

Surgical approach to microwave and radiofrequency liver ablation for hepatocellular carcinoma and colorectal liver metastases less than 5 cm: a systematic review and meta-analysis

Appendix 1

There are 4 notes in this document.

Note 1 is on page 2.

Note 2 is on page 3.

Note 3 is on page 9.

Note 4 in on page 11.

Note 1:

The original PICO questions were:

1. Should **Percutaneous** vs. **Laparoscopic MWA** be used for HCC less than 3 cm?
Main outcome(s) Incomplete Ablation, Local/Regional Recurrence, Complications
Proxy outcomes DFS, OS
2. Should **Percutaneous** vs. **Laparoscopic MWA** be used for HCC from 3-5cm?
Main outcome(s) Incomplete Ablation, Local/Regional Recurrence, Complications
Proxy outcomes DFS, OS
3. Should **Percutaneous** vs. **Laparoscopic MWA** be used for CRLM less than 3 cm?
Main outcome(s) Incomplete Ablation, Local/Regional Recurrence, Complications
Proxy outcomes DFS, OS
4. Should **Percutaneous** vs. **Laparoscopic MWA** be used for CRLM from 3-5cm?
Main outcome(s) Incomplete Ablation, Local/Regional Recurrence, Complications
Proxy outcomes DFS, OS
5. Should **MWA ablation (laparoscopic or open)** vs. **RFA ablation (laparoscopic or open)** be used for HCC or CRLM less than 3 cm?
Main outcome(s) Incomplete Ablation, Local/Regional Recurrence, Complications
Proxy outcomes DFS, OS
6. Should **MWA ablation (laparoscopic or open)** vs. **RFA ablation (laparoscopic or open)** be used for HCC or CRLM less than 3-5cm?
Main outcome(s) Incomplete Ablation, Local/Regional Recurrence, Complications
Proxy outcomes DFS, OS

Note 2:

Liver Ablation Literature Search Summary Chart

Literature search chart – Updated 2/19/22 – Final

Guideline: SAGES/AHPBA Joint ablation of liver lesions guideline

Committee Chairs: Dr. Ceppa and Dr. Haggerty / Liaison: Dr. Ayloo

Librarian: Holly Ann Burt

PICO Questions	
1.	Should Percutaneous vs. Laparoscopic MWA be used for HCC less than 3 cm?
2.	Should Percutaneous vs. Laparoscopic MWA be used for HCC from 3-5cm?
3.	Should Percutaneous vs. Laparoscopic MWA be used for CRLM less than 3 cm?
4.	Should Percutaneous vs. Laparoscopic MWA be used for CRLM from 3-5cm?
5.	Should MWA ablation (laparoscopic or open) vs. RFA ablation (laparoscopic or open) be used for HCC or CRLM less than 3 cm?
6.	Should MWA ablation (laparoscopic or open) vs. RFA ablation (laparoscopic or open) be used for HCC or CRLM less than 3-5cm?
Main outcome(s)	Incomplete Ablation, Local/Regional/Distant Recurrence Complications
Proxy outcomes	DFS, OS

Run Date: 12/24/19 and 6/22/21 Search run by: Holly Ann Burt		
Additional terms (See individual PICO questions for main search terms):		
Languages: English Species: Not Animals Publication years: All	Additional Limiters: Case reports Clinical Study Comparative Study Epidemiologic studies Evaluation Study Meta-Analysis Multicenter Study	Practice Guideline OR practice guidelines as topic Systematic Review Validation Study Analysis Guideline OR guidelines Randomized study OR studies
Database searched (Coverage)		Additional databases used
Systematic Reviews <input checked="" type="checkbox"/> Cochrane Library (2009-2020) Clinical Trials <input checked="" type="checkbox"/> Clinicaltrials.gov (2000 - 2020)	Medicine <input checked="" type="checkbox"/> CINAHL (1937-2020) <input checked="" type="checkbox"/> Embase (1947-2020) <input checked="" type="checkbox"/> PubMed (1809/1966-2020)	<input checked="" type="checkbox"/> ICTRP (International Clinical Trials Registry Platform) <input checked="" type="checkbox"/> Google Scholar
SEARCH RESULTS	Total items identified by database searches	3973
	Trials identified in database searches	171
	Additional articles located by handsearching (57 from trials / 65 during combined database search)	122
	Total duplicates found (questions were combined into a single database)	2858

		Total items to be screened (Single database)	1066
1	Should Percutaneous vs. Laparoscopic MWA be used for HCC less than 3 cm?		
2	Should Percutaneous vs. Laparoscopic MWA be used for HCC from 3-5cm?		
	Concept A	Concept B	Concept C
MESH terms	Microwaves Microwave thermotherapy (Embase)	Carcinoma, hepatocellular	
Text words	MWA Microwave ablation	HCC Hepatocellular cancer liver cell carcinoma	Percutaneous
Database	Final search strategies		Results
PubMed Q1-2 2019	(microwaves[mh] OR MWA[tiab] OR MWA[OT] OR "Microwave ablation") AND ("carcinoma, hepatocellular"[mh] OR HCC[tw] OR "Hepatocellular cancer") AND (case reports[ptyp] OR Clinical study[ptyp] OR Comparative Study[ptyp] OR Evaluation Study[ptyp] OR Meta-Analysis[ptyp] OR Multicenter Study[ptyp] OR Systematic review[ptyp] OR Validation Study[ptyp] OR randomized[tiab] OR study[tiab]) AND Percutaneous NOT (rat[tiab] OR rats[tiab] OR "animals"[MeSH Terms:noexp]) AND English[lang]		150
CINAHL Q1-2 2019	("Microwave ablation" OR MWA) AND Percutaneous AND ("Hepatocellular Carcinoma" OR HCC OR "Hepatocellular Cancer" OR "liver cancer")		67
Embase Q1-2 2019	(('microwave thermotherapy' OR 'microwave ablation') AND ('liver cell carcinoma'/exp OR crlm:ab,ti OR 'colorectal cancer'/exp OR 'colorectal liver metastasis':ab,ti) AND percutaneous AND ([systematic review]/lim OR [meta analysis]/lim OR [clinical study]/lim) AND [english]/lim NOT [animals]/lim - Note: Error, should be HCC, not CRLM)		277
Cochrane Q1-2 2019	(microwave ablation OR MWA) AND Percutaneous AND (hepatocellular carcinoma OR HCC OR Liver cancer)		57
ClinicalTrials Q1-2 2019	(Microwave ablation OR MWA) AND Percutaneous Hepatocellular Carcinoma OR HCC OR Hepatocellular Carcinoma OR Hepatocellular Cancers		12
PubMed Q1-2 2021	((microwaves[mh] OR MWA[tiab] OR MWA[ot] OR "Microwave ablation"[tw]) AND ("carcinoma, hepatocellular"[mh] OR HCC[tiab] OR HCC[ot] OR "Hepatocellular cancer") AND Percutaneous AND ("Case reports"[pt] OR "Clinical Study"[pt] OR "Comparative Study"[pt] OR "Epidemiologic studies" [mh] OR "Evaluation Study"[pt] OR "Meta-Analysis"[pt] OR "Multicenter Study"[pt] OR "Systematic Review"[pt] OR "Validation Study" [pt] OR randomized[tiab] OR analysis[tiab] OR study[tiab] OR studies [tiab] OR "Practice Guideline"[pt] OR "practice guidelines as topic"[mh] OR guideline[title] OR guidelines[title])) NOT (("animals"[MH:noexp] NOT "humans"[MH]) OR rat[tiab] OR rats[tiab] OR dog[tiab] OR dogs[tiab] OR mouse[tiab] OR mice[tiab] OR porcine[tiab]) AND English[lang]		224
CINAHL Q1-2 2021	("Microwave ablation" OR MWA) AND Percutaneous AND ("Hepatocellular Carcinoma" OR HCC OR "Hepatocellular Cancer" OR "liver cancer")		97

Embase Q1-2 2021	('microwave thermotherapy'/exp OR 'microwave ablation' OR 'microwave thermotherapy' OR mwa:ab,ti) AND (hcc:ab,ti OR 'liver cell carcinoma/exp' OR 'hepatocellular cancer':ab,ti) AND percutaneous AND [english]/lim AND ('practice guideline'/exp OR 'practice guideline' OR [cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [clinical study]/lim OR 'case report'/exp OR 'case report' OR 'case study'/exp OR 'case study') NOT ([conference abstract]/lim OR [animals]/lim)	191	
Cochrane Q1-2 2021	(microwave ablation OR MWA) AND Percutaneous AND (hepatocellular carcinoma OR HCC OR Liver cancer)	50	
ClinicalTrials Q1-2 2021	(Microwave ablation OR MWA) AND Percutaneous Hepatocellular Carcinoma OR HCC OR Hepatocellular Carcinoma OR Hepatocellular Cancers	17	
SEARCH RESULTS	Total items identified by database searches	1142	
	Trials identified in database searches	57	
	Additional articles located by handsearching	16	
	Total duplicates found – unknown, Items merged into single database		
	Total items to be screened – unknown, Items merged into single database		
3	Should Percutaneous vs. Laparoscopic MWA be used for CRLM less than 3 cm?		
4	Should Percutaneous vs. Laparoscopic MWA be used for CRLM from 3-5cm?		
	Concept A	Concept B	Concept C
MESH terms	Microwaves Microwave thermotherapy (Embase)	Colorectal neoplasms Colorectal liver metastasis (Embase) Liver neoplasms	
Text words	MWA Microwave ablation	CRLM Colorectal cancer Liver cell carcinoma	Percutaneous
Database	Final search strategies		Results
PubMed Q3-4 2019	(microwaves[mh] OR MWA[tiab] OR MWA[OT] OR "Microwave ablation") AND ("colorectal neoplasms"[mh] OR "liver neoplasms"[MeSH Terms] OR CRLM[tw] OR Colorectal[tw]) AND Percutaneous AND (case reports[ptyp] OR Clinical study[ptyp] OR Comparative Study[ptyp] OR Evaluation Study[ptyp] OR Meta-Analysis[ptyp] OR Multicenter Study[ptyp] OR Systematic review[ptyp] OR Validation Study[ptyp] OR randomized[tiab] OR study[tiab]) NOT (rat[tiab] OR rats[tiab] OR "animals"[MeSH Terms:noexp]) AND English[lang]		195
CINAHL Q3-4 2019	("Microwave ablation" OR MWA) AND Percutaneous AND (CRLM OR "Colorectal liver metastasis" OR "Colorectal cancer" OR (Colorectal AND "liver cancer"))		12
Embase Q3-4 2019	('microwave thermotherapy' OR 'microwave ablation') AND ('liver cell carcinoma'/exp OR crlm:ab,ti OR 'colorectal cancer'/exp OR 'colorectal liver metastasis':ab,ti) AND percutaneous AND ([systematic review]/lim OR [meta analysis]/lim OR [clinical study]/lim) AND [english]/lim NOT [animals]/lim		297

Cochrane Q3-4 2019	(microwave ablation OR MWA) AND Percutaneous AND (colorectal cancer OR CRLM OR Colorectal liver metastasis)	3	
ClinicalTrials Q3-4 2019	Microwave ablation OR MWA) AND Percutaneous CRLM OR Colorectal liver metastasis OR Colorectal	4	
PubMed Q3-4 2021	(microwaves[mh] OR MWA[tiab] OR MWA[OT] OR "Microwave ablation"[tw]) AND ("colorectal neoplasms"[mh] OR "liver neoplasms"[MeSH Terms] OR CRLM[tw] OR Colorectal[tw]) AND Percutaneous AND ("Case reports"[pt] OR "Clinical Study"[pt] OR "Comparative Study"[pt] OR "Epidemiologic studies" [mh] OR "Evaluation Study"[pt] OR "Meta-Analysis"[pt] OR "Multicenter Study"[pt] OR "Systematic Review"[pt] OR "Validation Study" [pt] OR randomized[tiab] OR analysis[tiab] OR study[tiab] OR studies [tiab] OR "Practice Guideline"[pt] OR "practice guidelines as topic"[mh] OR guideline[title] OR guidelines[title])) NOT (("animals"[MH:noexp] NOT "humans"[MH]) OR rat[tiab] OR rats[tiab] OR dog[tiab] OR dogs[tiab] OR mouse[tiab] OR mice[tiab] OR porcine[tiab]) AND English[lang]	292	
CINAHL Q3-4 2021	("Microwave ablation" OR MWA) AND Percutaneous AND (CRLM OR "Colorectal liver metastasis" OR "Colorectal cancer" OR (Colorectal AND "liver cancer"))	16	
Embase Q3-4 2021	('microwave thermotherapy'/exp OR 'microwave ablation' OR 'microwave thermotherapy' OR mwa:ab,ti) AND ('liver cell carcinoma'/exp OR crlm:ab,ti OR 'colorectal cancer'/exp OR 'colorectal liver metastasis':ab,ti) AND percutaneous AND [english]/lim AND ('practice guideline'/exp OR 'practice guideline' OR [cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [clinical study]/lim OR 'case report'/exp OR 'case report' OR 'case study'/exp OR 'case study') NOT ([conference abstract]/lim OR [animals]/lim)	305	
Cochrane Q3-4 2021	(microwave ablation OR MWA) AND Percutaneous AND (colorectal cancer OR CRLM OR Colorectal liver metastasis)	4	
ClinicalTrials Q3-4 2021	Microwave ablation OR MWA) AND Percutaneous CRLM OR Colorectal liver metastasis OR Colorectal	4	
SEARCH RESULTS	Total items identified by database searches	1132	
	Trials identified in database searches	12	
	Additional articles located by handsearching	8	
	Total duplicates found – unknown, Items merged into single database		
	Total items to be screened – unknown, Items merged into single database		
5	Should MWA ablation (laparoscopic or open) vs. RFA ablation (laparoscopic or open) be used for HCC or CRLM less than 3 cm?		
6	Should MWA ablation (laparoscopic or open) vs. RFA ablation (laparoscopic or open) be used for HCC or CRLM less than 3-5cm?		
	Concept A	Concept B	Concept C
MESH terms	Microwaves Microwave thermotherapy (Embase)	Carcinoma, hepatocellular Colorectal neoplasms Liver neoplasms	Radiofrequency Therapy

Text words	MWA Microwave ablation	CRLM Colorectal liver metastasis Colorectal cancer HCC Hepatocellular carcinoma Liver cell carcinoma Liver cancer	RFA Radiofrequency ablation
Database	Final search strategies		Results
PubMed Q5-6 2019	((microwaves[mh] OR MWA[tiab] OR MWA[OT] OR "Microwave ablation"[tw]) AND ("Radiofrequency Therapy"[mh] OR "Radiofrequency Ablation" OR RFA[tiab] OR RFA[OT])) AND ("colorectal neoplasms"[mh] OR "liver neoplasms"[MeSH Terms] OR CRLM[tw] OR Colorectal[tw] OR "carcinoma, hepatocellular"[mh] OR HCC[tw] OR "Hepatocellular cancer") AND (case reports[ptyp] OR Clinical study[ptyp] OR Comparative Study[ptyp] OR Evaluation Study[ptyp] OR Meta-Analysis[ptyp] OR Multicenter Study[ptyp] OR Systematic review[ptyp] OR Validation Study[ptyp] OR randomized[tiab] OR study[tiab]) NOT (rat[tiab] OR rats[tiab] OR "animals"[mh:noexp]) AND English[lang]		228
CINAHL Q5-6 2019	(RFA OR "radiofrequency ablation") AND (MWA OR "Microwave ablation") AND ("Hepatocellular Carcinoma" OR HCC OR "Hepatocellular Cancer" OR CRLM OR "Colorectal liver metastasis" OR "Colorectal cancer" OR "liver cancer")		57
Embase Q5-6 2019	('radiofrequency therapy' OR 'radiofrequency ablation') AND ('microwave thermotherapy' OR 'microwave ablation') AND ('liver cell carcinoma'/exp OR 'hepatocellular cancer':ab,ti OR crlm:ab,ti OR 'colorectal cancer'/exp OR 'colorectal liver metastasis':ab,ti) AND ([systematic review]/lim OR [meta analysis]/lim OR [clinical study]/lim) AND [english]/lim NOT [animals]/lim		343
Cochrane Q5-6 2019	("microwave ablation" OR MWA) AND ("radiofrequency ablation" OR RFA) AND ("colorectal cancer" OR CRLM OR "Colorectal liver metastasis" OR "hepatocellular carcinoma" OR HCC OR "Liver cancer")		48
ClinicalTrials Q5-6 2019	((RFA AND ablation) OR "radiofrequency ablation" OR "Radiofrequency therapy") AND (MWA OR Microwave OR "microwave ablation") CRLM OR liver cancer OR Colorectal liver metastasis OR Colorectal OR HCC OR "Hepatocellular Carcinoma" OR "Hepatocellular Cancers"		32
PubMed Q5-6 2021	((microwaves[mh] OR MWA[tiab] OR MWA[ot] OR "Microwave ablation") AND ("Radiofrequency Therapy"[mh] OR "Radiofrequency Ablation" OR RFA[tiab] OR RFA[OT]) AND ("colorectal neoplasms"[mh] OR "liver neoplasms"[MeSH Terms] OR CRLM[tw] OR Colorectal[tw] OR "carcinoma, hepatocellular"[mh] OR HCC[tiab] OR HCC[ot] OR "Hepatocellular cancer") AND ("Case reports"[pt] OR "Clinical Study"[pt] OR "Comparative Study"[pt] OR "Epidemiologic studies" [mh] OR "Evaluation Study"[pt] OR "Meta-Analysis"[pt] OR "Multicenter Study"[pt] OR "Systematic Review"[pt] OR "Validation Study" [pt] OR randomized[tiab] OR analysis[tiab] OR study[tiab] OR studies [tiab] OR "Practice Guideline"[pt] OR "practice guidelines as topic"[mh] OR guideline[title] OR		417

	guidelines[title])) NOT (("animals"[MH:noexp] NOT "humans"[MH]) OR rat[tiab] OR rats[tiab] OR dog[tiab] OR dogs[tiab] OR mouse[tiab] OR mice[tiab] OR porcine[tiab]) AND English[lang]	
CINAHL Q5-6 2021	(RFA OR "radiofrequency ablation") AND (MWA OR "Microwave ablation") AND ("Hepatocellular Carcinoma" OR HCC OR "Hepatocellular Cancer" OR CRLM OR "Colorectal liver metastasis" OR "Colorectal cancer" OR "liver cancer")	76
Embase Q5-6 2021	('radiofrequency therapy'/exp OR 'radiofrequency therapy' OR 'radiofrequency ablation' OR rfa:ab,ti) AND ('microwave thermotherapy'/exp OR 'microwave ablation' OR 'microwave thermotherapy' OR mwa:ab,ti) AND ('liver cell carcinoma'/exp OR 'hepatocellular cancer':ab,ti OR crlm:ab,ti OR 'colorectal cancer'/exp OR 'colorectal liver metastasis':ab,ti OR hcc:ab,ti) AND [english]/lim AND ('practice guideline'/exp OR 'practice guideline' OR [cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [clinical study]/lim OR 'case report'/exp OR 'case report' OR 'case study'/exp OR 'case study') NOT ([conference abstract]/lim OR [animals]/lim)	411
Cochrane Q5-6 2021	("microwave ablation" OR MWA) AND ("radiofrequency ablation" OR RFA) AND ("colorectal cancer" OR CRLM OR "Colorectal liver metastasis" OR "hepatocellular carcinoma" OR HCC OR "Liver cancer")	45
ClinicalTrials Q5-6 2021	((RFA AND ablation) OR "radiofrequency ablation" OR "Radiofrequency therapy") AND (MWA OR Microwave OR "microwave ablation") CRLM OR liver cancer OR Colorectal liver metastasis OR Colorectal OR HCC OR "Hepatocellular Carcinoma" OR "Hepatocellular Cancers"	40
SEARCH RESULTS	Total items identified by database searches	1699
	Trials identified in database searches	102
	Additional articles located by handsearching	33
	Total duplicates found – unknown, Items merged into single database	
	Total items to be screened – unknown, Items merged into single database	

Note 3:

NEWCASTLE - OTTAWA QUALITY ASSESSMENT SCALE
COHORT STUDIES

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability

Selection

1) Representativeness of the exposed cohort

- a) truly representative of the average _____ (describe) in the community ✱
- b) somewhat representative of the average _____ in the community ✱
- c) selected group of users eg nurses, volunteers
- d) no description of the derivation of the cohort

2) Selection of the non exposed cohort

- a) drawn from the same community as the exposed cohort ✱
- b) drawn from a different source
- c) no description of the derivation of the non exposed cohort

3) Ascertainment of exposure

- a) secure record (eg surgical records) ✱
- b) structured interview ✱
- c) written self report
- d) no description

4) Demonstration that outcome of interest was not present at start of study

- a) yes ✱
- b) no

Comparability

1) Comparability of cohorts on the basis of the design or analysis

a) study controls for _____ (select the most important factor) ✱

b) study controls for any additional factor ✱ (This criteria could be modified to indicate specific control for a second important factor.)

Outcome

1) Assessment of outcome

a) independent blind assessment ✱

b) record linkage ✱

c) self report

d) no description

2) Was follow-up long enough for outcomes to occur

a) yes (select an adequate follow up period for outcome of interest) ✱

b) no

3) Adequacy of follow up of cohorts

a) complete follow up - all subjects accounted for ✱

b) subjects lost to follow up unlikely to introduce bias - small number lost - > ____ % (select an adequate %) follow up, or description provided of those lost) ✱

c) follow up rate < ____% (select an adequate %) and no description of those lost

d) no statement

Note 4:

Table. Summary of inclusion criteria and group differences for KQ2.

Study Identifier	Inclusion criteria	Exclusion criteria	Group Differences
An 2021	The inclusion criteria were as follows:(i) a performance status of 0 or 1; (ii) presenting with a small single perivascular tumor (tumor size ≤ 3 cm; perivascular peritumoral vessel diameter > 3 mm); and (iii) availability of medical records and imaging data.	The exclusion criteria included the following: (i) patients who had undergone other treatments before ablation therapy; (ii) the presence of vascular invasion or extrahepatic metastases; (iii) severe coagulopathy; and (iv) inability to follow up.	Standardized mean differences in the unweighted cohort showed that significant differences were observed in cirrhosis, tumor size, alanine amino-transferase, aspartate aminotransferase, total bilirubin, and albumin. Given the potential imbalances in treatment assignment, we performed the inverse probability treatment weighting (IPTW) method to reduce observed biases between groups. Treatment propensity was calculated by logistic regression using a panel of potential confounding factors that could have affected the original therapeutic decisions. The standard mean difference (SMD) was used to evaluate the covariate balance. An SMD of less than 0.1 was considered a sign of sufficient balance. Based on this, after the IPTW was applied, the two groups were imbalanced/different (SMD >0.1) on a few factors including hepatic C as etiology of cirrhosis, tumor size, location of tumor in the left hemiliver, and number of ablation sessions
Correa-Gallego 2014	Undergone operative MWA of CRLM between 2008. Subsequently, queried the same database for patients who had undergone RFA of CRLM between 2001 and 2010 as historical controls	Lap or Perc approach	None
Lee 2017	Between March 2009 and January 2011, 26 consecutive patients with a diagnosis of HCC were recruited for MWA. The indications for MWA were: unresectable tumor; resectable tumor but patient preferred local ablation treatment to hepatectomy; tumor not feasible for percutaneous RFA; and no macroscopic vascular or bile duct invasion by the tumor. Between May 2003 and January 2011, a total of 219 patients underwent RFA treatment for malignant liver tumors in our institute.	We limited the use of MWA to patients with a maximum of two tumors and size of tumor up to 6 cm. Recurrent tumor after previous treatment was not considered a contraindication for MWA. excluded patients with more than two tumor nodules. Patients with concomitant hepatectomy were also excluded	Age (y) 62.5 (49-79) and 58 (43-77) in MWA and RFA resp. Male 19 (73.1%) and 40 (85.1%) in MWA and RFA resp. a-fetal protein (mg/L) 13.5 (1-23,956) and 25 (2-10,174) in MWA and RFA resp. Platelet (109 /L) 92.5 (25-265) and 127 (41-250) in MWA and RFA resp.

Sakaguchi 2009	All 391 patients with solitary HCC who underwent (primary) endoscopic thermal ablation between July 1994 and July 2005 as a primary treatment at six Japanese institutions. Criteria: Histologically proved HCC or hypervascular tumor on imaging modalities, treatment-naïve patients, solitary HCC.	No specific criteria reported	Location of HCC (superficial or deep) (96/46 for MW for 131/118 for RF) Longest diameter of HCC (mm; mean 1 SD) (22.8 for MW vs 24.8 for RF) Anesthesia (general or local) (99/44 for MW vs 244/5 for RF) Laparoscopy or thoracoscopy (134/8 for MW vs 245/4 for RF) See Table 1 for details.
Takahashi 2018	Patients with CRLM who underwent laparoscopic MTA between 2014 and 2017 were compared to those who were treated with laparoscopic RFA between 2011 and 2014. The patients underwent ablation, rather than resection in the light of the following scenarios: (1) unresectable tumors due to liver tumor burden or extrahepatic disease, (2) resectable tumors in patients unfit for a resection, (3) resectable small (<3 cm) tumors which would have required a major hepatectomy and patient electing to have ablation instead, and (4) patient preference after the pros and cons of potential treatment options were objectively discussed.	Not meeting above criteria	Didn't differ in baseline characteristics; although significant differences in total ablation and operative time.
Yang 2017	All patients with colorectal liver metastasis who were treated with either LMWA or LRFA from January 2010 to January 2016 were included in this study. The indications for laparoscopic ablation therapies (LMWA or LRFA) were as follows: a single lesion of ≤ 5 cm in diameter or 2 to 3 lesions of ≤ 3 cm in diameter unresectable because of the high risk of postoperative complications, without cirrhosis, and/or superficial lesions adjacent to abdominal viscera or deeply seeded lesions that were not amenable to percutaneous approaches.	Patients who underwent radical hepatic resection with ablation therapy were excluded from this study.	Average tumor maximum diameter was slightly higher in the MWA compared to the RFA group: 3cm (range 1-5) vs 2 cm (range 1-4)
Iida 2013	Patients with only hepatic metastases that were less than 3cm and superficially located	Extrahepatic metastases	Patients in the group that were ablated with RFA+MWA were younger. None of the patient in the lap RFA group had tumors located in segment 2.
Simo 2011	HCC in patients with cirrhosis when the lesion(s) are not amenable to percutaneous intervention due to: location at the dome of the liver, close proximity to the gallbladder, or other visceral organ. None of these patients are candidates for resection either secondary to severity of portal hypertension, degree of hepatic dysfunction or other comorbidities.	Four patients were excluded from the analysis: three due to mistargeting (one for RFA and two for MWA) and one secondary to an inability to visualize the tumor with intraoperative laparoscopic ultrasound.	More males in RFA

Santambrogio 2017

single lesion < 5 cm or two to three lesions
<3 cm unresectable due to the risk of
complications; CP - A & selected B class
early recurrence after surgical resection
percutaneous RFA Declined surgery

portal vein thrombosis pre-existing severe
liver disease CP - C

None