Kansas City

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Microwave Tumor Ablation

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Origination: 1/2012
Last Review: 1/2014
Next Review: 1/2015

Policy

Blue Cross and Blue Shield of Kansas City (Blue KC) will not provide coverage for microwave tumor ablation. This is considered investigational.

When Policy Topic is covered

Not Applicable

When Policy Topic is not covered

Microwave ablation of primary and metastatic tumors is considered **investigational**.

Considerations

There are no CPT codes specific to microwave ablation.

According to a 2012 American Medical Association publication (*Clinical Examples in Radiology*, Vol. 8, Issue 3; Summer 2012), "microwave is part of the radiofrequency spectrum, and simply uses a different part of the radiofrequency spectrum to develop heat energy to destroy abnormal tissue." Therefore, they instruct that microwave ablation should be reported using the CPT codes for radiofrequency ablation – 32998 (pulmonary), 47382 (liver), and 50592 (renal).

If there is no specific CPT code for ablation, the unlisted CPT code for the anatomic area should be reported such as code 60699 for unlisted procedure, endocrine system (for adrenal or thyroid ablation).

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 or 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.

Background

Microwave ablation (MWA) is a technique in which the use of 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 1 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.

Complications from MWA are usually considered mild and 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.

MWA is an ablative technique similar to radiofrequency or cryosurgical ablation. However, MWA has some potential hypothetical 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.

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 hyperspleenism, 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).

Hepatic Tumors. Hepatic tumors can arise either as primary liver cancer (hepatocellular cancer) or by metastasis to the liver from other primary cancer sites. 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. At present, surgical resection with adequate margins or liver transplantation constitutes the only treatments available with demonstrated curative potential. Partial liver resection, hepatectomy, is considered the gold standard. However, the majority of hepatic tumors are unresectable at diagnosis, due either to their anatomic location, size, number of lesions, or underlying liver reserve.

Various locoregional therapies for unresectable liver tumors have been investigated including: microwave coagulation, radiofrequency ablation, cryosurgical ablation (cryosurgery), laser ablation, trans-hepatic artery embolization/chemoembolization (TACE), percutaneous ethanol injection, and radioembolization (Yttrium-90 microspheres).

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 hoped that MWA will reduce the incidence of tumor progression while awaiting transplantation and thus maintain a patient’s candidacy for liver transplant during the wait time for a donor organ.

Renal Cell Carcinoma. Radical nephrectomy remains the principal treatment of renal cell carcinoma, however, partial nephrectomy or nephron-sparing surgery has been shown to be as effective as radical nephrectomy, with comparable long-term recurrence-free survival rates, in a select group of patients. Prognosis drops precipitously if the tumor extends outside the kidney capsule, since chemotherapy is relatively ineffective against metastatic renal cell carcinoma. Alternative therapies such as MWA are of interest in patients with small renal tumors when preservation of renal function is necessary (e.g., in patients with marginal renal function, a solitary kidney, bilateral tumors) and in patients with comorbidities that would render them unfit for surgery. Another consideration would be in patients at high risk of developing additional renal cancers (as in von Hippel-Lindau disease).

Regulatory Status

There are several devices cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process for MWA. Covidien's (a subsidiary of Tyco Healthcare) Evident Microwave Ablation System has 510(k) clearance for soft tissue ablation, including partial or complete ablation of non-resectable liver tumors. The following devices have 510(k) clearance for MWA of (unspecified) soft tissue:

- BSD Medical Corporation's MicroThermX Microwave Ablation System (MTX-180);
- Valleylab's (a subsidiary of Covidien) VivaWave Microwave Ablation System;
- Vivant's (acquired by Valleylab in 2005) Tri-Loop Microwave Ablation Probe;
- MicroSurgeon Microwave Soft Tissue Ablation Device;
- Microsulis Medical's Acculis Accu2i; and
- NeuWave Medical's Certus 140

These devices are considered substantially equivalent to previously FDA-approved radiofrequency and MWA devices.

This policy does not address MWA for the treatment of splenomegaly or ulcers or as a surgical coagulation tool.

Rationale

The policy was developed with a literature search of the MEDLINE database for the period of October 2012 through August 2013. The findings of the literature search are summarized below with select studies.

Literature Review

Breast

A 2010 review of ablation techniques by Z. Zhao, et al. for breast cancer found only 0-8% of breast tumors were completely ablated with microwave ablation (MWA). (1) The authors noted the studies identified for the review were mostly feasibility and pilot studies conducted in research settings. In 2012, W. Zhou and colleagues reported on 41 patients treated with MWA directly followed by mastectomy for single breast tumors with a mean volume of 5.26 cm ± 3.8 (range: 0.09–14.14 cm). (2) Complete tumor ablation was found by microscopic evaluation in 37 of the 41 tumors ablated (90%; 95% confidence interval [CI]: 76.9-97.3%). Reversible thermal injuries to the skin and pectoralis major muscle occurred in 3 patients.

Hepatocellular Carcinoma

The literature search identified many publications on studies of MWA for hepatocellular carcinoma (HCC), primarily small case series and retrospective reviews conducted in China and Japan. Only two studies were indexed in the PubMed database as randomized clinical trials. (3, 4) No randomized controlled trials (RCTs) comparing the use of MWA for HCC to the gold standard of surgical resection were identified. The following summarizes 2 systematic reviews (5, 6) and select studies reporting on 25 or more patients. All of the studies demonstrated that the technique of MWA provided good tumor ablation (87-100% ablation of targeted tumors) with low procedural complication rates. Associated morbidity and mortality, as well as overall survival and disease-free survival rates with MWA are similar

to radiofrequency ablation (RFA), which would be an appropriate comparator in patients with tumors not amenable to surgical resection. However, only one RCT comparing MWA directly to radiofrequency ablation was identified. (3)

In 2009, Ong and colleagues conducted a systematic review of studies on MWA for primary and secondary liver tumors. (5) Based on the results from 25 clinical studies reporting outcomes on MWA, the authors concluded MWA is an effective and safe technique for liver tumor ablation with low complication rates and survival rates comparable to hepatic resection. However, rates of local recurrence after MWA were noted to be higher than hepatic resection. In most studies, HCC recurrence rates were approximately 10% but were also noted to be as high as 50%, which the authors indicated can be addressed with further ablation. Survival rates in the studies on MWA for HCC were as high as 92% at 3 years and 72% at 5 years, which was noted to be comparable to RFA and percutaneous ethanol injections. Pain and fever were the most frequently reported complications, but complications increased when there were more tumors, larger tumors, and more microwave antennas used. Ong and colleagues concluded MWA is a promising treatment option for the treatment of liver tumors but should be reserved for patients not amenable to hepatic resection. The authors also noted further randomized clinical trials are warranted to compare MWA to other ablation procedures. Bertot and colleagues conducted a systematic review in 2011 of ablation techniques for primary and secondary liver tumors. (6) This review included 2 studies using MWA totaling 1,185 patients. (7, 8) The pooled mortality rate for MWA was 0.23% (95% CI: 0.0-0.58%). Major complication rates were 4.6% for MWA (calculated by using a random effects model, since there was significant heterogeneity). The authors concluded percutaneous ablation techniques, including MWA, are safe and have acceptable complication rates for the treatment of liver tumors.

In 2002, Shibata and colleagues reported on 72 consecutive patients with 94 small HCC nodules randomized by sealed envelopes to receive either percutaneous MWA or radiofrequency ablation performed by a single surgeon. (3) No significant differences were identified between the 2 treatment group characteristics, e.g., sex, age, nodule size, Child-Pugh cirrhosis class and number of nodules. In the radiofrequency ablation group, complete therapeutic effect was seen in 46 (96%) of 48 nodules (mean size 2.3 cm, range: 1.0–3.7) versus 41 (89%) of 46 nodules (mean size 2.2 cm, range: 0.9–3.4) treated with percutaneous MWA (p=0.26). Treatment outcomes were not significantly different between the percutaneous MWA and radiofrequency ablation groups in the rates of untreated disease during a follow-up range of 6-27 months (8 of 46 nodules vs. 4 of 48 nodules, respectively), and major complication rates (4 vs. 1, respectively). Major complications included one case of segmental hepatic infarction in the RFA group. In the MWA group, major complications included one case of each of the following: liver abscess, cholangitis with intrahepatic bile duct dilatation, subcutaneous abscess with skin burn and subcapsular hematoma. Life-threatening complications were not experienced. The number of treatment sessions required per nodule in the radiofrequency ablation group was significantly lower than in the percutaneous MWA group (1.1 vs. 2.4; p<0.001). However, treatment time per session was significantly shorter in the MWA group (33 minutes ± 11) than the radiofrequency ablation group (53 minutes ± 16).

Taniai and colleagues, in 2006, reported on 30 patients with multiple HCC tumors who underwent reduction hepatectomy with postoperative transcatheter arterial embolization. (4) Prior to surgery, patients were randomly assigned to receive no intraoperative adjuvant therapy (n=15) or intraoperative adjuvant therapy with either MWA (n=10) or RFA (n=5) of satellite lesions. No significant differences in characteristics were identified between the two treatment groups of no intraoperative adjuvant therapy vs. intraoperative adjuvant therapy, e.g., sex, age, nodule size (maximum tumor size 42.7 mm ± 23.5 vs. 37.8 mm ± 16, respectively), Child-Pugh cirrhosis class and number of nodules. Cumulative survival rates at 3 and 5 years were not significantly different in the group that did not receive intraoperative adjuvant therapy (35.0% and 0%, respectively) versus the intraoperative adjuvant therapy group (35.7% and 7.7%, respectively). A-fetoprotein, number of tumors, maximum tumor size and clinical stage, but not intraoperative adjuvant therapy, were identified as independent prognostic survival factors.

In April 2011, Simo and colleagues retrospectively compared laparoscopic MWA (13 patients with 15 tumors) to radiofrequency ablation (22 patients with 27 tumors) performed by a single surgeon for the treatment of HCC. (9) No significant differences were identified between the two treatment group characteristics except for sex (54% vs. 86% male, respectively). Average tumor size was 2.31 cm in the MWA group versus 2.53 cm in the radiofrequency ablation group. The authors reported average tumor ablation volumes were not significantly different at 28.99 cm for MWA and 23.43 cm for radiofrequency ablation. In the MWA group, at a mean follow-up of 7 months, disease-free survival was 54%, with 2 patients having received liver transplants, 31% having disease progression and 15% deceased. The RFA group was followed for a longer period of time at a mean of 19 months. This group experienced 50% survival without evidence of disease, with 4 patients having received liver transplants, 9% having disease progression, 36% deceased, and 5% lost to follow-up. Operative times were shorter in the MWA group (112 ± 40 vs. 149 ± 35 minutes). In 2013, Ding et al. also reported on a retrospective comparison of 113 patients treated with MWA for 131 HCC tumors and 85 patients treated with radiofrequency ablation (RFA) for 98 HCC tumors. (10) Rates of complete ablation, local recurrence, disease-free and cumulative survival (at 1, 2, 3, and 4 years), and major complications were not significantly different between groups. In another 2013 study by Ding et al., complications were retrospectively compared between 556 patients treated with MWA for 1,090 tumors (491 HCC, 18 cholangiocarcinoma, and 47 liver metastases) and 323 patients treated with RFA for 562 liver tumors (279 HCC, 6 cholangiocarcinoma, and 38 liver metastases). (11) Rates of death (2 of 556 MWA and 1 of 323 RFA patients), major complications and minor complications did not differ significantly between MWA and RFA groups.

In 2011, Zhou and colleagues prospectively evaluated percutaneous MWA for HCC in 215 patients with tumors equal to or less than 60 mm (median size 29 mm) in a single center, Phase II study. (12) The authors reported technical effectiveness in all patients. Overall survival rates at 1, 2, 3, 4 and 5 years were 94%, 82.9%, 66%, 54.1% and 44.4%, respectively, and median survival time was 40 months (range: 4–106 months). Complications related to the procedure included 3 cases of pleural effusion and one case of bile duct injury. In another prospective study by Zhou et al. in 2009, percutaneous MWA was performed on 124 patients with 144 HCC lesions and 28 patients with 35 lesions of hepatic metastases. (13) Included in this total of 152 patients were 59 patients with 61 lesions (mean size 27 mm) located less than 5 mm from the gastrointestinal tract and 93 patients with 126 lesions (mean size 24 mm) located more than 5 mm from the gastrointestinal tract. For lesions less than 5 mm from the gastrointestinal tract, the temperatures of the margins were monitored closely during ablation and to prevent thermal injury, ethanol injections were placed into marginal tumor tissue in 33 lesions that were protruding or in contact with the gastrointestinal tract. No procedural complications were noted; however, tumor seeding occurred in 3 patients. Complete ablation was achieved in 47 of 53 lesions (88.7%) in the group with tumors near the gastrointestinal tract and in 116 of the other 126 lesions (92.1%) as confirmed by imaging during the follow-up period ranging from 3-32 months. Local tumor progression occurred in 16 tumors during 1-9 months' follow-up. Separate treatment outcomes for hepatocellular tumors and hepatic metastasis were not provided.

Lu and colleagues, in 2005, reported on a retrospective comparison of 102 patients with HCC treated with either percutaneous MWA (49 patients with 98 nodules; mean size 2.5 cm) or radiofrequency ablation (53 patients with 72 nodules, mean size 2.6 cm). (7) Patient follow-up was 25.1 months in the MWA group and 24.8 months in the radiofrequency ablation group. Complete ablation was not significantly different in the treatment groups and was achieved in 93 of 98 tumors (94.9%) in the MWA group and in 67 of 72 tumors (93.1%) in the radiofrequency ablation group. However, complete ablation rates increased in tumors less than or up to 3 cm in size to 98.6% (73 of 74) in the MWA group and 98% (50 of 51) in the radiofrequency ablation group. In tumors greater than 3 cm, complete ablation rates decreased to 83.3% (20 of 24) in the MWA group and 81% (17 of 21) in the radiofrequency ablation group. There were also no significant differences found in the MWA group versus the radiofrequency ablation group in rates of local tumor recurrence (11.8% vs. 20.9%, respectively), major complications (8.2% vs. 5.7%, respectively) or disease-free survival at 1, 2 and 3 years (45.9%, 26.9% and 26.9% vs. 37.2%, 20.7%, and 15.5%, respectively).

In 2012, Takami and colleagues reported on 719 patients treated with intraoperative MWA for HCC (HCC) (mean tumor size 26.9mm) at a single institution. (14) The overall survival rates were 97.7% at 1 year, 62.1% at 5 years, and 34.1% at 10 years. Overall survival rates for 390 patients with 3 or fewer tumors measuring 3 cm or less were 97.9% at 1 year, 70.0% at 5 years, and 43.0% at 10 years. When MWA results were compared to 34 patients treated at the same institution with hepatic resection, overall survival, disease-free survival, and local recurrence rates were not significantly different.

In 2009, Liang et al. reported on a retrospective review of complications experienced with percutaneous MWA for the treatment of 1,928 malignant liver tumors in 1,136 patients at a single institution. (8) Each patient received an average of 1.8 treatment sessions for a total of 3,697 treatment sessions. Thirty patients (2.6%) experienced major complications, which included 5 cases of liver abscess and empyema, 2 bile duct injuries, 2 colon perforations, 5 tumor seedings, 12 pleural effusions requiring thoracentesis, 1 hemorrhage requiring arterial embolization, and 3 skin burns requiring resection for a total of 30 (2.6%) patient complications. Two deaths occurred within 30 days after MWA in patients with Child class B uncompensated cirrhosis. One patient (age 78) had multi-organ failure and died 14 days after treatment and another patient (age 83) had respiratory and cardiac failure and died 14 days after treatment. Minor complications included fever (83.4%), pain (80.1%), asymptomatic pleural effusion (10.4%), thickening of the gallbladder wall (2.8%), and arterioportal shunt (0.3%), small stricture of the bile duct (0.4%), and skin burn requiring no treatment (1.6%). A significantly higher rate of major complications and more ablation sessions were experienced when a noncooled-shaft antenna was used during the period of 1994 to 2005 (n=583) than with newer technology; cooled-shaft antennas were used beginning in 2005 (n=583). In a report on needle-track seeding from this same institution, Yu and colleagues followed 1,462 patients treated with percutaneous MWA for 2,530 liver tumors over a 14-year period. (15) Twelve seeding nodules with a mean size of 2.3 ± 0.7 cm (range: 1.3–3.9 cm) were found in 11 patients within 6-37 months (median 10 months) after receiving MWA.

Hepatic Metastasis from Primary Cancers from Other Sites

The literature searches identified many small studies on MWA for hepatic metastases and 3 systematic reviews. (5, 6, 16) In the Ong review described above, local recurrence rates for liver metastases after treatment with MWA averaged approximately 15% but varied between 0 and 50% in the 7 studies reviewed that addressed liver metastases. As noted above, Ong and colleagues concluded MWA is a promising treatment option for the treatment of liver tumors but should be reserved for patients not amenable to hepatic resection. Bertot and colleagues conducted a systematic review, also described above. (6) In 2011, Pathak and colleagues conducted a systematic review of ablation techniques for colorectal liver metastases, which included 13 studies on MWA totaling 406 patients with a minimum of 1-year follow-up. (16) Mean survival rates were 73%, 30% and 16% and ranged from 40–91.4%, 0–57% and 14–32% at 1-, 3- and 5-years' follow-up, all respectively. Minor and major complication rates were considered acceptable and ranged from 6.7–90.5% and 0–19%, respectively. Local recurrence rates ranged from 2-14%. The authors acknowledged limitations in the available studies but concluded survival rates for MWA are more favorable than for palliative chemotherapy alone.

Only one RCT comparing the use of MWA for hepatic metastases to the gold standard of surgical resection was identified. In 2000, Shibata et al. reported on a trial of 30 patients with hepatic metastases from colorectal cancer randomly assigned without stratification to treatment with either MWA after laparotomy (n=14) or hepatectomy (n=16). (17) The study began with 40 patients, but 10 patients were excluded because the researchers discovered intraoperatively that these patients did not meet study criteria due to having extensive metastasis or equal to or greater than 10 tumors. The treatment groups of MWA versus hepatectomy were not significantly different in age (mean age 61 in both groups) number of tumors (mean 4.1 vs. 3.0, respectively) or tumor size (mean 27 mm vs. 34 mm, respectively). The authors reported no significant differences in survival rates following MWA or hepatectomy (27 months vs. 25 months, respectively) and mean disease-free survival (11.3 vs. 13.3 months, respectively). However, intraoperative blood loss was significantly lower and no blood transfusions were required in the MWA group, whereas 6 patients in the hepatectomy group required blood transfusions. Complications in the microwave group consisted of one hepatic abscess and one

bile duct fistula. In the hepatectomy group, complications were one intestinal obstruction, one bile duct fistula and one wound infection.

In 2011, Lorentzen and colleagues reported on a retrospective review of percutaneous or open MWA in 39 patients with 125 liver metastases from the primary sites of colorectal cancer (n=31), breast cancer (n=6), carcinoid tumor (n=1), and gastrointestinal stromal tumor (n=1). (18) Complete ablation was achieved in 100% of tumors (median size of 1.5 cm) with one treatment session in 34 patients, 2 sessions for 4 patients, and 3 sessions for one patient. One case of liver abscess, which resolved after percutaneous drainage, was the only major complication reported. Four minor complications included one incidence of ascites and 3 complaints of puncture site pain. Upon median follow-up of 11 months, local tumor progression was seen in 12 of 125 tumors (9.6%) in 10 of the 39 patients (26%).

In a prospective, single institution Phase II study in 2010, Martin et al. reported on 100 patients treated with 270 open or laparoscopic MWAs for HCC (n=17) and liver metastases from the primary sites of colorectal (n=50), carcinoid (n=11) and other cancers (n=22 and included cholangiocarcinoma, metastatic breast, renal cell carcinoma, bladder, carcinoid, melanoma, and sarcoma). (19) Median tumor size was 3.0 cm. Thirty-eight patients were treated with MWA alone, 53 patients had MWA with concomitant hepatic resection while another 9 patients had MWA concomitant with other organ resection. Only 2 patients had incomplete ablations after the procedure. No bleeding complications were experienced, but 2 cases of hepatic abscess and 2 cases of hepatic insufficiency occurred. At median follow-up of 36 months, 5 patients were found to have incomplete ablations and only 2 patients (2%) had local tumor recurrence, while 37 patients (37%) developed recurrence at other nonablated sites.

In 2013, Liu et al. reported on 35 patients treated with MWA for 62 tumors and 54 patients treated with RFA for 70 tumors from liver metastases. (20) Ablation was complete in 88.6% (117 of 132) of tumors and was not significantly different between tumor types: 86.2% for metastatic colorectal cancer (56/65) and 91% for other metastatic disease 61/67). Nor was there a significant difference between MWA and RFA in the complete ablation rate. Tumors 3.0 cm or less were completely ablated significantly more often than tumors greater than 3.0 cm (93.5 vs. 66.7%, p=0.001).

Lung

Several studies have reported experience using MWA for lung tumors. (21-23) In 2012, Lu and colleagues reported on a retrospective review of 69 patients treated with MWA for inoperable lung cancer or metastatic pulmonary metastases. (24) Overall survival rates for patients with pulmonary metastases at 1 year, 2 years, and 3 years were 47.6%, 23.8%, and 14.3%, respectively. The recurrence-free survival rates for patients with non-small-cell lung cancer at 1 year, 2 years, and 3 years were 72.9%, 50.0%, and 27.1%, respectively. Overall survival rates were 66.7% at 1 year, 44.9% at 2 years, and 24.6% at 3 years. No deaths occurred within 30 days of the procedure; however, pneumothorax occurred in 24.64%. In 2012, Belfiore et al. reported on a retrospective review of 56 patients treated with MWA for inoperable lung cancer or metastatic pulmonary metastases. (25) Disease-specific survival rates were 69% at 1 year, 54% at 2 years, and 49% at 3 years. Pneumothorax was reported in 18 patients (32.12%). In 2011, Vogl et al. reported on a prospective study of 80 patients treated with MWA for inoperable pulmonary metastases. (26) Survival rates were 91.3% at 1 year and 75% at 2 years. No deaths occurred within 60 days of the procedure; however, pneumothorax occurred in 11 of 130 MWA sessions (8.5%), and pulmonary hemorrhage occurred in 8 of 130 sessions (6.2%).

Primary Renal Tumors

In 2012, Guan and colleagues reported on a prospective randomized study to compare the use of MWA to partial nephrectomy (the gold standard of nephron-sparing surgical resection) for solitary renal tumors less than 4 cm. (27). Forty-eight patients received MWA and 54 had partial nephrectomy. Patients in the MWA group had significantly fewer postoperative complications than the partial nephrectomy group (6 [23.5%] vs. 18 [33.3%]; p=0.0187). MWA patients also had significantly less postoperative renal function declines (p=0.0092) and estimated perioperative blood loss (p=0.0002) than partial nephrectomy patients. At last follow-up, estimated glomerular filtration rate declines in both

groups were similar (p=1.0000). Disease-specific deaths did not occur and overall local recurrence-free survival by Kaplan-Meier estimates at 3 years were 91.3% for MWA and 96.0% for partial nephrectomy (p= 0.5414). Longer follow-up is needed.

Several small case studies on renal tumors have been reported. In 2012, Yu and colleagues reported on a retrospective review of 46 patients treated with MWA for renal cell carcinoma. (28) Complete ablation occurred in 98% of tumors (48 of 49), which had a mean tumor size of 3.0 cm ± 1.5. At a median follow-up of 20.1 months, all 46 patients were metastasis-free. Overall survival rates were 100% at 1 and 2 years and 97.8% at 3 years.

In 2011, Muto and colleagues reported complete tumor coagulation necrosis in 10 patients treated with laparoscopic MWA for clear cell renal carcinoma with a median tumor size of 2.75 cm. (29) Depending on tumor size, the microwave antennas were used 1 to 3 times for a mean application time of 14.1 minutes. No complications were reported during or after the procedure. Bai et al. in 2010, reported complete laparoscopic MWA in 17 of 18 clear cell renal carcinoma tumors with a mean tumor size of 2.8 cm. (30) In this study, evidence of disease progression was not found in any of the patients followed up for a median of 20 months including the patient with an incomplete ablation who was followed for 31 months. Complications reported were mild (18.2%), and renal function did not significantly deteriorate. However, in a 2011 study of 10 patients with solid-enhancing renal tumors (median size of 3.65 cm), treated with laparoscopic (n=7) or percutaneous (n=3) MWA, Castle and colleagues reported tumor recurrence was seen in 3 of 8 tumors upon mean follow-up time of 17.9 months. (31) Since tumor size was larger in this study, mean ablation time was 21 minutes. Additionally, 20% of patients experienced intraoperative complications while 40% experienced postoperative complications including, perinephric hematoma, splenic capsular tear, pleuritic chest pain, skin burn, fever, hematuria, genitofemoral neuralgia, and urinoma.

In another study, Guan and colleagues reported on the safety of retroperitoneoscopic MWA for renal hamartoma in 2010. (32) In this case series report, 15 of 16 patients had complete tumor ablation. Disease recurrence was not found in all 16 patients at a median follow-up of 16 months.

Other Tumors or Conditions

No RCTs on the use of MWA for other tumors or conditions were identified. Case studies and retrospective reviews on MWA for adrenal carcinoma, (33) metastatic bone tumors, (34) intrahepatic primary cholangiocarcinoma, (35) benign thyroid tumors, (36) and other nononcologic conditions (i.e., bleeding peptic ulcers, esophageal varices, secondary hypersplenism) were identified.

Ongoing Clinical Trials

A September 13, 2013 search of online site ClinicalTrials.gov identified one randomized trial on MWA. In this Phase III, prospective RCT, MWA will be compared to radiofrequency ablation in the treatment of unresectable hepatocellular carcinoma no more than 6 cm in diameter (NCT01340105). Patients may only have up to 3 nodules that are amenable to ablation and do not have any major vascular or bile duct invasion. Patients with resectable tumors may be included in the study if local ablation is preferred. The trial began in April 2011 in Hong Kong, China and expects to recruit 92 patients. This study is expected to be completed in April 2016.

Clinical Input Received through Physician Specialty Societies and Academic Medical Centers

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

2011

In response to requests, input was received from 2 physician specialty societies (3 reviews) and 4 academic medical centers (6 reviews) while this policy was under development. Eight reviewers considered microwave ablation investigational to treat primary tumors such as hepatocellular

carcinoma, benign and malignant renal tumors, lung tumors, adrenal tumors or cholangiocarcinoma. The reviewers noted insufficient evidence and a need for further studies on microwave ablation. However, 1 reviewer indicated microwave ablation for primary tumors including, but not limited to hepatocellular carcinoma, benign and malignant renal tumors, lung tumors, adrenal tumors and cholangiocarcinoma, may be considered a treatment option and 1 other reviewer indicated microwave ablation for renal tumors may be considered a treatment option.

Four reviewers considered microwave ablation investigational to treat liver metastases. However, 2 reviewers indicated microwave ablation for liver metastases may be considered a treatment option. One reviewer noted microwave ablation may be appropriate for tumors not amenable to radiofrequency ablation or other local treatments. This reviewer also indicated microwave ablation may be more appropriate for tumors located near large blood vessels.

Summary

Based on review of the published data (which consist largely of small case series and limited randomized trials) and clinical input, there is insufficient evidence to permit conclusions concerning the comparative effectiveness of microwave ablation (MWA) to other ablative techniques on health outcomes. Therefore, MWA of hepatocellular carcinoma, liver metastases from primary cancers from other sites, renal cell carcinoma, other renal tumors and all other tumors is considered investigational. Studies show MWA results in a wide range of complete tissue ablation (from 50–100%) depending on tumor size with complete ablation common and nearing 100% with smaller tumors (e.g., ≤3 cm). Recurrence of tumors at ablated sites is very low. However, recurrence of tumors at nonablated sites is common and may be due to the nature of the disease state (e.g., in hepatocellular carcinoma). Intraoperative and postoperative minor and major complications are low, especially in cases where tumors are smaller and more accessible. While some earlier studies found MWA required more treatment sessions to achieve adequate ablation, more recent studies using newer MWA technology that deliver larger ablation zones with cooled-shaft antennas have demonstrated shorter ablation times and fewer complications. While MWA has theoretical advantages over radiofrequency ablation, studies on the use of MWA with larger numbers of patients and longer follow-up are needed to adequately assess health outcomes. Patient selection criteria and rationale for using MWA over other established techniques such as surgical resection or radiofrequency ablation are needed. Results of the ongoing Phase III trial comparing MWA to radiofrequency ablation will provide additional information in determining the role of MWA in the treatment of hepatocellular carcinoma. Information from additional future studies may indicate a role for MWA for the treatment of tumors for control of local tumor growth, palliation of symptoms, and extended survival durations in tumors that are not amenable to resection or in patients who are not surgical candidates. However, in total, the current available evidence is insufficient to permit conclusions on net health outcomes of MWA of tumors, and this technique is considered investigational.

Practice Guidelines and Position Statements

The National Comprehensive Cancer Network (NCCN) guidelines on hepatobiliary cancers 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. (37) Ablation should only be considered when tumors are accessible by percutaneous, laparoscopic or open approaches The guidelines indicate hepatocellular carcinoma tumors equal to or less than 3 centimeters may be curatively treated with ablation alone. Hepatocellular carcinoma tumors between 3-5 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, there are only 2 reviews cited in the guideline on ablative techniques to support these recommendations, but these reviews are not specific to MWA [category 2A].

In the NCCN guidelines on neuroendocrine tumors, MWA is listed as one treatment option (along with radiofrequency ablation or cryoablation) for liver metastases as hepatic regional therapy in carcinoid

tumors and pancreatic endocrine (islet cell) tumors when there is unresectable disease and/or distant metastases. (38) These guidelines note, currently, there are limited prospective data and no randomized clinical trials on ablative therapies (including MWA), and data on these ablative techniques are emerging. Additionally, the 2 articles cited in the guideline on ablative techniques are not specific to MWA [category 2B].

The National Institute for Health and Clinical Excellence (NICE) published updated guidance on MWA for the Treatment of Metastases in the Liver in August 2011. (39) This guidance indicates “Current evidence on microwave ablation for the treatment of liver metastases raises no major safety concerns. The evidence on efficacy is inadequate in quantity and quality. Therefore this procedure should only be used with special arrangements for clinical governance, consent and audit or research.” NICE also published guidance on MWA for hepatocellular cancer in 2007. (40) This guidance indicates “Current evidence on the safety and efficacy of microwave ablation 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 states there are no major concerns regarding the efficacy of MWA but notes there is limited long-term survival data available.

The American College of Chest Physicians (ACCP) evidence-based guidelines on the treatment of non-small-cell lung cancer note that insufficient data are available on ablative therapies including MWA of tumors. (41)

Medicare National Coverage
No national coverage determination.

References

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.

13. 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.
14. 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.
15. 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.
16. Pathak S, Jones R, Tang JM et al. Ablative therapies for colorectal liver metastases: a systematic review. Colorectal Dis 2011; 13(9):e252-65.
17. Shibata T, Niinobu T, Ogata N et al. Microwave coagulation therapy for multiple hepatic metastases from colorectal carcinoma. Cancer 2000; 89(2):276-84.
18. 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.
19. 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.
20. 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.
21. 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.
22. 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.
23. He W, Hu XD, Wu DF et al. Ultrasonography-guided percutaneous microwave ablation of peripheral lung cancer. Clin Imaging 2006; 30(4):234-41.
24. 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.
25. 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.
26. 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.
27. 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.
28. 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.
29. 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.
30. 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.
31. 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.
32. Guan W, Bai J, Hu Z et al. Retroperitoneoscopic microwave ablation of renal hamartoma: middle-term results. J Huazhong Univ Sci Technol Med Sci 2010; 30(5):669-71.
33. 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.
34. 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.
35. 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.
36. 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; 82(1):e11-6.
37. National Comprehensive Cancer Network. Hepatobiliary Cancers. Clinical practice guidelines in oncology, v.2.2013 Available online at: http://www.nccn.org/professionals/physician_gls/pdf/hepatobiliary.pdf

38. National Comprehensive Cancer Network. Neuroendocrine Tumors. Clinical practice guidelines in oncology, v.1.2013 Available online at: http://www.nccn.org/professionals/physician_gls/pdf/neuroendocrine.pdf
39. National Institute for Clinical Excellence (NICE). Microwave Ablation for the Treatment of Metastases in the Liver. 2011. Available online at: http://www.nice.org.uk/nicemedia/live/11333/56036/56036.pdf
40. National Institute for Clinical Excellence (NICE). Microwave Ablation of Hepatocellular Carcinoma. 2007. Available online at: http://publications.nice.org.uk/microwave-ablation-of-hepatocellular-carcinoma-ipg214
41. 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.

Billing Coding/Physician Documentation Information

32998	Ablation therapy for reduction or eradication of 1 or more pulmonary tumor(s) including pleura or chest wall when involved by tumor extension, percutaneous, radiofrequency, unilateral
47382	Ablation, 1 or more liver tumor(s), percutaneous, radiofrequency
50592	Ablation, 1 or more renal tumor(s), percutaneous, unilateral, radiofrequency
76940	Ultrasound guidance for, and monitoring of, parenchymal tissue ablation

Additional Policy Key Words

N/A

Policy Implementation/Update Information

1/1/12	New policy; considered investigational.
1/1/13	No policy statement changes.
1/1/14	No policy statement changes.