Lung Ablation: Year in Review

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Disclosures

Robert Suh: Consultant – Boston Scientific, NeuWave Medical, Varian; Speakers' Bureau – Boehringer Ingelheim

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SIR Position Statement: NSCLC and Metastatic Disease to the Lungs

LEVEL OF EVIDENCE

A HIGH QUALITY EVIDENCE

Types of Evidence	Characteristics of Evidence
Multiple RCTs	Homogeneity of RCT study population
Systematic reviews or meta-analyses of high-quality RCTs	Intention-to-treat principle maintained
	Appropriate blinding
RCT data supported by high-quality registry studies	Precision of data (narrow CIs)
	Appropriate follow-up (consider duration and patients lost to follow-up)
	Appropriate statistical design

B MODERATE QUALITY EVIDENCE—Randomized Study Design

Types of Evidence	Characteristics of Evidence
≥ 1 RCTs	RCTs with limitations (eg, < 80% follow-up, heterogeneity of patient population, bias, etc)
Systematic reviews or meta-analyses of moderate-quality RCTs	Imprecision of data (small sample size, wide CIs)

C MODERATE QUALITY EVIDENCE—Nonrandomized Study Design

Types of Evidence	Characteristics of Evidence
Nonrandomized trials	Nonrandomized controlled cohort study
Observational or registry studies	Observational study with dramatic effect
Systematic reviews or meta-analyses of moderate quality studies	Outcomes research
	Ecological study

D LIMITED QUALITY EVIDENCE

Types of Evidence	Characteristics of Evidence
Observational or registry studies with limited design and execution	Case series
	Case-control studies
Systematic reviews or meta-analyses of studies limited by design and execution	Historically controlled studies

E EXPERT OPINION

Types of Evidence	Characteristics of Evidence
Expert consensus based on clinical practice	Expert opinion without explicit critical appraisal or based on physiology, bench research, or "first principles"

STRENGTH OF RECOMMENDATION

Strong Recommendation	Moderate Recommendation	Weak Recommendation	No Recommendation
Supported by high quality evidence for or against recommendation	Supported by moderate quality evidence for or against recommendation; new research may be able to provide additional context	Supported by weak quality evidence for or against recommendation; new research likely to provide additional context	Insufficient evidence in the literature to support or refute recommendation

CI = confidence interval; RCT = randomized controlled trial.

Tam et al. *JVIR* 2018;29:1347-1349.

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SIR Position Statement: NSCLC and Metastatic Disease to the Lungs

Recommendation	Qualifications	LOE	SOR
Stage IA	Safe and effective treatment with minimal complications and survival outcomes comparable to SBRT and sublobar resection	C	Moderate
Recurrent	Safe and effective treatment option	C	Moderate

LOE: Level of Evidence
SOR: Strength of Recommendation

Ablation: Local Control Stage I NSCLC

		568 (694)	1-year	2-year	3-year	4-year	5-year	*LC*
radiofrequency	Simon 2007[1]	71	78%	57%	36%	27%	27%	*47%*
	Huang 2010[2]	33	80%	46%			24%	*76%*
	Ambrogi 2011[3]	57	83%	62%	40%	32%	25%	*41%*
	Hiraki 2011[4]	50	94%	86%	74%	67%	61%	*69%*
	Kodama 2012[5]	44	98%		73%		55%	*89%*
	Palussiere 2014[6]	87	92%	78%	66%	63%	58%	*79%*
	Huang 2018[7]	50	96%	87%	67%		36%/1%	*74%*
	RAPTURE[8]	33	93%	75%				*88%*
	ACOSOG Z4033[9]	51	86%	70%				*60%*
	Palussiere 2018[10]	42	92%	64%	58%			*81%*
mwcy	Yang 2014[11]	47	89%	63%	43%	37%	16%	*48%*
	Han 2019[12]	63	97%	93%	63%	54%	33%	*64%*
	Nance 2021[13]	21	68%	62%			46%	*90%*
	Moore 2015[14]	45	89%		78%		68%	*89%*

[1]Simon et al. *Radiology* 2007; 18:1264-1269.
[2]Huang et al. *Eur J CT Surg* 2010; 39:348-351.
[3]Ambrogi et al. *J Thorac Oncol* 2011; 6:2044-2051.
[4]Hiraki et al. *J Thorac CV Surg* 2011; 142:24-30.
[5]Kodama et al. *CVIR* 2012; 35:563-569.
[6]Palussiere et al. *CVIR* 2015; 38:160-166.
[7]Huang et al. *Int J Surg* 2018; 53:143-150.
[8]Lencioni et al. *Lancet Oncol* 2008; 9:621-628.
[9]Dupuy et al. *Cancer* 2015; 121:3491-3498.
[10]Palussiere et al. *J Cardiovasc Surg* 2018; 13:91.
[11]Yang et al. *J Surg Onc* 2014; 110:758-763.
[12]Han et al. *Thoracic Cancer* 2019; 10:2236-2242.
[13]Nance et al. *J Clin Imaging Sci* 2021;11:1-9.
[14]Moore et al. *JVIR* 2015; 26:312-319.
[15]Chan et al. *J Thorac Imaging* 2011; 26:18-26.
[16]Jiang et al. *Ann Thorac Med* 2018; 13:243-250.
[17]Bi et al. *Int J R O Bio Phy* 2016; 95:1378-1390.

71% : 78%[15] : 81%[16]

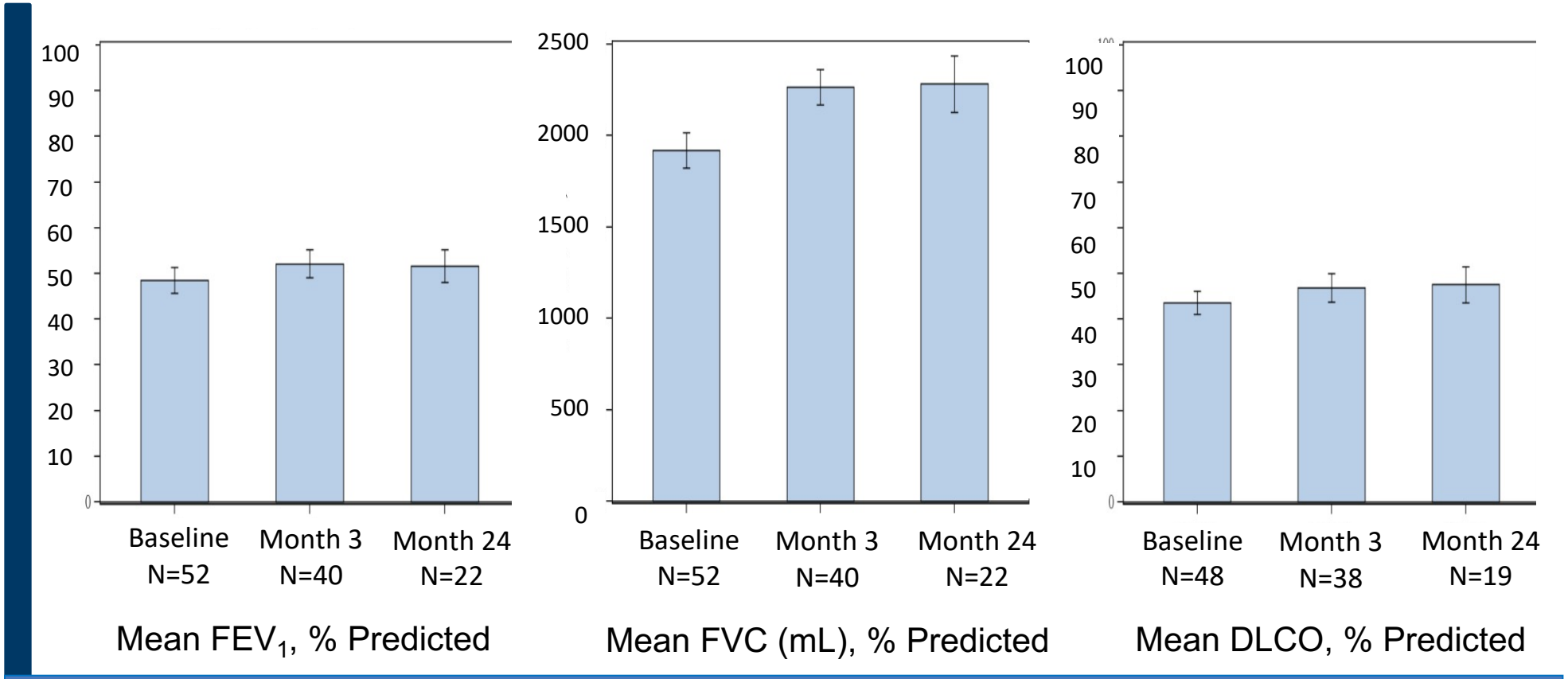
SBRT : 86%[17]

SIR Position Statement: NSCLC and Metastatic Disease to the Lungs

Recommendation	Qualifications	LOE	SOR
Stage IA	Safe and effective treatment with minimal complications and survival outcomes comparable to SBRT and sublobar resection	C	Moderate
Recurrent	Safe and effective treatment option	C	Moderate
Lung function	Should be considered alongside surgical resection and SBRT in patients who require preservation of lung parenchyma function	C	Moderate

LOE: Level of Evidence
SOR: Strength of Recommendation

Ablation: Lung Preservation



FVC improved > 400 mL 20% after RFA at 3 mos (*p = 0.02*) and 24 mos (*p = 0.01*)

Dupuy et al. *Cancer* 2015;121:3491-3498.

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Stage IA	Safe and effective treatment with minimal complications and survival outcomes comparable to SBRT and sublobar resection	C	Moderate
Recurrent	Safe and effective treatment option	C	Moderate
Lung function	Should be considered alongside surgical resection and SBRT in patients who require preservation of lung parenchyma function	C	Moderate
Metastases	May be appropriate in some patients, including those with a limited number of small (≤3 cm) lung metastases	C	Weak
Energy modality	RFA, CA, and MWA are all appropriate modalities for image-guided thermal ablation of 1° or 2° lung tumors. The method of ablation should be determined by lesion characteristics and risk mitigation and should be left to the discretion of the operating physician.	C	Weak
Biopsy	Recommended before or during thermal ablation, when safe and possible	D	Weak

LOE: Level of Evidence
SOR: Strength of Recommendation

ABLATION GUIDELINES FOR NSCLC CARCINOMA

SOURCE	DATE	Ablation Guideline	Qualifications
NCCN	2020 [1]	Stage IA	Peripheral T1abc, N0: option for selected patients
		T1-3, N0	Option for selected patients
		Multiple	Asymptomatic solitary metachronous
		Locoregional recurrence	Option for selected patients
		Locoregional recurrence	Progression on EGFR or ALK therapy: option for selected patients
ACCP/STS	2012/3 [2,3]	Stage I	Peripheral, < 3cm
CIRSE	2020 [4]	Stage I	Contraindications to surgery or stereotactic radiotherapy
			T1a, T1b: curative intent
		Other Stages	Contraindications to surgery or stereotactic radiotherapy
ESMO	2017 [5]	Stage I	Contraindications to surgery or stereotactic radiotherapy
SIR	2021 [6]	Stage IA	Safe and effective treatment with minimal complications and survival outcomes comparable to SBRT and sublobar resection
		Recurrent	Safe and effective treatment option

NCCN-National Comprehensive Cancer Network
ACCP-American College of Chest Physicians
STS-Society of Thoracic Surgeons
CIRSE-Cardiovascular & Interventional Radiology Society of Europe
ESMO-European Society for Medical Oncology
SIR-Society of Interventional Radiology

SIO

Lung Ablation: Year in Review

- For Stage I NSCLC, IGTA is a safe and effective treatment with minimal complications and survival outcomes comparable to SBRT and sublobar resection.
  - No significant sustained decline in FEV_1 and DLCO (high-risk)
- For recurrent NSCLC, IGTA is a safe and effective treatment option.
- For metastatic disease to the lungs, IGTA may be appropriate in some patients, including those with a limited number of small (≤ 3 cm) lung metastases.
- As RFA, CA, and MWA are all appropriate modalities, the method of ablation should be determined by lesion characteristics and risk mitigation and should be left to the discretion of the operating physician.
- Biopsy is recommended before or during thermal ablation, when safe and possible.

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- *Future research in the form of comparative studies (either randomized controlled trials or well-conducted cohort studies) is required to strengthen the evidence base for image-guided thermal ablation in patients with inoperable stage I NSCLC, recurrent NSCLC, and metastatic lung disease. (Level of Evidence, E; Strength of Recommendation, Moderate)*

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