Medical Coverage Policy | Radiofrequency Ablation of Miscellaneous Solid Tumors Excluding Liver Tumors

EFFECTIVE DATE: 03|01|2023
POLICY LAST UPDATED: 11|01|2023

OVERVIEW

In radiofrequency ablation (RFA), a probe is inserted into the center of a tumor and the noninsulated electrodes, which are shaped like prongs, are projected into the tumor; heat is then generated locally by a high-frequency, alternating current that flows from the electrodes. The local heat treats the tissue adjacent to the probe, resulting in a 3 cm to 5.5 cm sphere of dead tissue. The cells killed by RFA are not removed, but are gradually replaced by fibrosis and scar tissue. If there is local recurrence, it occurs at the edge and, in some cases, may be retreated. RFA may be performed percutaneously, laparoscopically, or as an open procedure.

MEDICAL CRITERIA

Medicare Advantage Plans and Commercial Products

RFA to treat an isolated peripheral non-small-cell lung cancer lesion that is no more than 3 cm in size is covered when both of the following criteria is met:

- Surgical resection or radiation treatment with curative intent is considered appropriate based on stage of disease, however, medical comorbidity renders the individual unfit for those interventions;
- Tumor is located at least 1 cm from the trachea, main bronchi, esophagus, aorta, aortic arch branches, pulmonary artery and the heart;

RFA to treat malignant nonpulmonary tumor(s) metastatic to the lung that are no more than 3 cm in size is covered when all of the following criteria is met:

- In order to preserve lung function when surgical resection or radiation treatment is likely to substantially worsen pulmonary status; OR when the individual is not considered a surgical candidate; and,
- There is no evidence of extrapulmonary metastases; and
- The tumor is located at least 1 cm from the trachea, main bronchi, esophagus, aorta, aortic arch branches, pulmonary artery and the heart; and,
- No more than 3 tumors per lung should be ablated; and,
- Tumors should be amenable to complete ablation; and,
- Twelve months should elapse before a repeat ablation is considered.

RFA as a palliative treatment for pain is covered when the following criteria is met:

- In patients with osteolytic bone metastases who have failed or are poor candidates for standard treatments such as radiation or opioids;

RFA as a treatment for osteoid osteomas is covered when the following criteria is met:

- The osteoid osteoma cannot be managed successfully with medical treatment;

PRIOR AUTHORIZATION

Medicare Advantage Plans and Commercial Products:

Prior authorization is recommended and obtained via the online tool for participating providers. See the Related Policies section.

POLICY STATEMENT

Radiofrequency ablation of tumors is covered for patients who meet the medical criteria listed above; all other indications outside the liver, including, but not limited to tumors of the breast, head and neck, thyroid, pancreas, adrenal gland, ovary and pelvic/abdominal metastases of unspecified origin are considered not covered for Medicare Advantage Plans and not medically necessary for Commercial Products as the evidence is insufficient to determine the effects of the technology on health outcomes.

COVERAGE

Benefits may vary between groups and contracts. Please refer to the appropriate Benefit Booklet, Evidence of Coverage or Subscriber Agreement for the applicable surgery benefits/coverage.

BACKGROUND

RFA is being evaluated to treat various tumors, including inoperable tumors, or to treat patients ineligible for surgery due to age, presence of co-morbidities, or poor general health. Goals of RFA may include (1) controlling local tumor growth and preventing recurrence; (2) palliating symptoms; and (3) extending survival duration for patients with certain tumors. The effective volume of RFA depends on the frequency and duration of applied current, local tissue characteristics, and probe configuration (e.g., single vs. multiple tips). RFA can be performed as an open surgical procedure, laparoscopically, or percutaneously, with ultrasound or computed tomography (CT) guidance.

Potential complications associated with RFA include those caused by heat damage to normal tissue adjacent to the tumor (e.g., intestinal damage during RFA of kidney), structural damage along the probe track (e.g., pneumothorax as a consequence of procedures on the lung), or secondary tumors if cells seed during probe removal.

RFA was initially developed to treat inoperable tumors of the liver. Recently, reports have been published on use of RFA to treat other tumors. For some of these, RFA is being investigated as an alternative to surgery for operable tumors. Well-established local or systemic treatment alternatives are available for each of these malignancies. The hypothesized advantages of RFA 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).

Osteoid Osteomas

Osteomas are the most common type of benign bone tumor, comprising 10% to 20% of benign and 2% to 3% of all bone tumors. They are typically seen in children and young adults, with most diagnosed in patients between 5 and 20 years of age. Osteomas are most common in the lower extremity (usually the long bones, mainly the femur) and less common in the spine. These tumors typically have a characteristic clinical presentation and radiologic appearance, with pain, usually continuous and worse at night, and usually relieved by aspirin or other nonsteroidal anti-inflammatory drugs (NSAIDs). The natural history of the osteoid osteoma varies based on its location, and although they rarely exceed 1.5 cm, may produce bone widening and deformation, limb length inequality, or angular deviations when near a growth plate. When located in the spine, these lesions may lead to painful scoliosis or torticollis. Sometimes they heal spontaneously after 3 to 7 years.

Treatment options include medical management with NSAIDs, surgical excision (wide/en bloc excision or curetting), or the use of CT- or magnetic resonance imaging (MRI)-guided minimally invasive procedures including core drill excision, laser photocoagulation, or RFA. For many years, complete surgical excision was the classic treatment of osteomas, usually performed in patients with pain, despite medical management. Complete surgical excision has several disadvantages. A substantial incision may be necessary and removal of a considerable amount of bone (especially in the neck of the femur) increases the need for bone grafting and/or internal fixation (which often necessitates a second procedure to remove the metal work). Other possible risks include avascular necrosis of the femoral head and postoperative pathologic fracture. In

addition, surgical excision leads to a lengthier period of convalescence and postoperative immobilization. Anatomically inaccessible tumors may not be completely resectable and may recur. RFA of osteoid osteoma is done with a needle puncture, so no incision or sutures are needed, and patients may immediately walk on the treated extremity and return to daily activities as soon as the anesthetic effect wears off. The risk of recurrence with RFA of an osteoma is 5% to 10%, and recurrent tumors can be retreated with RFA. In general, RFA is not performed in many spinal osteomas because of possible thermal-related nerve damage.

For individuals who have painful osteoid osteomas who receive RFA, the evidence includes numerous observational studies and systematic reviews of these studies. Relevant outcomes are symptoms, change in disease status, QOL, medication use, and treatment-related morbidity. In a systematic review of thermal ablation techniques, clinical success(pain-free) was achieved in 94% to 98% of patients. Most patients (89% to 96%) remained pain-free when assessed during longer-term follow-up. Another systematic review reported similar success rates noting an average 8.3% failure rate among patients receiving computed tomography-guided RFA. Although no randomized trials of RFA for osteoid osteomas have been performed, the uncontrolled studies have demonstrated RFA can provide adequate symptom relief with minimal complications, for a population for whom short-term symptom relief and avoidance of invasive procedures are appropriate clinical outcomes. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Palliation for Bone Metastases
After lung and liver, bone is the third most common metastatic site and is relatively frequent among patients with primary malignancies of the breast, prostate, and lung. Bone metastases often cause osteolysis (bone breakdown), resulting in pain, fractures, decreased mobility, and reduced quality of life. External beam irradiation often is the initial palliative therapy for osteolytic bone metastases. However, pain from bone metastases is refractory to radiotherapy in 20% to 30% of patients, while recurrent pain at previously irradiated sites may be ineligible for additional radiation due to risks of normal tissue damage. Other alternatives include hormonal therapy, radiopharmaceuticals such as strontium 89, and bisphosphonates. Less often, surgery or chemotherapy may be used for palliation, and intractable pain may require opioid medications. RFA has been investigated as another alternative for palliating pain from bone metastases.

For individuals who have painful osteolytic bone metastases who have failed or are poor candidates for standard treatments who receive RFA, the evidence includes a prospective cohort study and case series. Relevant outcomes are symptoms, change in disease status, quality of life (QOL), medication use, and treatment-related morbidity. A prospective cohort study and case series have shown clinically significant pain relief (defined as a decrease of 2 units from baseline on the Brief Pain Inventory scale) or reduction in opioid use following treatment of painful osteolytic metastases. A multicenter, prospective study reported significant reductions in pain through the 6-month follow-up period, with 59% of patients achieving immediate improvement in pain within 3 days of RFA. The population is comprised of patients with few or no treatment options, for whom short-term pain relief is an appropriate clinical outcome. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Primary Pulmonary Tumors
Surgery is the current treatment of choice in patients with stage 1 primary non-small-cell lung cancer (NSCLC; stage 1 includes 1a: T1N0M0 and 1b: T2N0M0). Approximately 20% of patients present with stage 1 disease, although this number is expected to increase as a result of screening programs, advances in imaging modalities, and widespread use of CT scans for other indications. Postsurgical recurrence rates of stage 1 NSCLC have been reported as between 20% and 30%, with most occurring at distant sites; locoregional recurrences occur in approximately 12%. Large differences in survival outcome are observed after surgery in stage 1 patients, with 5-year overall survival (OS) rates, ranging from 77% for small T1 tumors to 35% for large T2 tumors. Untreated, stage 1 NSCLC has a 5-year OS rate of 6% to 14%.

Patients with early stage NSCLC who are not surgical candidates may be candidates for radiotherapy with curative intent. In the 2 largest retrospective radiotherapy series, patients with inoperable disease treated with definitive radiotherapy achieved 5-year survival rates of 10% and 27%. In both studies, patients with T1N0 tumors had better 5-year survival rates of 60% and 32%, respectively. Stereotactic body radiotherapy (SBRT) has gained more widespread use, as it is a high-precision mode of therapy that allows for delivery of very high doses of radiation. Two- to 3-year local control rates of stage 1 NSCLC with SBRT have ranged from 80% to 95%. SBRT has been investigated in patients unfit to undergo surgery, with survival rates similar to surgical outcomes. RFA also is being investigated in patients with small primary lung cancers or lung metastases who are deemed medically inoperable.

For individuals who have inoperable primary pulmonary tumors or nonpulmonary tumors metastatic to the lung who receive RFA, the evidence includes prospective observational studies and systematic reviews of these studies. Relevant outcomes are OS, change in disease status, QOL, and treatment-related morbidity. A multicenter study found that for tumors less than 3.5 cm in size, RFA can lead to a complete response in as many as 88% of patients for at least 1 year. Two-year survival rates have been reported to range from 41% to 75% in case series, with 5-year survival rates of 20% to27%. In general, the evidence suggests that RFA results in adequate survival and tumor control in patients who are not surgical candidates, with low morbidity rates. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Breast Tumors
The treatment of small breast cancers has evolved from total mastectomy to more conservative treatment options such as lumpectomy, with more acceptable cosmetic outcomes and preservation of the breast. The selection of surgical approach balances the patient's desire for breast conservation and the need for tumor-free margins in resected tissue. Minimally invasive nonsurgical techniques such as RFA are appealing if they can produce local control and survival equivalent to breast-conserving surgical alternatives. Nonsurgical ablative techniques pose difficulties such as the inability to determine tumor size, complete tumor cell killing, and local recurrence. Additionally, RFA can cause burning of the skin or damage to muscle, possibly limiting use in patients with tumors near the skin or chest wall.

For individuals who have breast tumors who receive RFA, the evidence includes observational studies and systematic reviews of these studies. Relevant outcomes are overall survival, change in disease status, quality of life, and treatment-related morbidity. Evidence has reported varied and incomplete ablation rates with concerns about postablation tumor cell viability. Long-term improvements in health outcomes have not been demonstrated. Additionally, available studies do not permit comparisons with conventional breast-conserving procedures. Further studies, with long-term follow-up, should focus on whether RFA of the breast for small tumors can provide local control and survival rates comparable with conventional breast-conserving treatment. The evidence is insufficient to determine the effects of the technology on health outcomes.

Benign Thyroid Tumors
Surgical resection is the primary treatment choice for medically unresponsive, symptomatic benign thyroid tumors and thyroid carcinomas. However, techniques for ablation of thyroid tumors (e.g., RFA, microwave ablation) are being investigated.

For individuals who have benign thyroid tumors who receive RFA, the evidence includes RCTs, prospective studies, case series, and systematic reviews of these studies. Relevant outcomes are symptoms, change in disease status, quality of life, medication use, and treatment-related morbidity. Systematic reviews have demonstrated that RFA results in a significant reduction in thyroid nodule size with a 2020 review showing that these changes remain durable through at least 36 months. Complication rates are generally low, but include voice changes. The data are limited by significant heterogeneity in meta-analyses, a lack of generalizability to populations outside Republic of Korea and Italy, and a lack of comparators more relevant to practice in the United States. Further studies comparing RFA to PEI or surgery would be more

informative in determining the potential utility of RFA in patients with symptomatic or large benign thyroid tumors as these are the recommended treatment options per the American Thyroid Association. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Head and Neck Cancer
In patients with head and neck cancer with recurrent disease, surgical salvage attempts are poor in terms of local control, survival, and quality of life, and these recurrent tumors are often untreatable with standard salvage therapies. Palliative chemotherapy or comfort measures may be offered. The safety and efficacy of RFA has been investigated as an option for palliative treatment in these situations.

For individuals who have miscellaneous tumors (eg, head and neck, thyroid cancer, pancreas) who receive RFA, the evidence includes a few case series, prospective observational studies, and retrospective comparative studies. Relevant outcomes are overall survival, change in disease status, quality of life, and treatment-related morbidity. There is a limited evidence base for these tumor types. Reporting on outcomes or comparisons with other treatments is limited. These studies do not permit conclusions on the health benefits of RFA. The evidence is insufficient to determine the impact of the technology on health outcomes.

CODING

Medicare Advantage Plans and Commercial Products
The following codes are considered medically necessary when the criteria above has been met:

20982 Ablation therapy for reduction or eradication of 1 or more bone tumors (eg, metastasis) including adjacent soft tissue when involved by tumor extension, percutaneous, including imaging guidance when performed; radiofrequency

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, including imaging guidance when performed, unilateral; radiofrequency

There are no specific CPT codes for indications including, but not limited to tumors of the breast, head and neck, thyroid, pancreas, adrenal gland, ovary and pelvic/abdominal metastases of unspecified origin therefore the appropriate unlisted CPT code should be used.

RELATED POLICIES

Preauthorization via Web-Based Tool for Procedures

PUBLISHED

Provider Update, January 2024
Provider Update, January 2023
Provider Update, December 2021
Provider Update, January 2021
Provider Update, December 2019

REFERENCES

1. Jatoi I, Sung H, Jemal A. The Emergence of the Racial Disparity in U.S. Breast-Cancer Mortality. N Engl J Med. Jun 23 2022; 386(25): 2349-2352. PMID 35713541
2. Yedjou CG, Sims JN, Miele L, et al. Health and Racial Disparity in Breast Cancer. Adv Exp Med Biol. 2019; 1152:31-49. PMID 31456178
3. Levy J, Hopkins T, Morris J, et al. Radiofrequency Ablation for the Palliative Treatment of Bone Metastases: Outcomes from the Multicenter Osteo Cool Tumor Ablation Post-Market Study (OPuS One Study) in 100 Patients. J Vasc Interv Radiol. Nov 2020; 31(11): 1745-1752. PMID 33129427
4. Goetz MP, Callstrom MR, Charboneau JW, et al. Percutaneous image-guided radiofrequency ablation of painful metastases involving bone: a multicenter study. J Clin Oncol. Jan 15 2004; 22(2): 300-6. PMID 14722039

5. Gronemeyer DH, Schirp S, Gevargez A. Image-guided radiofrequency ablation of spinal tumors: preliminary experience with an expandable array electrode. Cancer J. Jan-Feb 2002; 8(1): 33-9. PMID 11898806
6. Kojima H, Tanigawa N, Kariya S, et al. Clinical assessment of percutaneous radiofrequency ablation for painful metastatic bone tumors. Cardiovasc Intervent Radiol. Nov-Dec 2006; 29(6): 1022-6. PMID 16988875
7. Tordjman M, Perronne L, Madelin G, et al. CT-guided radiofrequency ablation for osteoid osteomas: a systematic review. Eur Radiol. Nov 2020; 30(11): 5952-5963. PMID 32518986
8. Lanza E, Thouvenin Y, Viala P, et al. Osteoid osteoma treated by percutaneous thermal ablation: when do we fail? A systematic review and guidelines for future reporting. Cardiovasc Intervent Radiol. Dec 2014; 37(6): 1530-9. PMID 24337349
9. Albisinni U, Facchini G, Spinnato P, et al. Spinal osteoid osteoma: efficacy and safety of radiofrequency ablation. Skeletal Radiol. Aug 2017; 46(8): 1087-1094. PMID 28497160
10. Lassalle L, Campagna R, Corcos G, et al. Therapeutic outcome of CT-guided radiofrequency ablation in patients with osteoid osteoma. Skeletal Radiol. Jul 2017; 46(7): 949-956. PMID 28429047
11. Rimondi E, Mavrogenis AF, Rossi G, et al. Radiofrequency ablation for non-spinal osteoid osteomas in 557patients. Eur Radiol. Jan 2012; 22(1): 181-8. PMID 21842430
12. Sahin C, Oc Y, Ediz N, et al. The safety and the efficacy of computed tomography guided percutaneous radiofrequency ablation of osteoid osteoma. Acta Orthop Traumatol Turc. Sep 2019; 53(5): 360-365. PMID31371131
13. Knudsen M, Riishede A, Lucke A, et al. Computed tomography-guided radiofrequency ablation is a safe and effective treatment of osteoid osteoma located outside the spine. Dan Med J. May 2015; 62(5). PMID 26050823
14. Rosenthal DI, Hornicek FJ, Torriani M, et al. Osteoid osteoma: percutaneous treatment with radiofrequency energy. Radiology. Oct 2003; 229(1): 171-5. PMID 12944597
15. Liu SY, Chu CM, Kong AP, et al. Radiofrequency ablation compared with laparoscopic adrenalectomy for aldosterone-producing adenoma. Br J Surg. Oct 2016; 103(11): 1476-86. PMID 27511444
16. Schlijper RC, Grutters JP, Houben R, et al. What to choose as radical local treatment for lung metastases from colo-rectal cancer: surgery or radiofrequency ablation?. Cancer Treat Rev. Feb 2014; 40(1): 60-7. PMID 23768754
17. Ratko TA, Vats V, Brock J, et al. Local Nonsurgical Therapies for Stage I and Symptomatic Obstructive Non- Small-Cell Lung Cancer (Comparative Effectiveness Review No. 112). Rockville, MD: Agency for Healthcare Research and Quality; 2013.
18. Bilal H, Mahmood S, Rajashanker B, et al. Is radiofrequency ablation more effective than stereotactic ablative radiotherapy in patients with early stage medically inoperable non-small cell lung cancer?. Interact Cardiovasc Thorac Surg. Aug 2012; 15(2): 258-65. PMID 22581864
19. Chan VO, McDermott S, Malone DE, et al. Percutaneous radiofrequency ablation of lung tumors: evaluation of the literature using evidence-based techniques. J Thorac Imaging. Feb 2011; 26(1): 18-26. PMID 20829720
20. Huang L, Han Y, Zhao J, et al. Is radiofrequency thermal ablation a safe and effective procedure in the treatment of pulmonary malignancies?. Eur J Cardiothorac Surg. Mar 2011; 39(3): 348-51. PMID 20663679
21. Zemlyak A, Moore WH, Bilfinger TV. Comparison of survival after sublobar resections and ablative therapies for stage I non-small cell lung cancer. J Am Coll Surg. Jul 2010; 211(1): 68-72. PMID 20610251
22. Lencioni R, Crocetti L, Cioni R, et al. Response to radiofrequency ablation of pulmonary tumours: a prospective, intention-to-treat, multicentre clinical trial (the RAPTURE study). Lancet Oncol. Jul 2008; 9(7): 621-8. PMID18565793
23. Zhu JC, Yan TD, Glenn D, et al. Radiofrequency ablation of lung tumors: feasibility and safety. Ann Thorac Surg. Apr 2009; 87(4): 1023-8. PMID 19324122
24. Pennathur A, Abbas G, Gooding WE, et al. Image-guided radiofrequency ablation of lung neoplasm in 100consecutive patients by a thoracic surgical service. Ann Thorac Surg. Nov 2009; 88(5): 1601-6; discussion 1607-8.PMID 19853119

25. Xia LY, Hu QL, Xu WY. Efficacy and Safety of Radiofrequency Ablation for Breast Cancer Smaller Than 2 cm: A Systematic Review and Meta-Analysis. Front Oncol. 2021; 11: 651646. PMID 34012918
26. Peek MCL, Ahmed M, Napoli A, et al. Minimally invasive ablative techniques in the treatment of breast cancer: a systematic review and meta-analysis. Int J Hyperthermia. Mar 2017; 33(2): 191-202. PMID 27575566
27. Zhao Z, Wu F. Minimally-invasive thermal ablation of early-stage breast cancer: a systemic review. Eur J Surg Oncol. Dec 2010; 36(12): 1149-55. PMID 20889281
28. Soukup B, Bismohun S, Reefy S, et al. The evolving role of radiofrequency ablation therapy of breast lesions. Anticancer Res. Sep 2010; 30(9): 3693-7. PMID 20944155
29. Ito T, Oura S, Nagamine S, et al. Radiofrequency Ablation of Breast Cancer: A Retrospective Study. Clin Breast Cancer. Aug 2018; 18(4): e495-e500. PMID 29079443
30. Li P, Xiao-Yin T, Cui D, et al. Evaluation of the safety and efficacy of percutaneous radiofrequency ablation for treating multiple breast fibroadenoma. J Cancer Res Ther. Dec 2016; 12(Supplement): C138-C142. PMID 28230006
31. Wilson M, Korourian S, Boneti C, et al. Long-term results of excision followed by radiofrequency ablation as the sole means of local therapy for breast cancer. Ann Surg Oncol. Oct 2012; 19(10): 3192-8. PMID 22911363
32. Kinoshita T, Iwamoto E, Tsuda H, et al. Radiofrequency ablation as local therapy for early breast carcinomas. Breast Cancer. Jan 2011; 18(1): 10-7. PMID 20072824
33. Imoto S, Wada N, Sakemura N, et al. Feasibility study on radiofrequency ablation followed by partial mastectomy for stage I breast cancer patients. Breast. Apr 2009; 18(2): 130-4. PMID 19324550
34. Garbay JR, Mathieu MC, Lamuraglia M, et al. Radiofrequency thermal ablation of breast cancer local recurrence: a phase II clinical trial. Ann Surg Oncol. Nov 2008; 15(11): 3222-6. PMID 18709415
35. Haugen BR, Alexander EK, Bible KC, et al. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer: The American Thyroid Association Guidelines Task Force on Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid. Jan 2016; 26(1): 1-133. PMID26462967
36. Cho SJ, Baek JH, Chung SR, et al. Long-Term Results of Thermal Ablation of Benign Thyroid Nodules: A Systematic Review and Meta-Analysis. Endocrinol Metab (Seoul). Jun 2020; 35(2): 339-350. PMID 32615718
37. Chen F, Tian G, Kong D, et al. Radiofrequency ablation for treatment of benign thyroid nodules: A PRISMA-compliant systematic review and meta-analysis of outcomes. Medicine (Baltimore). Aug 2016; 95(34): e4659.PMID 27559968
38. Fuller CW, Nguyen SA, Lohia S, et al. Radiofrequency ablation for treatment of benign thyroid nodules: systematic review. Laryngoscope. Jan 2014; 124(1): 346-53. PMID 24122763
39. Kim JH, Yoo WS, Park YJ, et al. Efficacy and Safety of Radiofrequency Ablation for Treatment of Locally Recurrent Thyroid Cancers Smaller than 2 cm. Radiology. Sep 2015; 276(3): 909-18. PMID 25848897
40. Owen RP, Khan SA, Negassa A, et al. Radiofrequency ablation of advanced head and neck cancer. Arch Otolaryngol Head Neck Surg. May 2011; 137(5): 493-8. PMID 21576561
41. Brook AL, Gold MM, Miller TS, et al. CT-guided radiofrequency ablation in the palliative treatment of recurrent advanced head and neck malignancies. J Vasc Interv Radiol. May 2008; 19(5): 725-35. PMID 18440462
42. Owen RP, Silver CE, Ravikumar TS, et al. Techniques for radiofrequency ablation of head and neck tumors. Arch Otolaryngol Head Neck Surg. Jan 2004; 130(1): 52-6. PMID 14732768
43. Rey VE, Labrador R, Falcon M, et al. Transvaginal Radiofrequency Ablation of Myomas: Technique, Outcomes, and Complications. J Laparoendosc Adv Surg Tech A. Jan 2019; 29(1): 24-28. PMID 30198831
44. Yin G, Chen M, Yang S, et al. Treatment of uterine myomas by radiofrequency thermal ablation: a 10-yearretrospective cohort study. Reprod Sci. May 2015; 22(5): 609-14. PMID 25355802

45. Liu B, Mo C, Wang W, et al. Treatment outcomes of percutaneous radiofrequency ablation versus adrenalectomy for adrenal metastases: a retrospective comparative study. J Endocrinol Invest. Sep 2020; 43(9): 1249-1257. PMID32166699
46. Yang MH, Tyan YS, Huang YH, et al. Comparison of radiofrequency ablation versus laparoscopic adrenalectomy for benign aldosterone-producing adenoma. Radiol Med. Oct 2016; 121(10): 811-9. PMID 27300650
47. Hasegawa T, Takaki H, Kodama H, et al. Three-year Survival Rate after Radiofrequency Ablation for Surgically Resectable Colorectal Lung Metastases: A Prospective Multicenter Study. Radiology. Mar 2020; 294(3): 686-695.PMID 31934829
48. Locklin JK, Mannes A, Berger A, et al. Palliation of soft tissue cancer pain with radiofrequency ablation. J Support Oncol. Sep-Oct 2004; 2(5): 439-45. PMID 15524075
49. Rosenthal DI. Radiofrequency treatment. Orthop Clin North Am. Jul 2006; 37(3): 475-84, viii. PMID 16846772
50. Liapi E, Geschwind JF. Transcatheter and ablative therapeutic approaches for solid malignancies. J Clin Oncol. Mar 10 2007; 25(8): 978-86. PMID 17350947
51. Spiliotis JD, Datsis AC, Michalopoulos NV, et al. Radiofrequency ablation combined with palliative surgery may prolong survival of patients with advanced cancer of the pancreas. Langenbecks Arch Surg. Jan 2007; 392(1): 55-60. PMID 17089173
52. Zou YP, Li WM, Zheng F, et al. Intraoperative radiofrequency ablation combined with 125 iodine seed implantation for unresectable pancreatic cancer. World J Gastroenterol. Oct 28 2010; 16(40): 5104-10. PMID 20976848
53. Cantore M, Girelli R, Mambrini A, et al. Combined modality treatment for patients with locally advanced pancreatic adenocarcinoma. Br J Surg. Aug 2012; 99(8): 1083-8. PMID 22648697
54. Rombouts SJ, Vogel JA, van Santvoort HC, et al. Systematic review of innovative ablative therapies for the treatment of locally advanced pancreatic cancer. Br J Surg. Feb 2015; 102(3): 182-93. PMID 25524417
55. Kameyama S, Murakami H, Masuda H, et al. Minimally invasive magnetic resonance imaging-guided stereotactic radiofrequency thermocoagulation for epileptogenic hypothalamic hamartomas. Neurosurgery. Sep 2009; 65(3):438-49; discussion 449. PMID 19687687
56. Vavra P, Dostalik J, Zacharoulis D, et al. Endoscopic radiofrequency ablation in colorectal cancer: initial clinical results of a new bipolar radiofrequency ablation device. Dis Colon Rectum. Feb 2009; 52(2): 355-8. PMID19279436
57. Mylona S, Karagiannis G, Patsoura S, et al. Palliative treatment of rectal carcinoma recurrence using radiofrequency ablation. Cardiovasc Intervent Radiol. Aug 2012; 35(4): 875-82. PMID 22167304
58. Ripley RT, Gajdos C, Reppert AE, et al. Sequential radiofrequency ablation and surgical debulking for unresectable colorectal carcinoma: thermo-surgical ablation. J Surg Oncol. Feb 2013; 107(2): 144-7. PMID 22927225
59. Howington JA, Blum MG, Chang AC, 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-e313S. PMID 23649443
60. Donington J, Ferguson M, Mazzone P, et al. American College of Chest Physicians and Society of Thoracic Surgeons consensus statement for evaluation and management for high-risk patients with stage I non-small cell lung cancer. Chest. Dec 2012; 142(6): 1620-1635. PMID 23208335
61. Orloff LA, Noel JE, Stack BC, et al. Radiofrequency ablation and related ultrasound-guided ablation technologies for treatment of benign and malignant thyroid disease: An international multidisciplinary consensus statement ofthe American Head and Neck Society Endocrine Surgery Section with the Asia Pacific Society of Thyroid Surgery, Associazione Medici Endocrinologi, British Association of Endocrine and Thyroid Surgeons, European Thyroid Association, Italian Society of Endocrine Surgery Units, Korean Society of Thyroid Radiology, Latin American Thyroid Society, and Thyroid Nodules Therapies Association. Head Neck. Mar 2022; 44(3): 633-660. PMID34939714
62. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Non-small cell lung cancer. Version 3.2022. Updated March 16, 2022.https://www.nccn.org/professionals/physician_gls/pdf/nscl.pdf. Accessed August 12, 2022.

63. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Thyroid Carcinoma. Version 2.2022. Updated May 5, 2022.https://www.nccn.org/professionals/physician_gls/pdf/thyroid.pdf. Accessed August 13, 2022.
64. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Colon Cancer. Version 1.2022. Updated February 25, 2022. https://www.nccn.org/professionals/physician_gls/pdf/colon.pdf.Accessed August 10, 2022.
65. National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): Head and Neck Cancers. Version 2.2022. Updated April 26, 2022.https://www.nccn.org/professionals/physician_gls/pdf/head-and-neck.pdf. Accessed August 14, 2022.
66. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Breast Cancer. Version 4.2022. Updated June 21, 2022. https://www.nccn.org/professionals/physician_gls/pdf/breast.pdf.Accessed August 16, 2022.
67. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Bone Cancer. Version 1.2023. Updated August 2, 2022. https://www.nccn.org/professionals/physician_gls/pdf/bone.pdf.Accessed August 17, 2022.
68. National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): Pancreatic Adenocarcinoma. Version 1.2022. Updated February 24, 2022.https://www.nccn.org/professionals/physician_gls/pdf/pancreatic.pdf. Accessed August 15, 2022.
69. National Institute for Health and Care Excellence (NICE). Computed tomography-guided thermocoagulation of osteoid osteoma [IPG53]. 2004; https://www.nice.org.uk/guidance/ipg53. Accessed August 10, 2022.
70. National Institute for Health and Care Excellence (NICE). Percutaneous radiofrequency ablation for primary and secondary lung cancers [IPG372]. 2010; https://www.nice.org.uk/guidance/ipg372. Accessed August 11, 2022.
71. National Institute for Health and Care Excellence (NICE). Ultrasound-guided percutaneous radiofrequency ablation for benign thyroid nodules [IPG562]. 2016; https://www.nice.org.uk/guidance/IPG562. Accessed August 13, 2022.