group, October 2019. Available for comment October 4 through November 18, 2019

Medical Policy Group, September 2020

Medical Policy Group, October 2020

This medical policy is not an authorization, certification, explanation of benefits, or a contract. Eligibility and benefits are determined on a case-by-case basis according to the terms of the member's plan in effect as of the date services are rendered. All medical policies are based on (i) research of current medical literature and (ii) review of common medical practices in the treatment and diagnosis of disease as of the date hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield's administration of plan contracts.