ABLATION OF PULMONARY TUMORS

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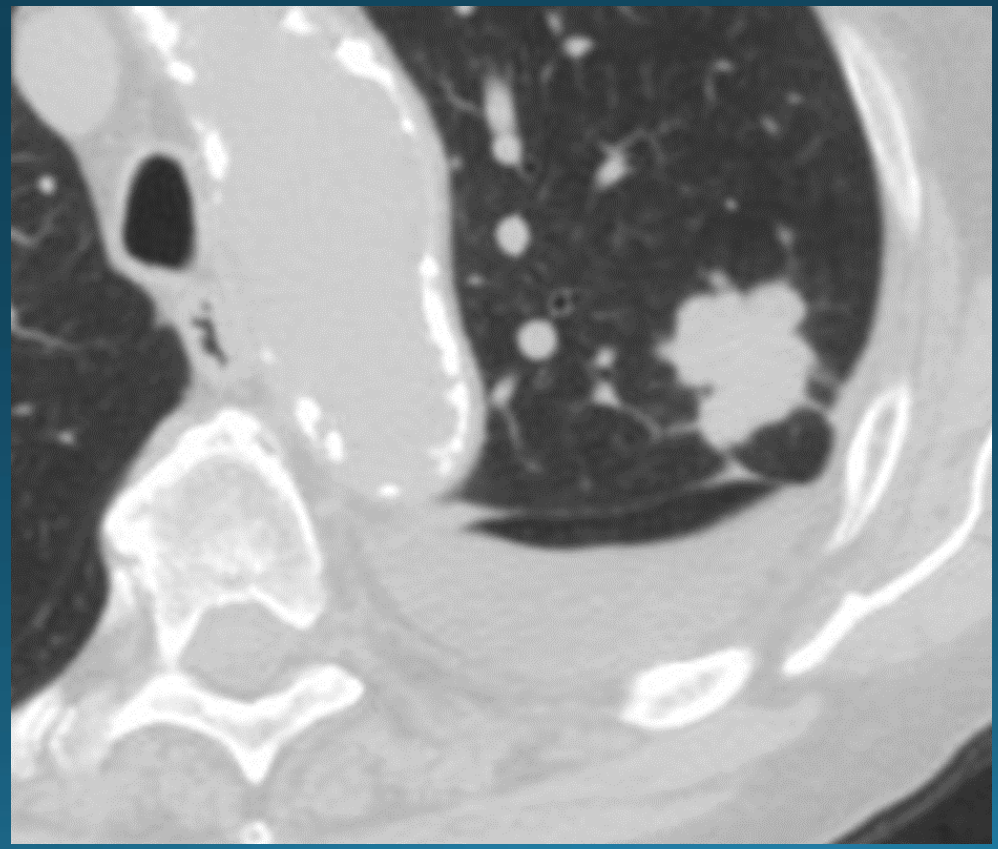
Thermal ablation

- RFA
-MWA
-CRYOABLATION

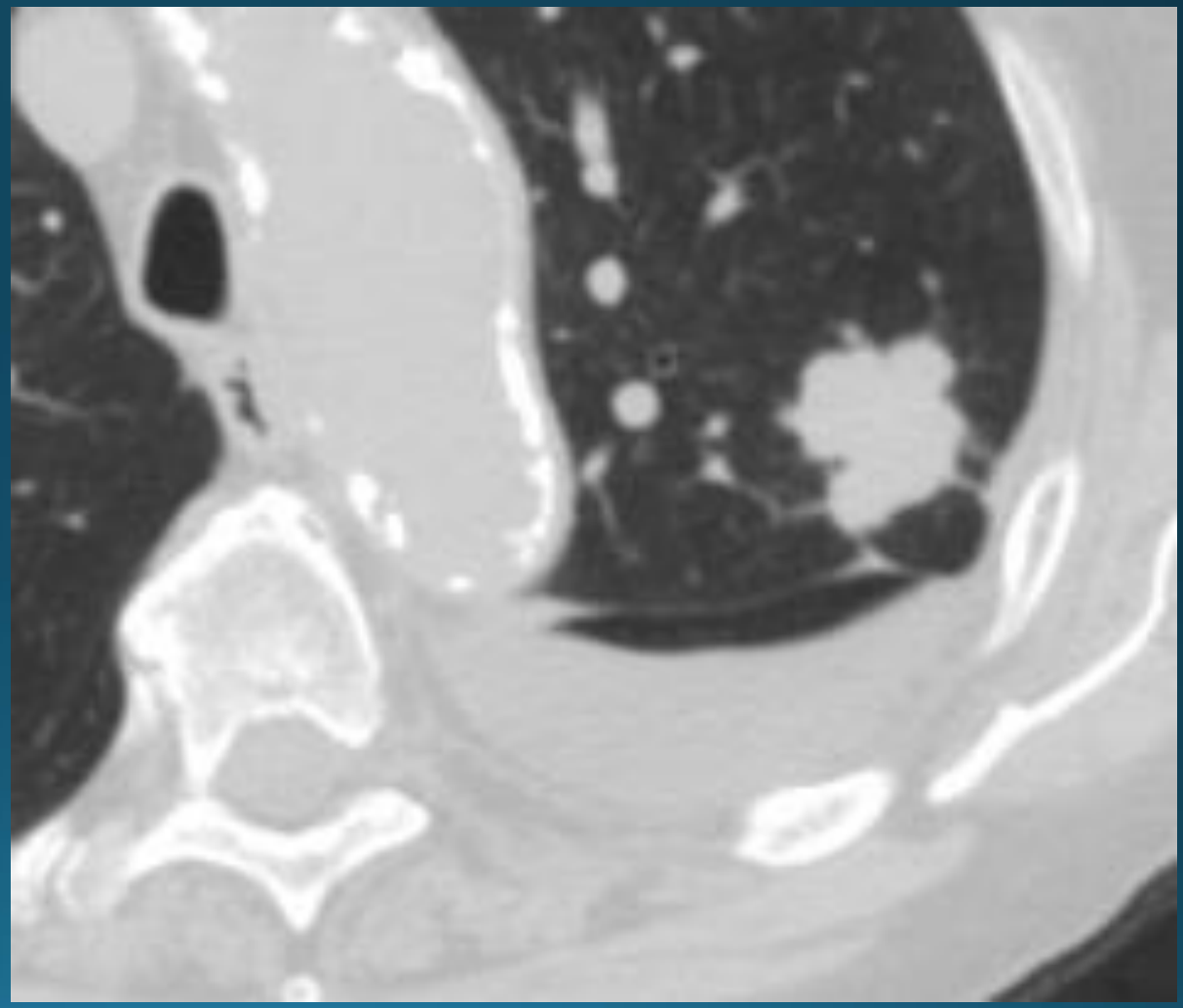
THE LUNG IS A PERFECT ORGAN FOR THERMAL ABLATION:
RFA, MWA AND CRYO-ABLATION

- HEAT: HIGH HEAT INSOLATION – ENERGY STAYS INSIDE THE TUMOR
- COLD: INDUCED EDEMA AND HEMORRHAGE IMPROVE ICE FORMATION.

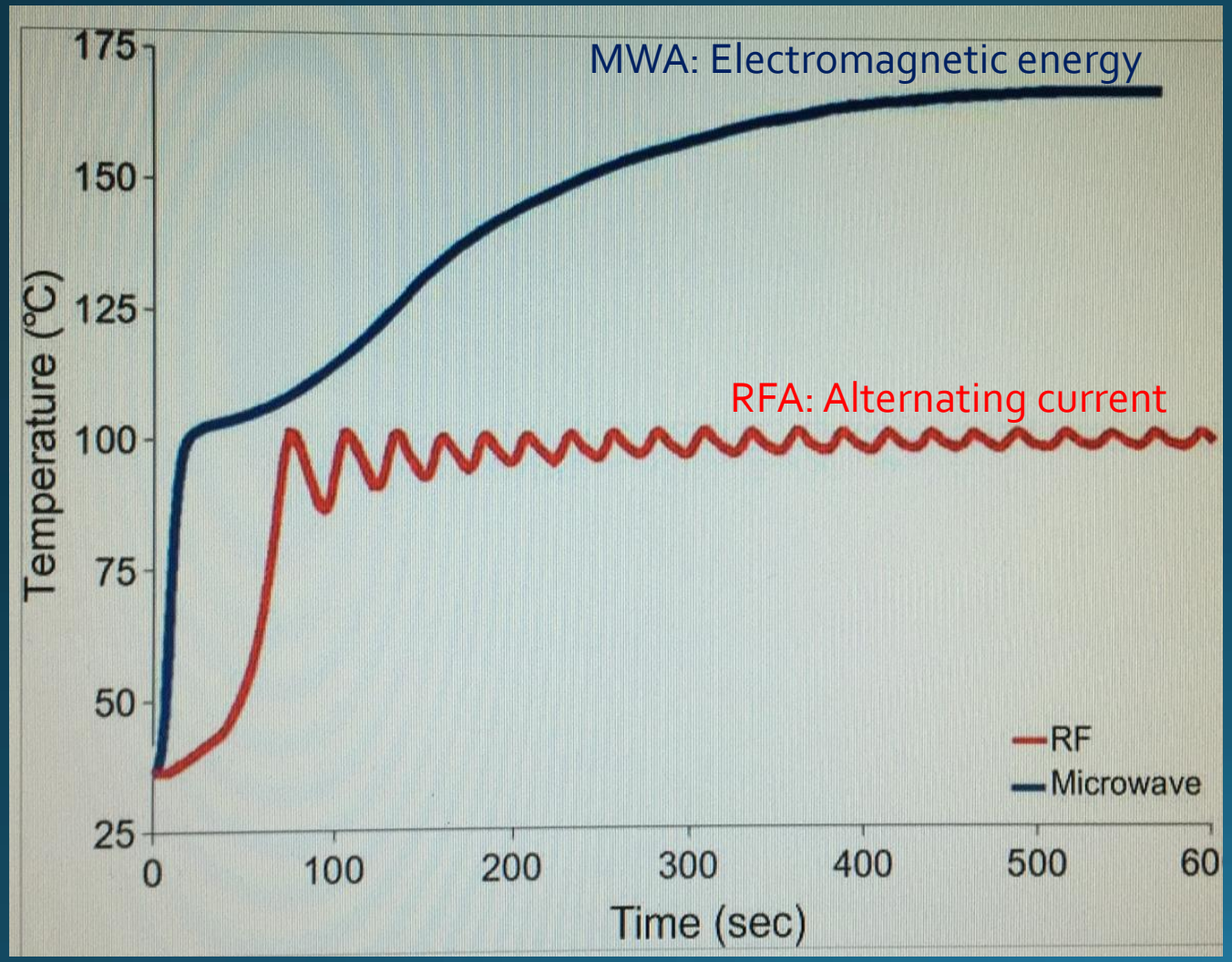


DEMANDS TO ACHIEVE TUMOR CONTROL IN THE TUMOR BED.

1. Total necrosis of the ablated area
2. Inclusion of microextensions of tumor cells in the periphery, (safetyzone)
3. Strict patient selection



ACHIVEMENT OF TOTAL ABLATION NECROSIS



FACTORS IMPORTANT FOR CELL DEATH:

- **TEMPERATURE, ABOVE 60 C - CELLS WILL DIE**
- **HOW FAST CAN THE RISE IN TEMPERATURE BE ACHIEVED**
- **IN MWA ENERGY CAN BE DELIEVERED DESPITE CHARRING AND VAPORIZATION**
- **MWA COAGULATES VESSELS UP TILL 5 MM RFA UP TILL 3 MM TO REDUCE THE HEAT SINK EFFECT.**

RADIOFREQUENCY-ABLATION

PROXIMITY TO VESSELS > 3 MM LARGER AIRWAYS

110 C, VAPORIZATION – act as electrical insulator

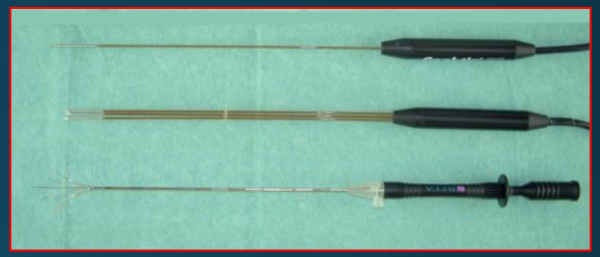
90-95 C CHARRING – act as electrical insulator

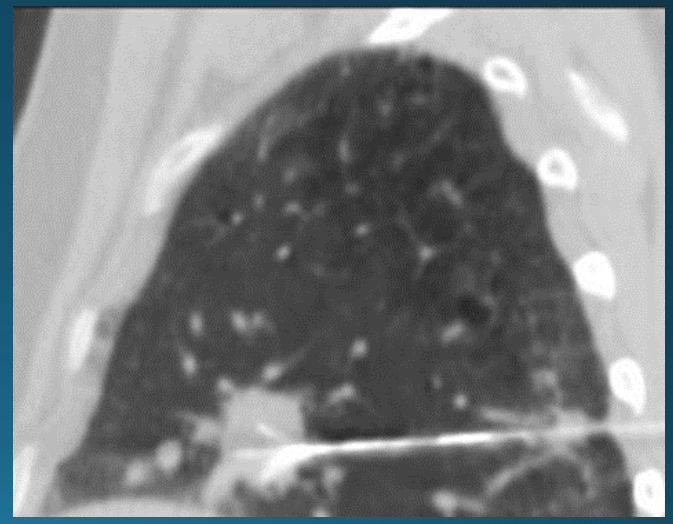
60 C CELL DEATH

37 C BODY TEMPERATURE

The principle of Radiofrequency ablation is a rapidly alternating current (4-500 kHz) between the probe positioned in the tumor and a grounding pad. Frictional heat is created by ionic agitation and a temperature above 60 C will cause cell death

IMPORTANT:
THE TISSUE HAS TO BE ABLE TO CONDUCT CURRENT.



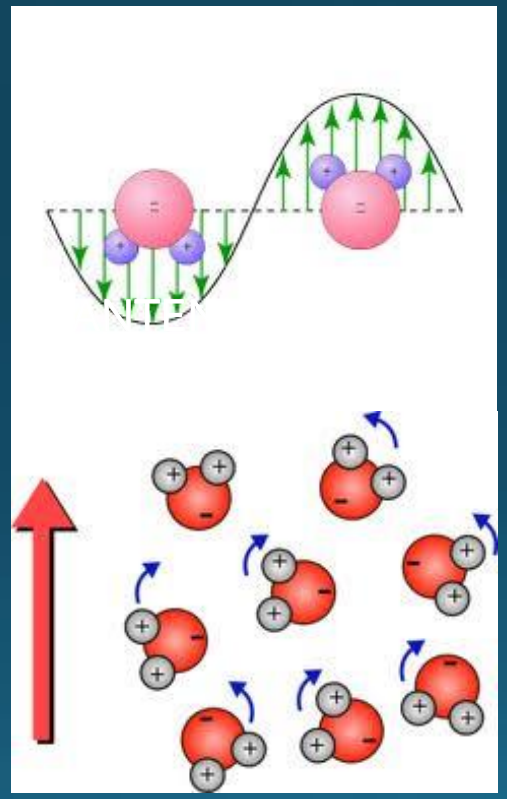


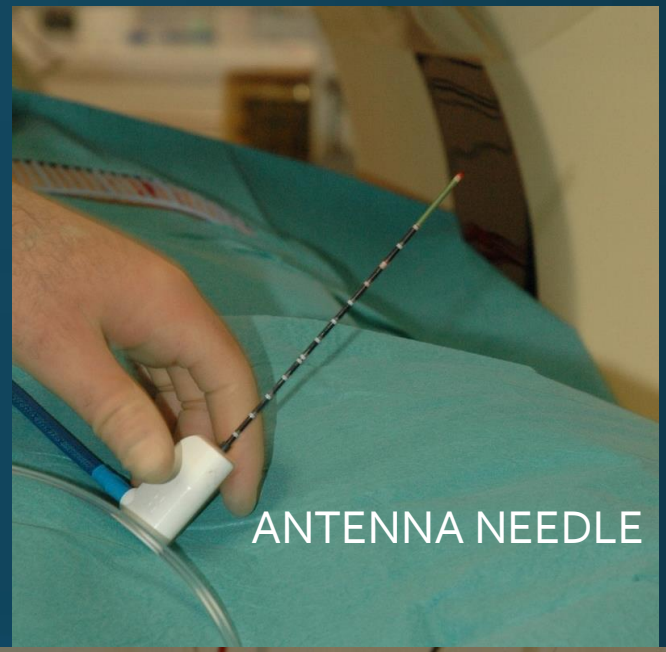
MICROWAVE-ABLATION

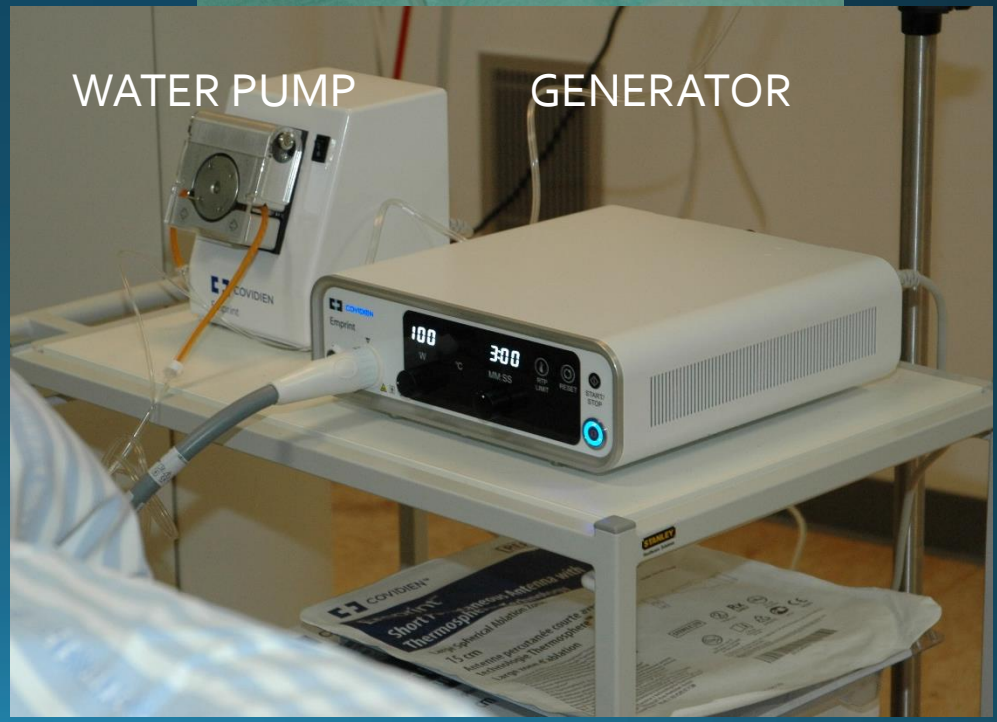
A microwave antenna applies electromagnetic energy to the tissue.

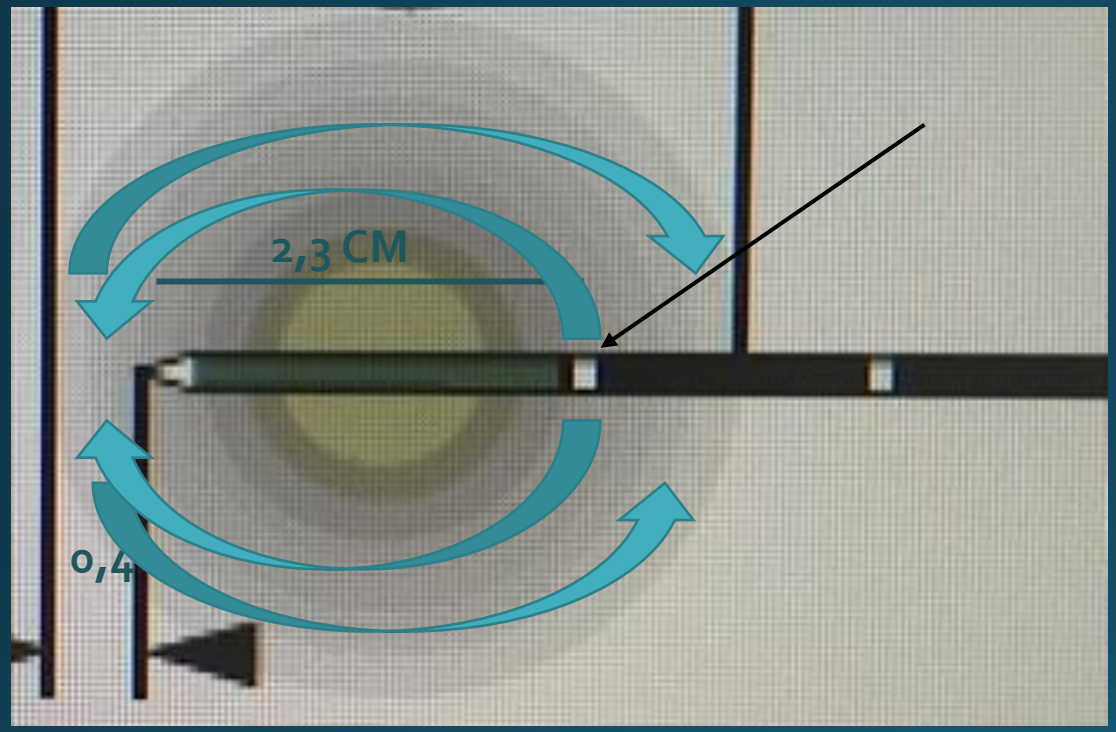
Water molecules are bipolar and will allign to the magnetic field and flip the molecules forth and backwards 2-5 billion times a second (915 or 2450 MHz) producing heat by kinetic energy.

Advantages:
No limitations by charred or desiccated tissue nor to vaporization
Coagulates vessels up till 5 mm
Fast, normally 2-10 minuttes..
100% necrotic ablation zone









THE MAGNETIC FIELD IS INITIATED FROM THE FEEDING POINT, PROPAGATES FORWARD TO THE TIP AND THEN BACKWARDS

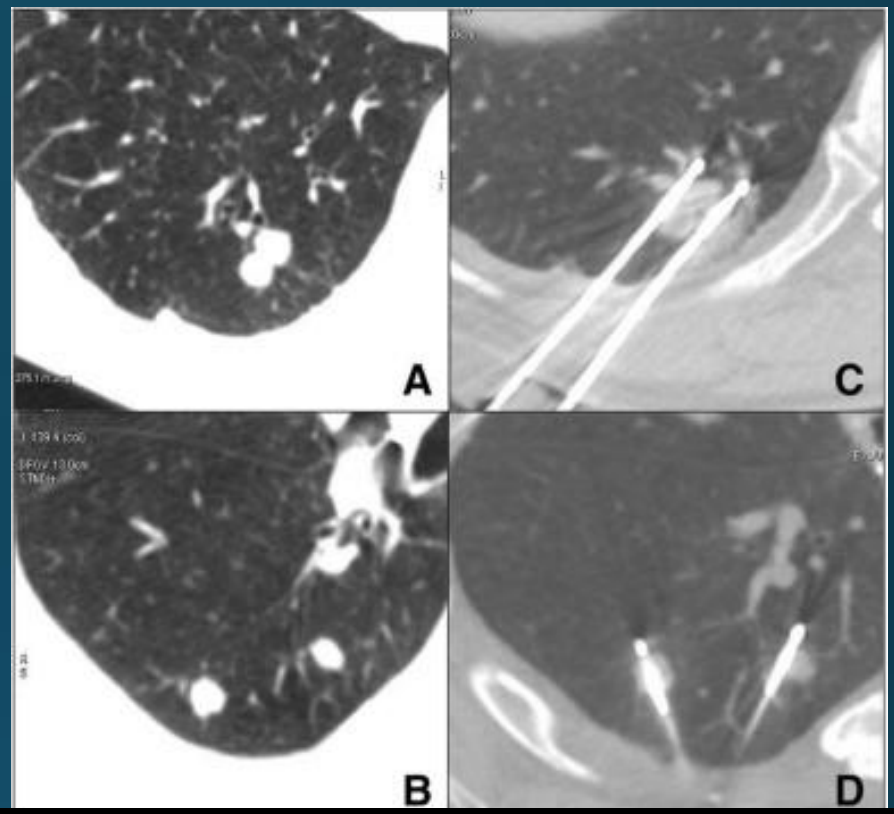
CRYOTHERAPY

At -20°C cells are killed by protein denaturation and membrane disruption.
Cooling down and thawing 3 cycles, example: freeze: 5+10+10 min.

Direct actions: Repetitive freeze-thawing cycles increases cellular injury with formation of intra- and extracellular ice crystals.

Indirect actions: vasoconstruction and occlusion of blood vessels, secondary occlusion of vessels, osmotic changes and local tissue edema

Result: hypoxic tissue injury and coagulation necrosis



Benefits:
Preserves collagenous architecture
Seems to reduce complications in areas of previous radiation
May result in less pain in tumors along the pleura

Draw backs:
more expensive and time consuming
Increased risk of hemorrhage
Increased risk of pneumothorax if multiple neddle placements
Increased risk of recurrence when a vessel >3 mm is 3 mm or less from the tumor border.

DEMANDS TO ACHIEVE TUMOR CONTROL IN THE TUMOR BED.

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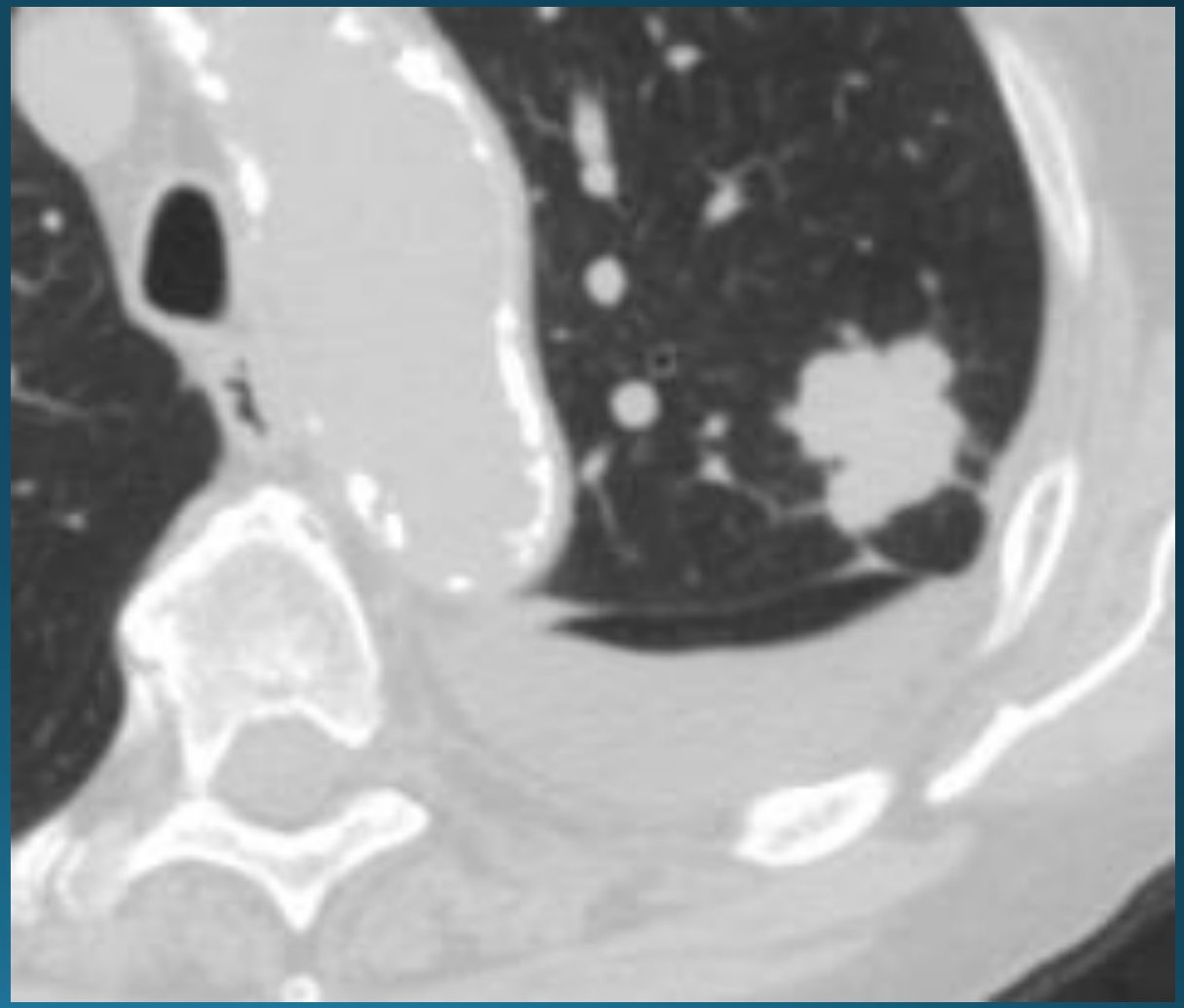
3. Strict patient selection



PRIMARY VS. SECUNDARY LUNG TUMOR

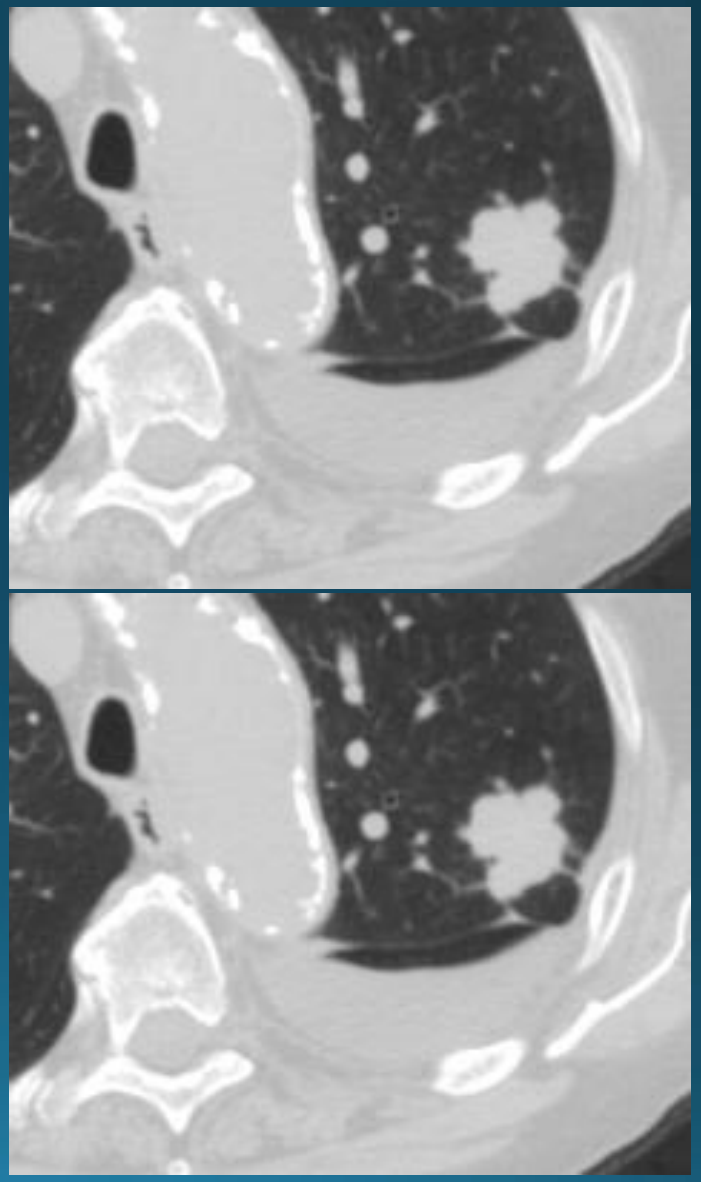
PRIMARY LUNG TUMOR:

SQUAMOUS CELL TUMOR:
MICROEXTENSIONS UP TILL 0,6 CM FROM THE TUMOR BORDER

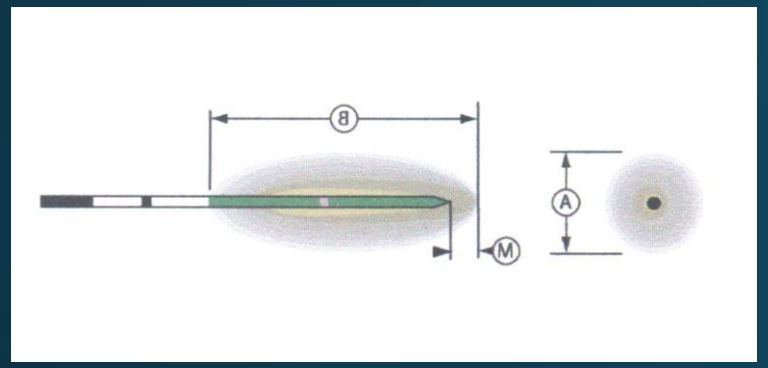
ADENOCARCINOMA:
MICROEXTENSIONS UP TILL 0,8 CM FROM THE TUMOR BORDER

METASTASIS:

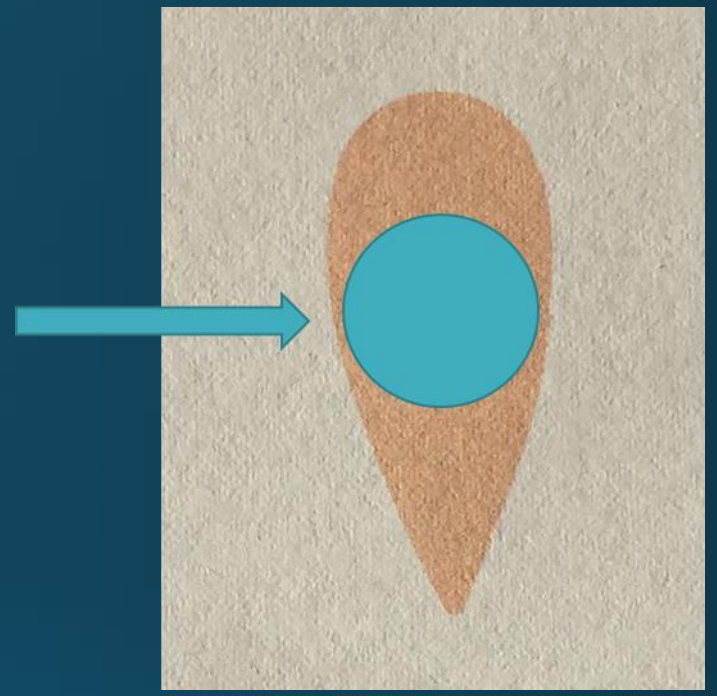
NORMALLY ONLY TUMOR CELL EXTENSIONS TOWARD THE BRONCHUS

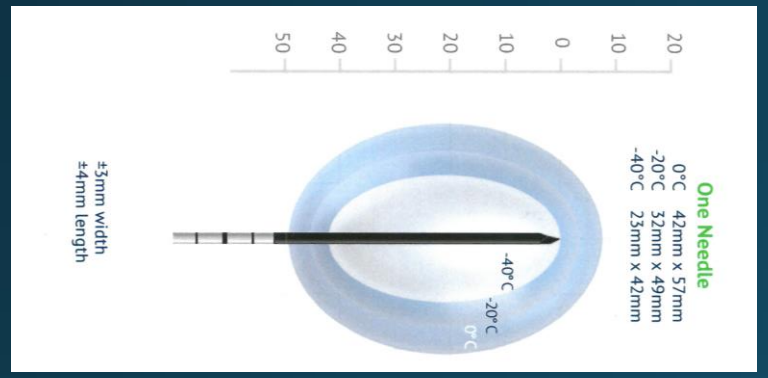


CHALLENGE IN COVERAGE

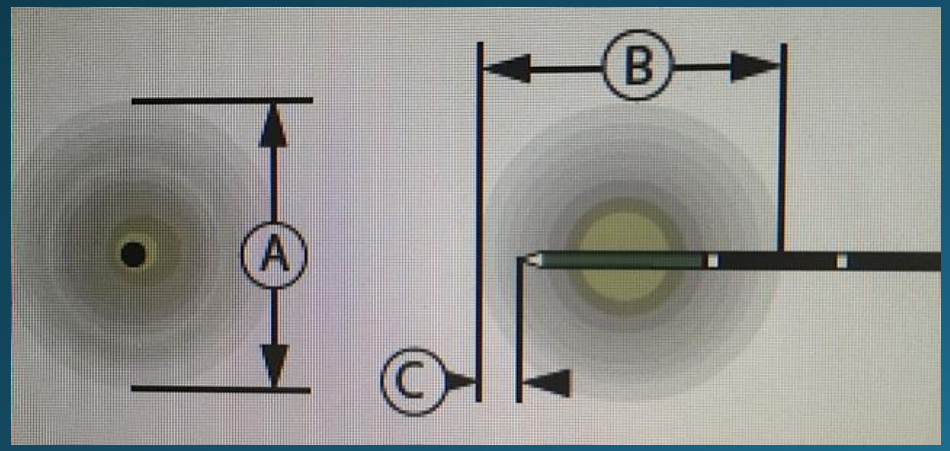


MWA AND RFA





CRYO



MWA AND RFA

Options:

1. Reposition of antenna (challenge with geometry)

2. Cluster technique seems not to be suitable in the lungs due to risk of pneumothorax and atelectasis. In actelactasis the size of necrosis is unpredictable.

DIR
Diagn Interv Radiol 2018; 24: 31–37
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INTERVENTIONAL RADIOLOGY
ORIGINAL ARTICLE

A comparison between 915 MHz and 2450 MHz microwave ablation systems for the treatment of small diameter lung metastases

Thomas J. Vogl*
Andrei Roman*
Nour-Eldin A. Nour-Eldin
Wolfgang Hohenforst-Schmidt
Iliana Bednarova
Benjamin Kaltenbach

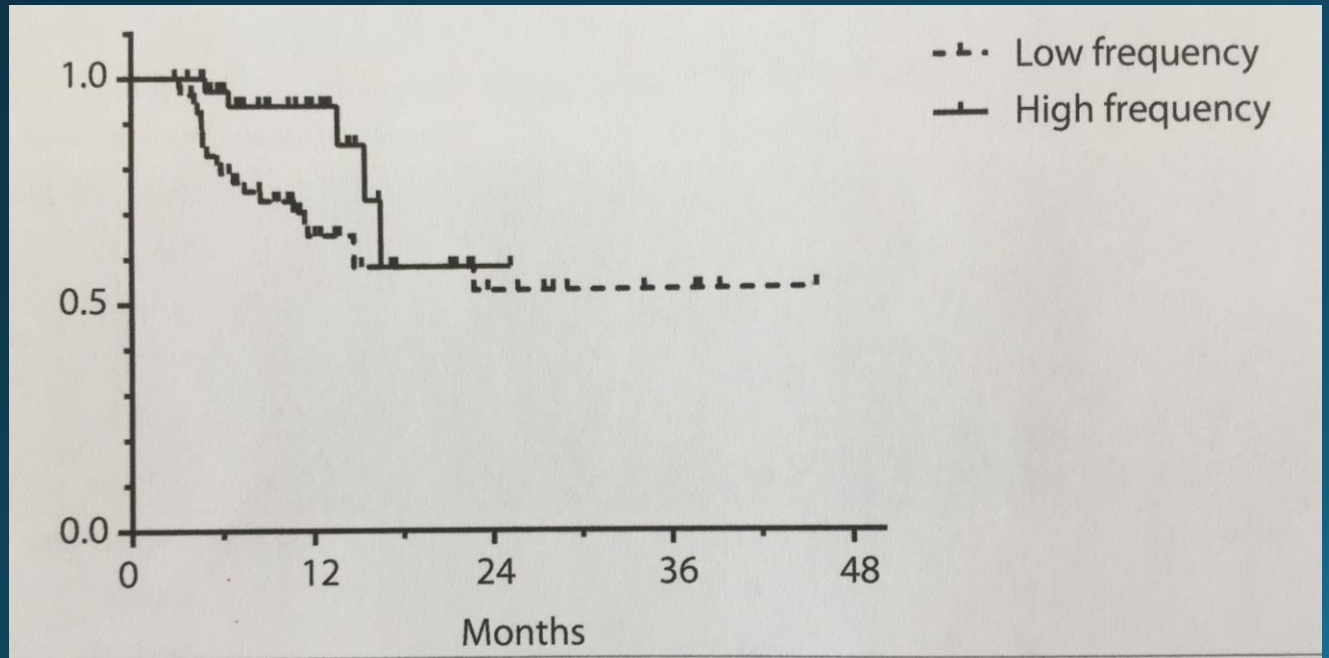


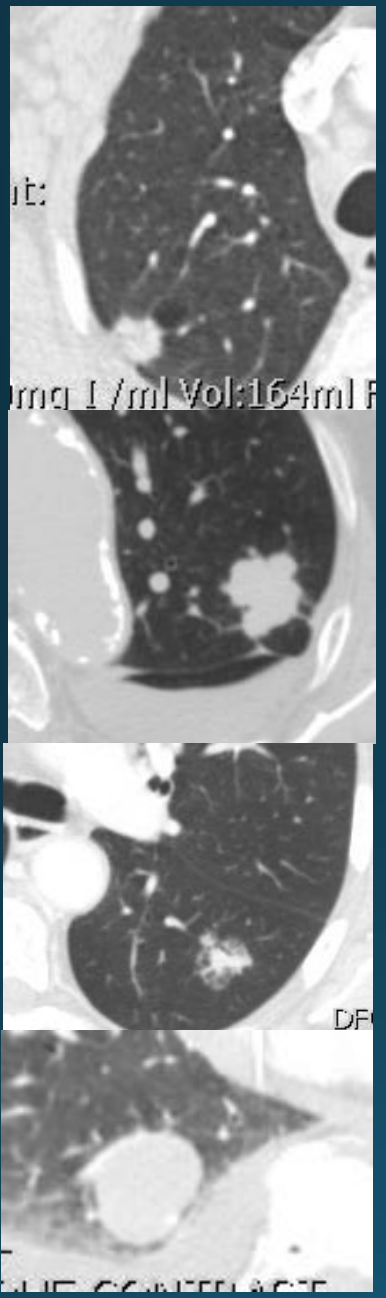
Figure 2. Local progression-free survival rates. Fewer local progressions can be observed for the HF group.

TUMORS: 55
PATIENTS: 36
FOLLOW-UP
LF, MEDIAN: 13.8 MONTHS (3-45.7)
HF, MEDIAN: 11.7 MONTHS (3-28.8)
TUMOR SIZE
LF: 1.0±0.4 CM (0.3-2.5 CM)
HF: 1.1±0.6 CM (0.4-2.56CM)

SAFETY ZONE.
LF NO LTP: 0.6±0.2 CM
LF WITH LTP: 0.3±0.2 CM
HF NO LTP: 0.9±0.4 CM
HF WITH LTP: 0.6±0.1 CM

6, 12 AND 18 MONTHS LTP FREE SURVIVAL
LF: 79%, 65.2%, 53%
HF: 97.1%, 93.7%, 58.4%

2nd generation mwa



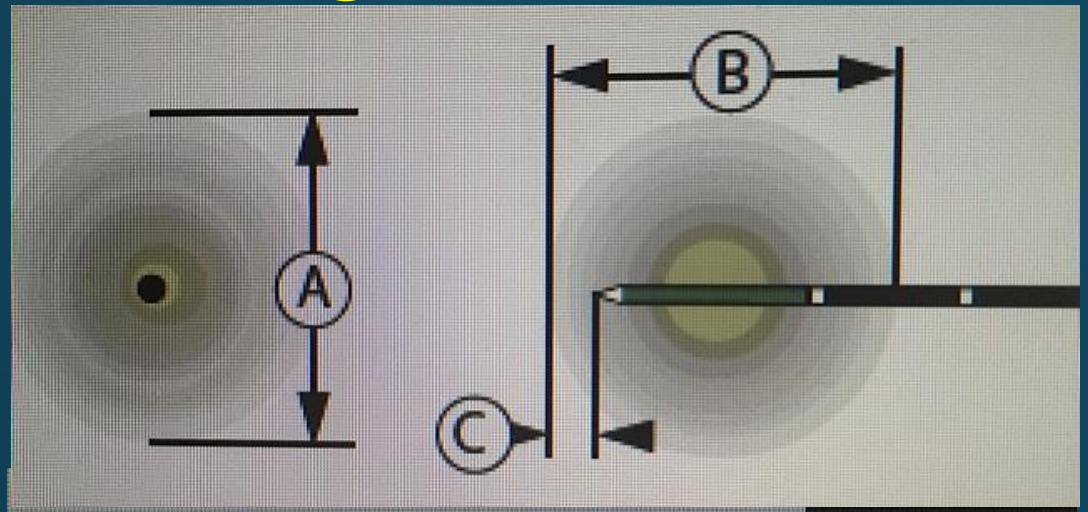


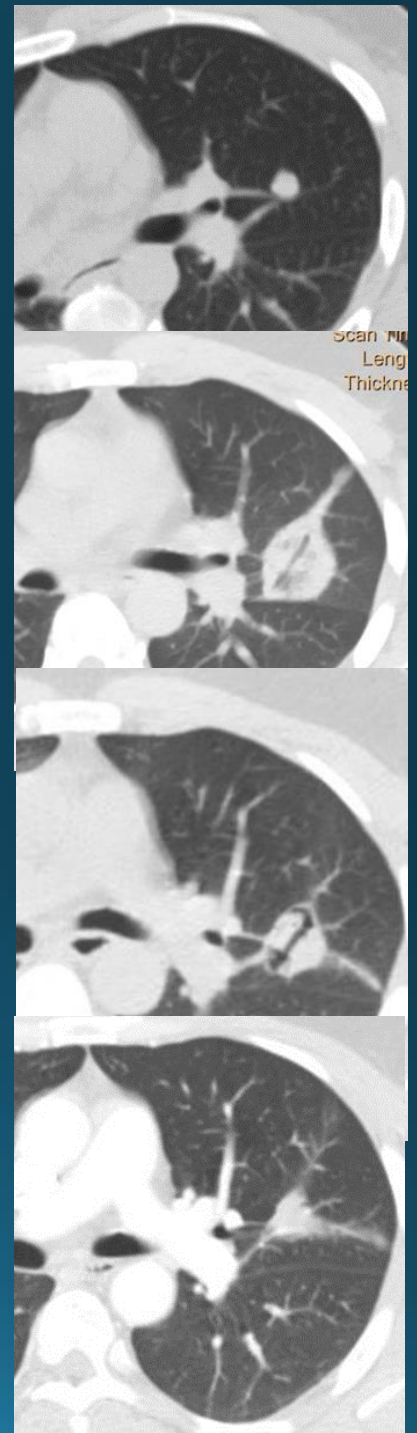
Table 3A			100 W
A	B	C	MM:SS
1.7 cm	2.9 cm	0.2 cm	1:00
2.8 cm	3.5 cm	0.3 cm	3:30
3.5 cm	3.8 cm	0.4 cm	8:30
3.7 cm	4.1 cm	0.4 cm	10:00

Before

1 week

1 month

3 months



CAN EFFECTIVELY INCLUDE TUMOR AND SAFETY ZONE

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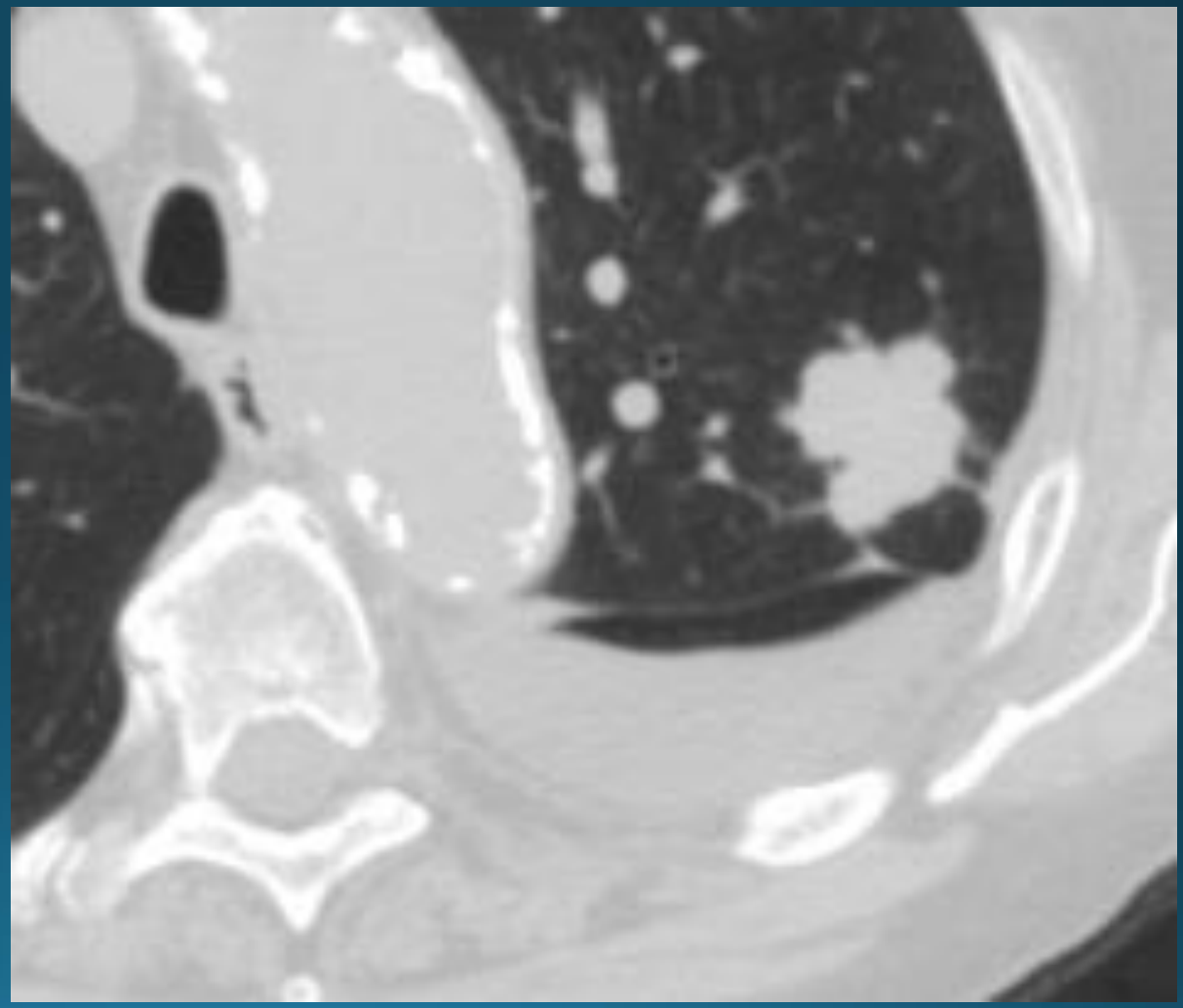
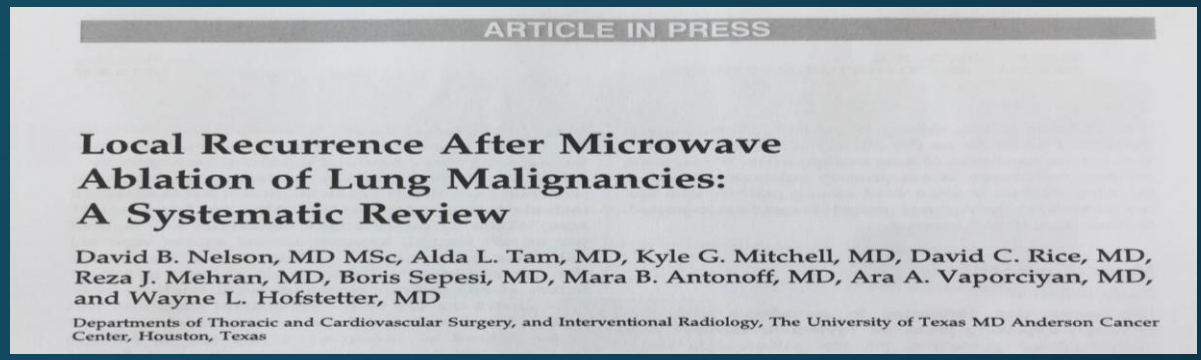


PATIENT SELECTION:

TUMOR SIZE - RISK OF RECURRENCE



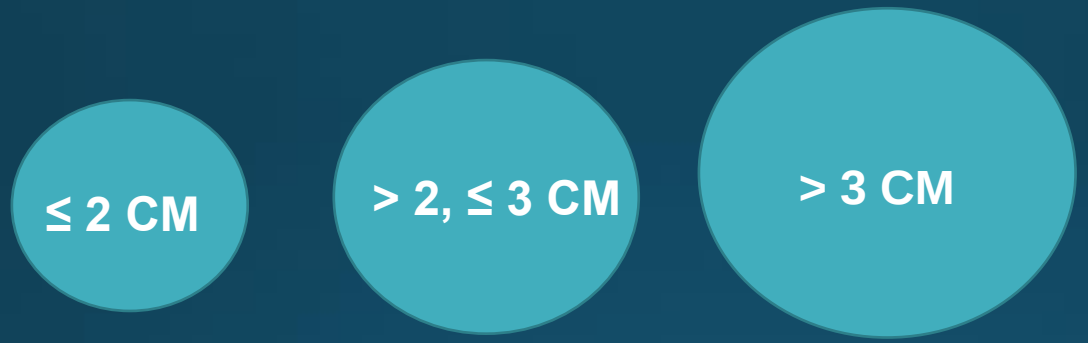
ARTICLE IN PRESS

Local Recurrence After Microwave Ablation of Lung Malignancies: A Systematic Review

David B. Nelson, MD MSc, Alda L. Tam, MD, Kyle G. Mitchell, MD, David C. Rice, MD, Reza J. Mehran, MD, Boris Sepesi, MD, Mara B. Antonoff, MD, Ara A. Vaporciyan, MD, and Wayne L. Hofstetter, MD

Departments of Thoracic and Cardiovascular Surgery, and Interventional Radiology, The University of Texas MD Anderson Cancer Center, Houston, Texas

The Society of Thoracic Surgeons



Tumors > 3 or 4 cm in 4 studies:	26, 36, 50 and 75%
Tumors less than 3 or 3,5 cm in 4 studies:	5, 18, 18 and 19%

TREND:
CORRELATION BETWEEN ESTIMATES OF LOCAL RECURRENCE AND YEAR OF TREATMENT.
STUDIES WHERE LAST PATIENTS WERE ENROLLED IN 2011, ESTIMATES OF RECURRENCE: 22-37%
FOR LAST PATIENTS ENROLLED IN 2016 THE ESTIMATES OF RECURRENCE: 9-26%

PATIENT SELECTION:

TUMOR LOCATION - RISK OF RECURRENCE
Cut-off 5 cm from hilum.

Thermal Ablation of Colorectal Lung Metastases: Retrospective Comparison Among Laser-Induced Thermotherapy, Radiofrequency Ablation, and Microwave Ablation

VOGL TJ ET AL. AJR 2016;207:1340-1349

	MWA	RFA
CENTRAL LESION WITH COMPLETE ABLATION	5	3
CENTRAL LESION WITH TUMOR PROGRESSION	7	8
PERIPHERAL LESION WITH COMPLETE ABLATION	86	42
PERIPHERALLESION WITH TUMOR PROGRESSION	5	12

METASTASIS 0.5 – 5 CM

PATIENT SELECTION:

PATIENTS WITH HIGHER RISK OF COMPLICATIONS

LUNG FIBROSIS (UIP / NSIP)
PREVIOUS RADIATION THERAPY IN THE AREA
BULLOUS OR SEVERE EMPHYSEMA
PULMONARY HYPERTENSION

INFECTION/ABSCES
PNEUMONONITIS
PNEUMOTHORAX
HEMORRHAGE

PATIENT SELECTION:

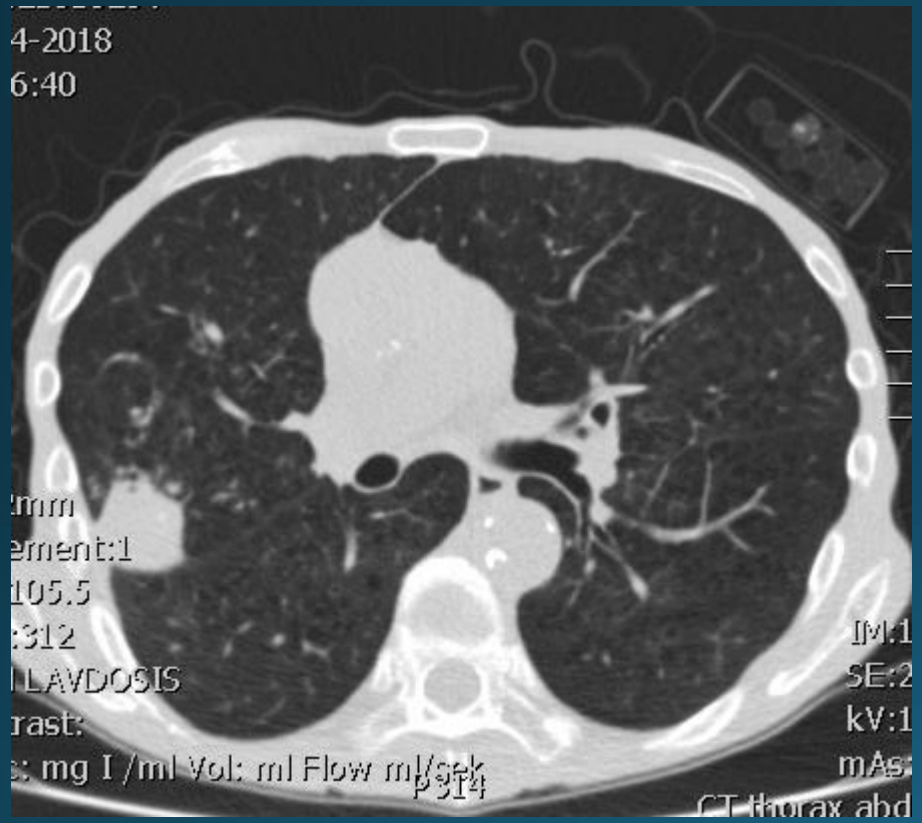
TUMOR LOCATION - RISK OF COMPLICATIONS OR INCOMPLETE ABATION

≥ 1 CM FROM:

- **MAJOR AIRWAYS.**
- **HEART.**
- **LARGER VESSELS.**
- **PHRENIC- RECURRENT- AND BRACHIAL NERVES.**
- **DIAPHRAGM.**

EARLY-STAGE-LUNG CANCER – CURATIVE INTENTED TREATMENT

TREATMENTS STRATEGY CONSENCUS AT THE MULTI DISCIPLINARY - TUMOR BOARD.



- BIOPSY PROVEN MALIGNANCY
- EBUS BIOPSIES: N0
- NEGATIVE PET OR BIOPSY PROVEN NON-MALIGNANCY IN SUSPICIOUS CT- AND PET FINDINGS.

TREATMENT STRATEGY, EARLY STAGE LUNG CANCER

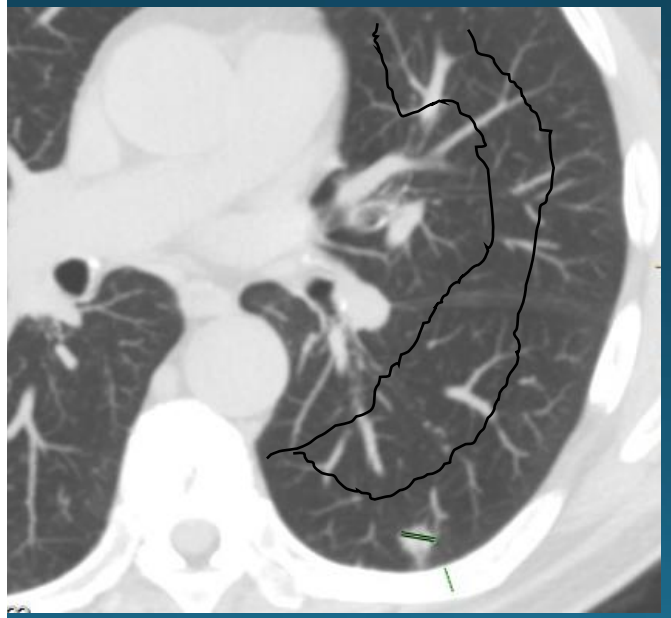
Peripheral zone:	**MWA or SBRT**
Mid zone:	**SBRT or MWA**
Central zone:	**SRBT**

EARLY-STAGE-LUNG-CANCER FOR MWA/RFA:

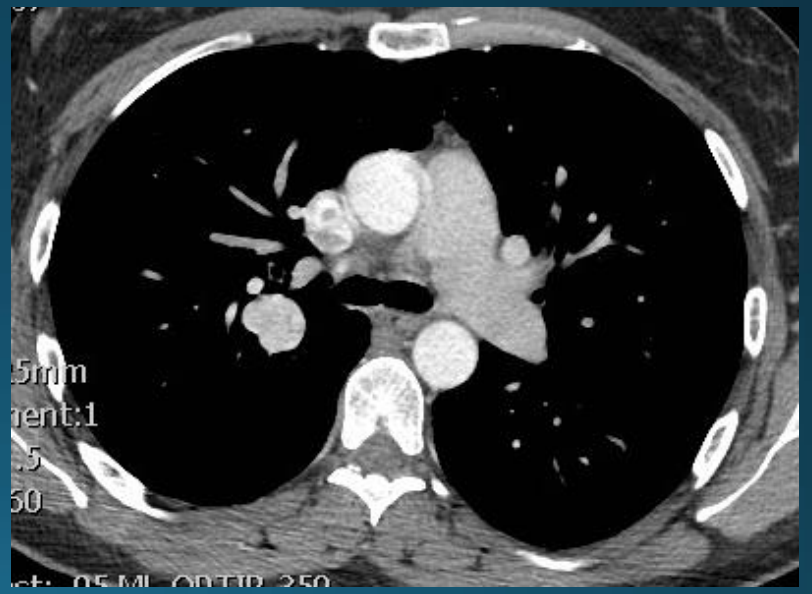
- **NON-SURGICAL CANDIDATES**
- **PRIMARY LUNG TUMOR ≤2-3 CM**
- **LOCAL TUMOR BED RECURRENCE AFTER RADIATION THERAPY OR SURGERY**
- **PATIENTS WHO REFUSE SURGERY.**

OR

- **IF TOP PRIORITY IS TO PRESERVE LUNG CAPACITY.**



CRYO- RFA- MWA ≤ 3 CM



STEREOTACTIC RADIATION ≤ 4 CM

OUTCOME AFTER RF- AND MW-ABLATION OF PRIMARY LUNG CANCER.

			Overall survival	Disease free survival
Simon CJ 2007	75 ptt RFA	75% Stage 1A 25% Stage 1B Size: 2.7 cm (0.6-8.5 cm)	1Y 2Y 3Y 5Y 78% 57% 37% 27% Tumors ≤ 3 cm: 5Y ≈ 50%	local tumor progression free rates for tumors ≤ 3 cm: 1Y 2Y 3Y 4Y 5Y 83% 64% 57% 47% 47%
Lencioni R 2008	33 ptt., 38 tumors RFA Prospective Multi Center	< 3.5 cm Mean: 1.7 cm (0.5-3.4 cm)	All tumors 1Y 2Y 70% 48% Stage 1 2Y 79% Stage I, 2Y cancer specific surv: 92%	DFS: at least 1Y follow-up: 88% (includes both primary lung cancer and metastases)
Simon TG 2012	82 ptt	1.0-5.4 cm, mean: 2.1 cm N0-disease. 75 ptt. stage: 1A + 1B	Stage 1A 1Y 3Y 84.2% 76.1% Stage 1B 1Y 3Y 79% 67.3%	NA
Kodama K 2012	44 ptt, 54 tumors Recurrence after surgery	0.6 – 4 cm, mean: 1.7 cm± 0.9	Tumors ≤ 3 cm 1Y 3Y 5Y 100% 79.8% 60.5% 3.1 – 4.0 cm 1Y 3Y 83.3% 31.3%	DFS: 1Y 3Y 76.7% 41.1%
Dupuy DE 2015	51 ptt., 51 tumors RFA Prospective Multi Center	≤ 3 cm, Stage 1A	All tumors 1Y 2Y 87.3% 69.8% tumors < 2 cm 2Y 83.3%	Local recurrence free rate: 1Y: 68.9%, 2Y: 59.8% Local recurrence within the first year did not affect survival
Palussièr J 2015	87 ptt RFA + MWA (5)	Median size: 2.1 cm (1-5.4cm) N0-disease, 75% stage 1, 3% stage 2A+3A, 22% stage IV	1Y 2Y 3Y 5Y 91.9% 77.5% 66.1% 58.1%	DFS: 1Y 2Y 5Y 64.5% 46.1% 27.9%

BEFORE TREATMENT:

OLIGOMETASTATIC LUNG DISEASE

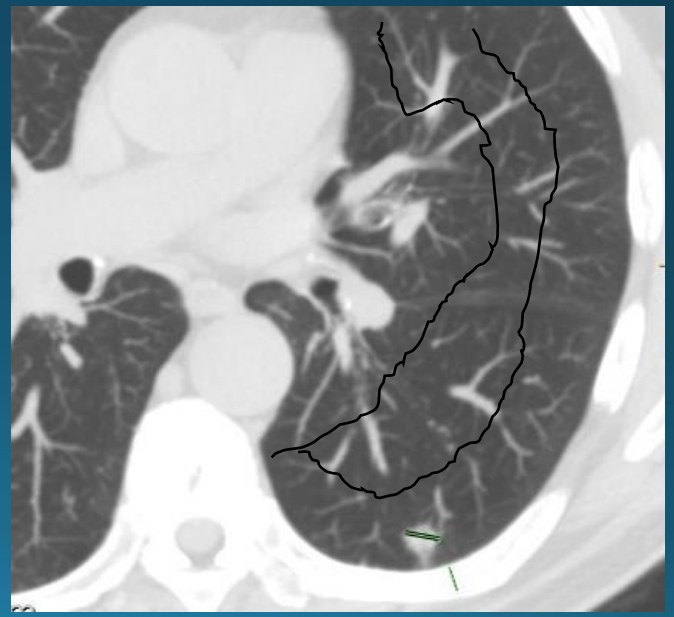
- KNOWN PRIMARY MALIGNANT TUMOR
- BIOPSY PROVEN MALIGNANCY IN LUNG TUMOR
  OR BIOPSY PROVEN MALIGNANCY FROM SYNCHRONOUS METASTASES IN OTHER ORGAN E.G LIVER IN CRC.
- OR IF SMALL AND NOT SUITABLE FOR BIOPSY, WITH TUMOR GROWTH ON 2 SUCCESSIVE CT-SCANS (MIN. 25% INCREASE IN VOLUME OVER 3 MONTHS)

TREATMENT STRATEGY IN OLIGOMETASTATIC LUNG DISEASE

OLIGOMETASTATIC LUNG DISEASE FOR RF- OR MW-ABLATION:

- NON-SURGICAL CANDIDATES OR IF SURGERY FOR A SMALL METASTASIS DUE TO LOCATION MAY COST AN ENTIRE LOBE
- TUMOR ≤3 CM
- MAX 2-3 LUNG METASTASES
- OR PATIENTS WHO REFUSE TO UNDERGO SURGERY.

Location:	
Peripheral zone:	MWA/RFA – SRBT
Mid zone:	MWA/RFA – SRBT
Inner zone:	SRBT – MWA/RFA



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Published online 16 February 2015

Radiofrequency ablation is a valid treatment option for lung metastases: experience in 566 patients with 1037 metastases

T. de Baère[1]*, A. Aupérin[2], F. Deschamps[1], P. Chevallier[3], Y. Gaubert[4], V. Boige[5], M. Fonck[6], B. Escudier[5] & J. Palussiére[7]

Departments of [1]Image Guided Therapy; [2]Biostatistics, Gustave Roussy Cancer Campus, Villejuif; [3]Department of Imaging, Hopital Archet 2, Nice; [4]Department of Imaging, Hopital de la Timone, Marseille; [5]Department of Medical Oncology, Gustave Roussy Cancer Campus, Villejuif; Departments of [6]Medical Oncology; [7]Imaging, Institut Bergonie, Bordeaux, France

Table 1. Rates (standard error) of overall survival, progression-free survival and treatment failure according to the primary

	Primary				
	Colon (N = 191)	Rectum (N = 102)	Kidney (N = 68)	Sarcoma (N = 51)	Other (N = 154)
Overall survival					
1 year	92.9% (1.9)	93.6% (2.5)	95.5% (2.6)	94.1% (3.3)	89.0% (2.6)
3 years	76.1% (3.7)	64.9% (6.3)	73.5% (6.5)	58.0% (8.2)	59.1% (4.6)
5 years	56.0% (6.0)	49.6% (8.4)	53.8% (9.1)	41.5% (9.3)	49.4% (6.4)
Progression-free survival					
1 year	37.6% (3.6)	30.4% (4.8)	39.7% (5.9)	43.0% (7.0)	49.0% (4.1)
3 years	17.0% (3.0)	8.6% (3.2)	13.8% (4.9)	26.5% (6.6)	17.6% (3.4)
5 years	14.8% (3.0)	6.4% (3.0)	9.2% (5.0)	15.9% (6.2)	7.6% (3.9)
Treatment failure					
1 year	10.9% (2.4)	14.5% (3.7)	7.4% (3.2)	6.1% (3.4)	9.9% (2.5)
2 years	16.2% (3.0)	30.7% (5.7)	13.0% (5.0)	8.3% (4.0)	16.4% (3.5)
3 years	16.2% (3.0)	30.7% (5.7)	25.1% (9.3)	8.3% (4.0)	16.4% (3.5)

Tumor size: 4-70 mm,
mean: 17 mm, median: 15 mm
Tumor ≤ 2 cm: 70%
>2, ≤ 3 cm: 22%
>3 cm: 8%

5Y OS all metastases: 51% - With-in the range of best results obtained by surgery

4 Y DFS all metastases: 13.1% - call for neo-adjuvant or adjuvant chemotherapy?

Local tumor progression at the site of RFA

	1Y	2y	3Y	4y
Per patient:	10.4%	15.5%	17.5%	18.1%
Per tumor:	5.9%	8.5%	10.2%	11.0%

Effect of strict inclusion criteria

	Median OS	Size	Mean number of metastases	Extrapulmonary disease	Disease free interval < 12 mo.
De Beare T (2015) Ptt: 566	62 months	92% ≤ 3 cm Median: 1.5 cm	1.8	22%	21%
Chua TC (2010) Ptt: 148	51 months	40% > 4 cm			
Gillams A (2013) Ptt: 122	41 months		3.3	51%	52%

De Baere T et al. Annals of Oncology 26:987-991, 2015
Chua C et al. Annals of Oncology 21:2017-2022, 2010
GillamsA et al. Eur Radiol (2015) 25:3438-3454

Cryoablation

Yashiro H 2013 (1)	**71 ptt. 11 primary cancer 199 metastasis Technical failures: 20,5%**	**Size, median: 12,8 mm Range: 3-42mm Observation time: Median 454 days (79-2467)**		**Local progression free survival: 1Y 2Y 3Y 80,4% 69% 67,7% Vessel >3mm increased risk of recurrence**
McDewitt JL 2016	42 ptt 19 primary cancer 24 metastasis Technical failures: 2%	21: less than 2 cm 13: 2-3 cm 13: > 3cm	OS T1 tumor: 1Y 2Y 3Y 100% 86% 63%	median progression free survival: 11 months
De Baere T 2015	40 ptt 60 metastasis	Mean: 1,4 cm. 48: less than 2 cm 11: 2-3 cm 1: > 3cm	Minimum 12 mo. Follow-up. 1Y OS: 97,5%	Local tumor control: 1Y: 94,2 %

(1) J Vasc Interv Radiol 2013; 24:813–821, (2) J Vasc Interv Radiol 2016; 27:1371–1379, (3) J Thorac Oncol. 2015;10: 1468–1474

WHICH ABLATION TECHNIQUE IS SUPERIOR?

- NO EVIDENCE FOR DIFFERENCES IN TERMS OF EFFICACY OR COMPLICATIONS BETWEEN RFA AND MWA
- MWA HAS BETTER LOCAL TUMOR CONTROL IN RECENT COMPARED TO PRIMARY REPORTS
- DIFFERENT INCLUSION CRITERIAS IN STUDIES
- DIFFERENT ABLATION SYSTEMS

TREATMENT PLANNING

example: mwa

THE HIGHER EFFECT, THE BETTER?

-

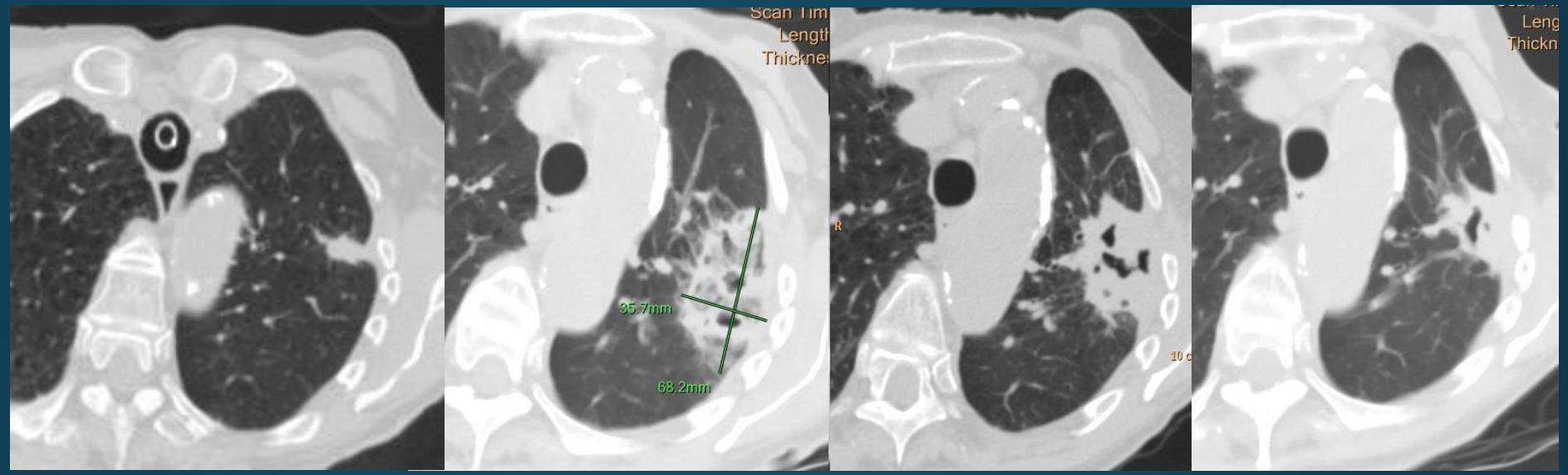
WE RECOMMEND MAX 75w IN THE LUNGS.

100w: WE HAD 3 REFERRALS TO THORACIC SURGERY UNIT IN THE FIRST 12 PATIENTS

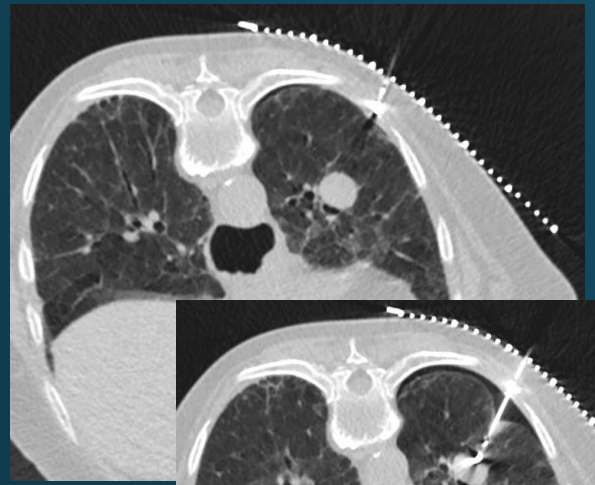
AFTER DECREASE IN EFFECT FROM 100 TO 75w WE REDUCED THE FREQUENCY FROM 25 TO 4%

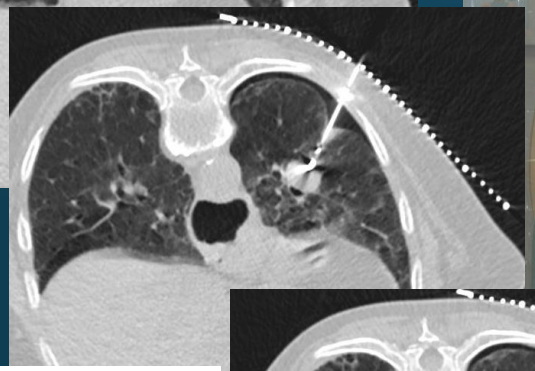
TREATMENT PLANNING - LOCATION AND ABLATION NECROSIS

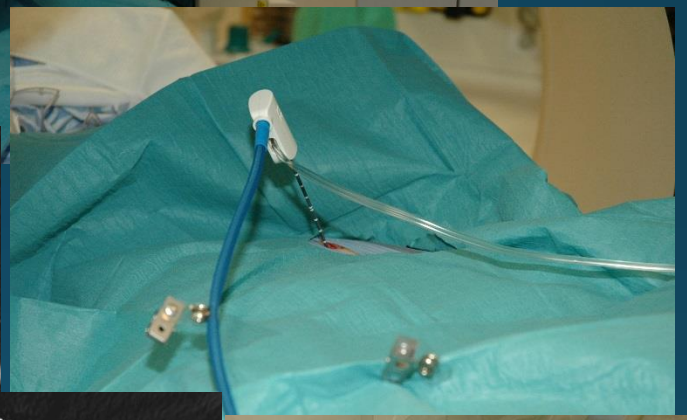
ABLATION CLOSE TO THE CHEST WALL WILL RESULT IN A MORE ELONGATED NECROSIS, LARGER THAN PREDICTED



Before 1 week 1 Month 3 Months







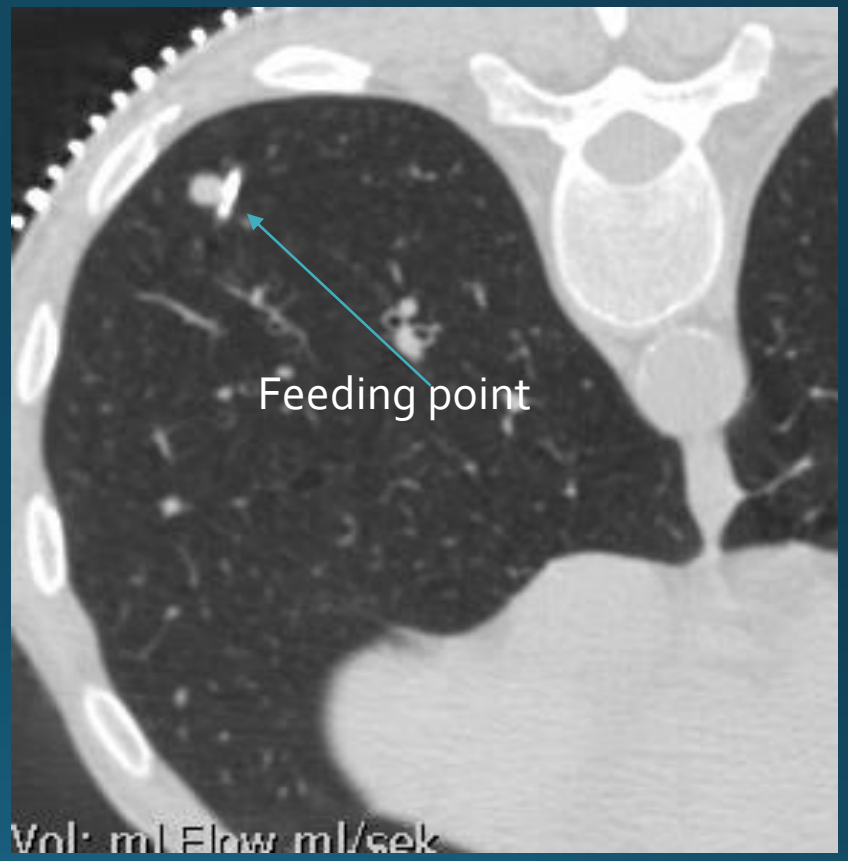
CT-FLOURO-TECHNIQUE
COLLIMATION: 2.4 MM
30-50 mAS.

NEDDLE PUNCTURE IN SAME RESPIRATORY PHASE, NORMALLY EXPIRATION

Procedural time:
Positioning of antenna and MWA:
5-15 minuttes.
The time consuming part is preparation and anesthesia.

Typical case:
Patient arrives 08.00
Patient ready for extubation:
09.10 – 09.30.

SMALL NODULES



In particular CRC metastasis presents hard and difficult to penetrate

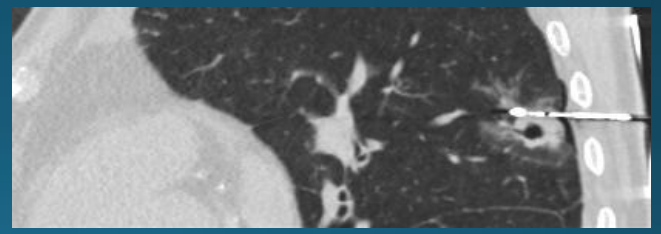
QUALITY CHECK IMMIDIATELY AFTER TREATMENT
THE SAFETY ZONE.

2 MIN. AFTER START OF ABLATION

4 MIN.

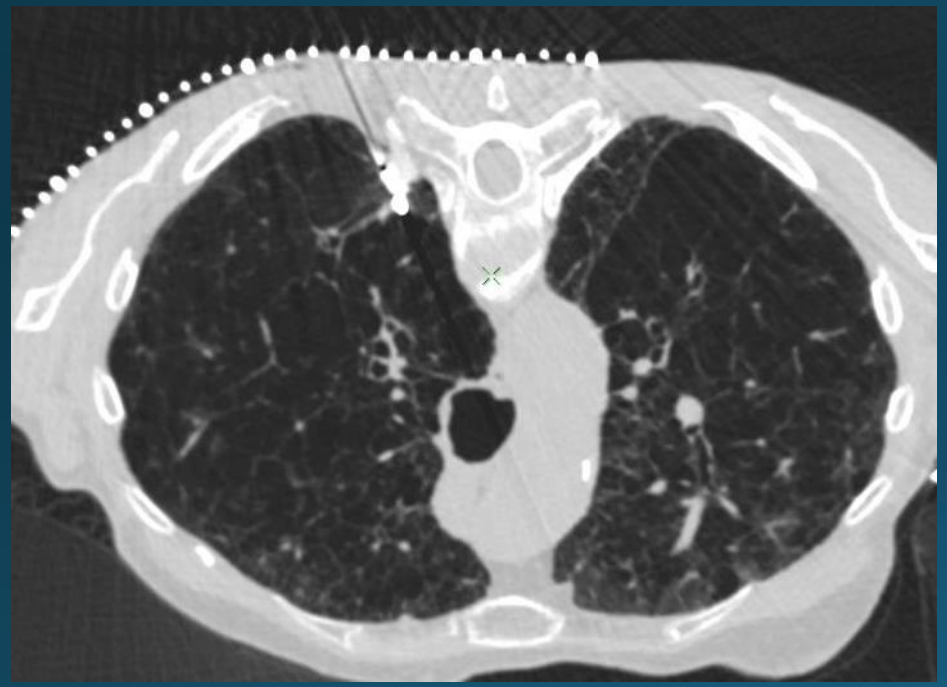
12 MIN.
TUBE INSERTED

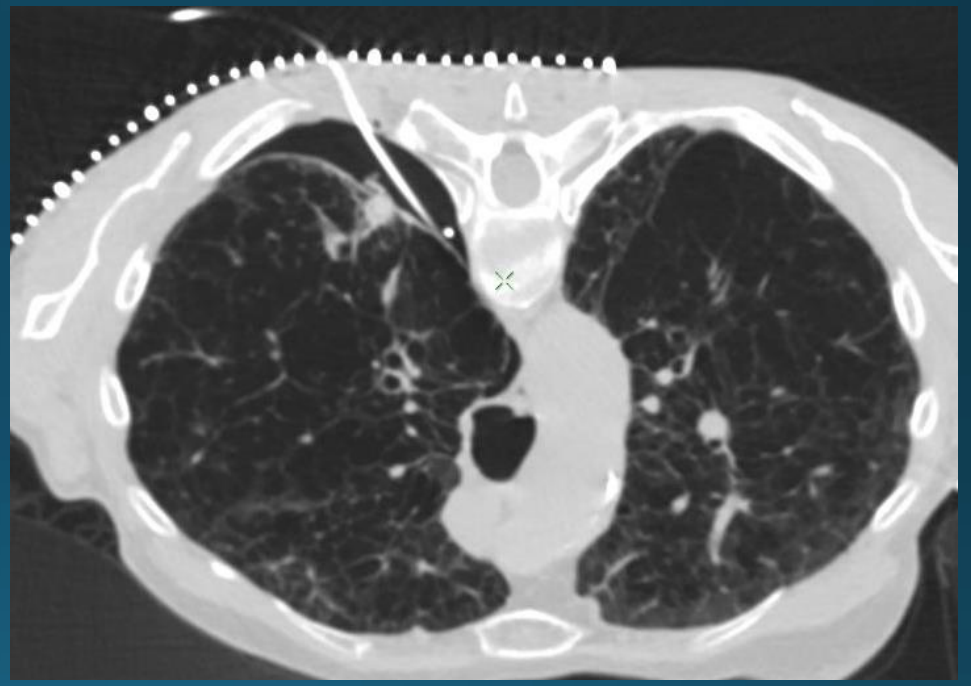
REPOSITION OF ANTENNA



PULL THE NEEDLE BACK AND REPOSITION WITHOUT AN ADDITIONAL PUNCTURE

PNEUMOTHORAX AND TUBE PLACEMENT



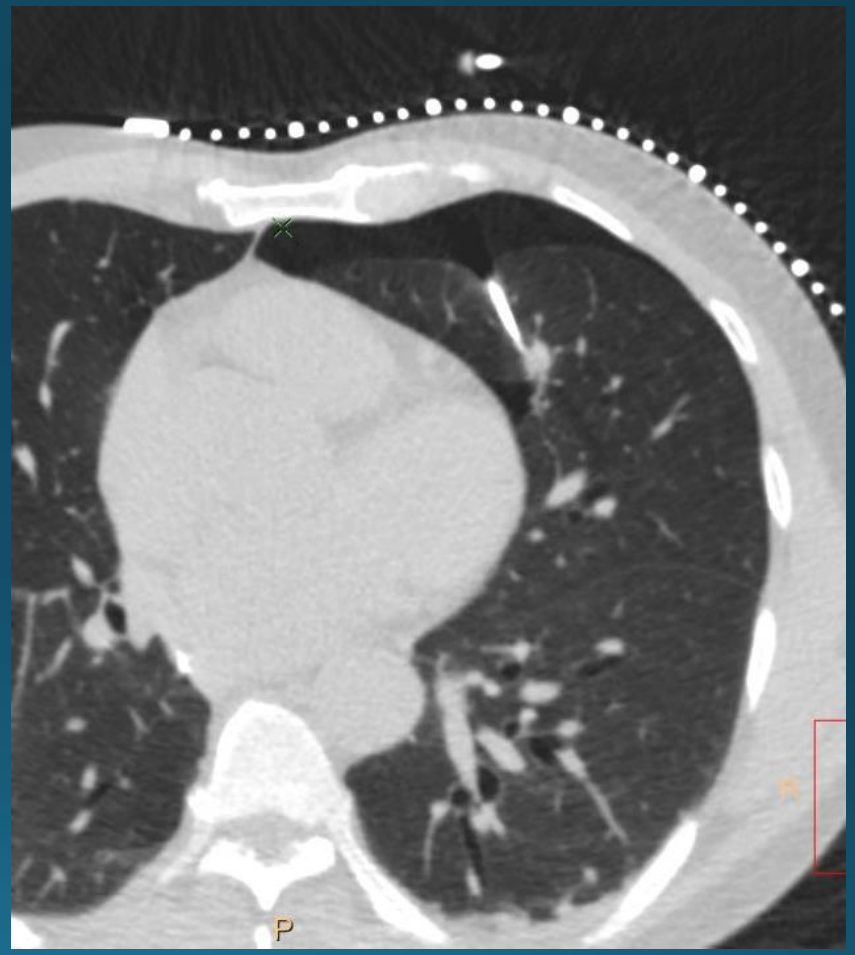


PNEUMOTHORAX AND PUNCTURE

MIGHT BE DIFFICULT TO PENETRATE THE VISCERAL PLEURA, WHICH FOLLOWS THE NEEDLE TIP INSIDE THE LUNG.
COMPARABLE TO NEEDLE PUNCTURE A TENNIS BALL IN A BUCKET OF WATER.

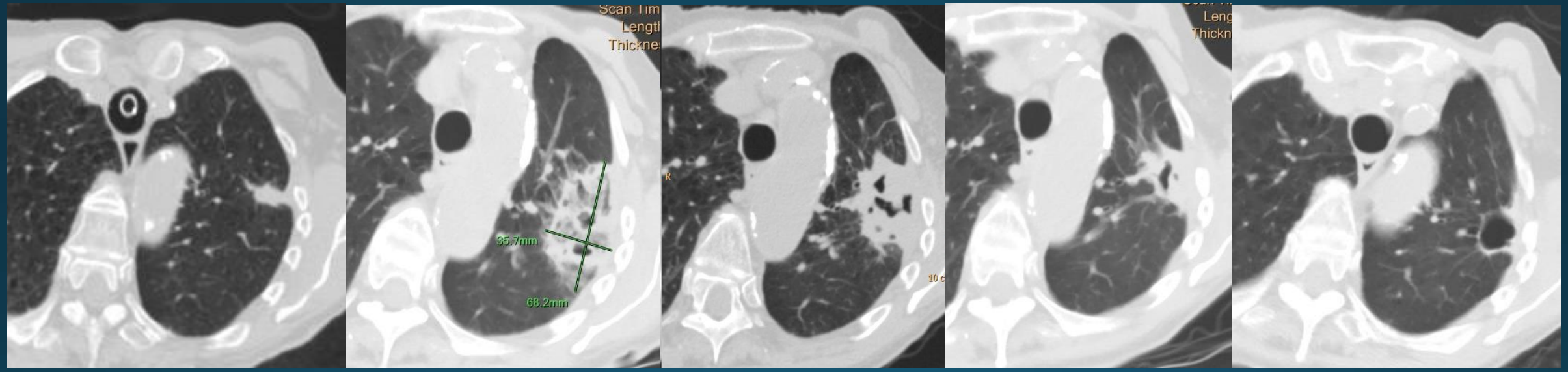
OPTIONS:

- DRAIN WITH CATHETER AND TRY AGAIN
- SPEAR THE TUMOR



HOW TO EVALUATE LOCAL TUMOR RESPONSE AFTER THERMAL ABLATION?

Recist 1.1: 20% increase in size is Progressive Disease.



Before | 1 week | 1 Month | 3 Months | 6 Months

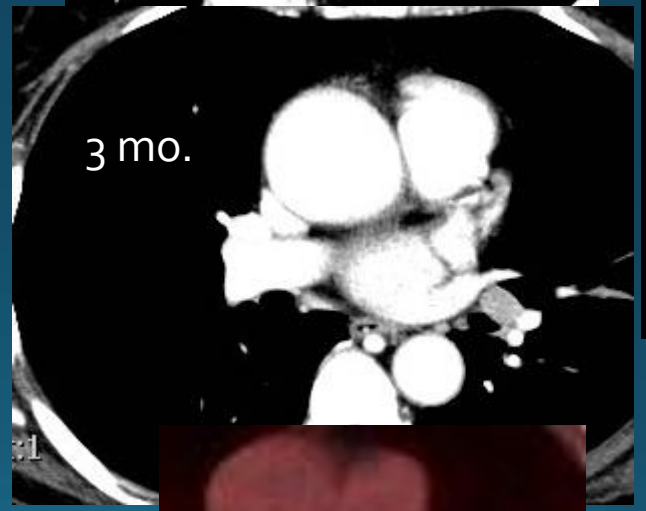
- tumor/ablation necrosis increases in size after RFA/MWA
- MWA MAX SIZE AFTER 7 DAYS (SWINE MODEL)
- RFA MAX SIZE AFTER 3 MONTHS

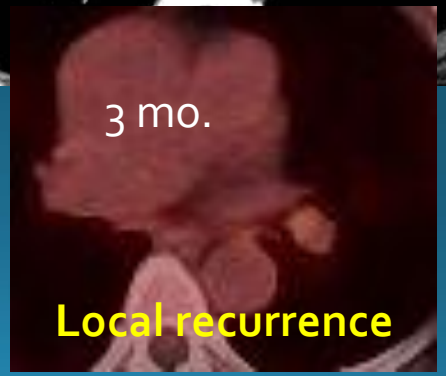
The same temporal change in size of microwave ablation necrosis is demonstrated in a Swine model .
Kodama H et al Diagnostic and Interventional imaging (2019) 100 , 279-285

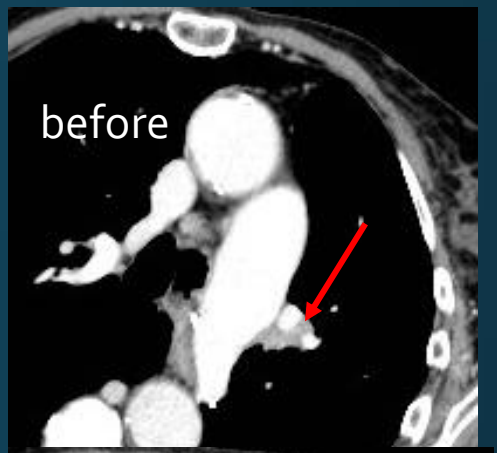
HOW TO EVALUATE LOCAL TUMOR RESPONSE AFTER THERMAL ABLATION?

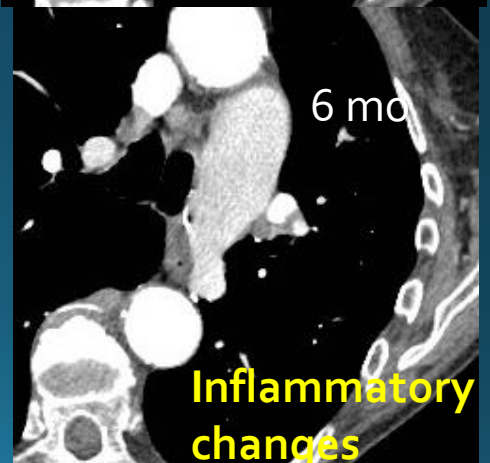
General agreement of local recurrence if:

- increase in size after 3 months
- new-coming nodular change
- new-coming contrast enhancement in any soft tissue focus > 9 mm
- HU-change over time in dynamic contrast evaluation by ROI placed inside the tumor
- PET-positive area within the necrosis after 6 months.
- Increase in N1 lymphnode size after 3-6 months.



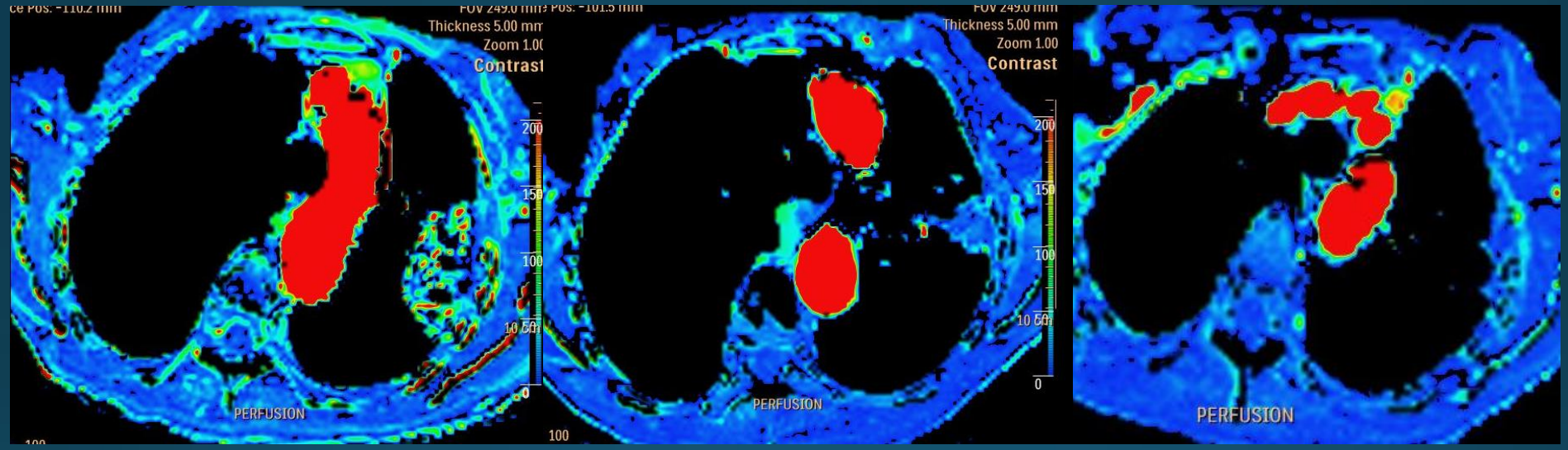






Cheang S et al, Semin Interv Radiol 2013;30:157-168
Higuchi M et al, J Cancer Res Clin Oncol 2014;140:1957-1963
Bonichon F et al, Eur J Nucl Med Mol imaging 2013;40:1817-1827
Yoo DC et al, Am J Roentgenol 2011;197:334-340
Deandreis D et al, Radiology 2011;258:270-276
Suh RD et al. Radiology 2003;229(3):821-9

VISUAL ASSESSMENT OF BLOOD FLOW PATTERNS BY DYNAMIC CONTRAST ENHANCED COMPUTER TOMOGRAPHY

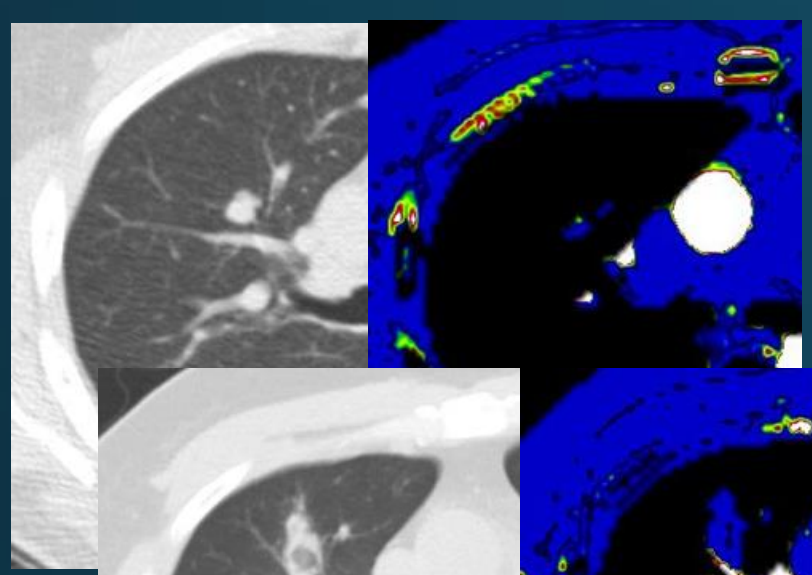


1 week 3 Month 6 Months

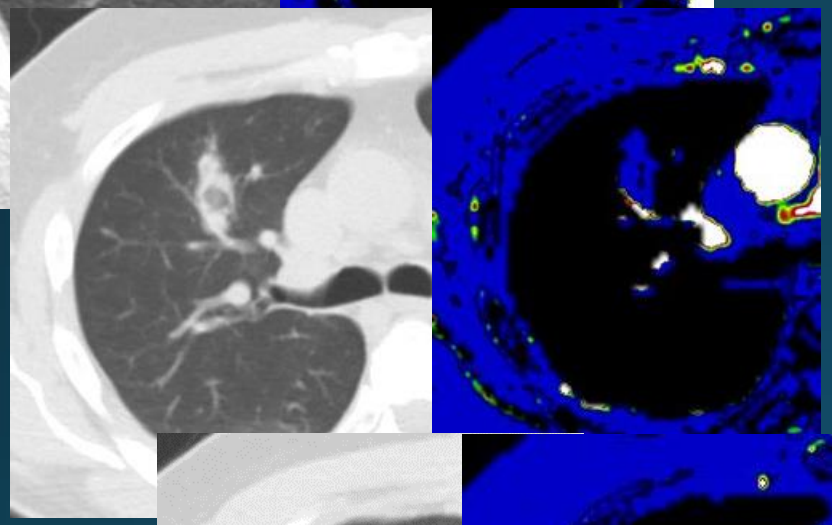
DCE-CT: 60 ml Iodixanol 270 mgI/ml, scantime: 70 sec with 35 successive series of images.
The series analysed by commercial available Philips software (perfusion).
For an 80 kg patient the DCE-CT dose was at 4 cm coverage: 9,5 mSv and 18mSv at 8 cm.

Harders S et al. Acta Radiologica Open 6(5) 1-6, 2017

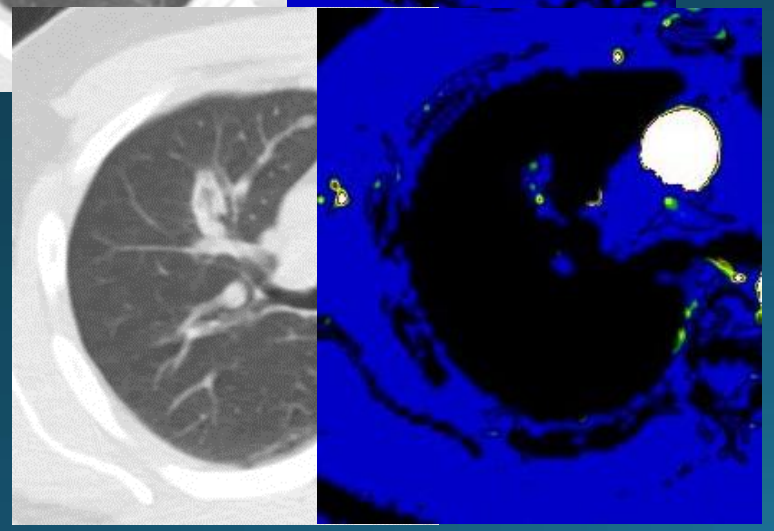
METASTATIC SPREAD FROM RENAL CELL CARCINOMA (1.generation mwa system)



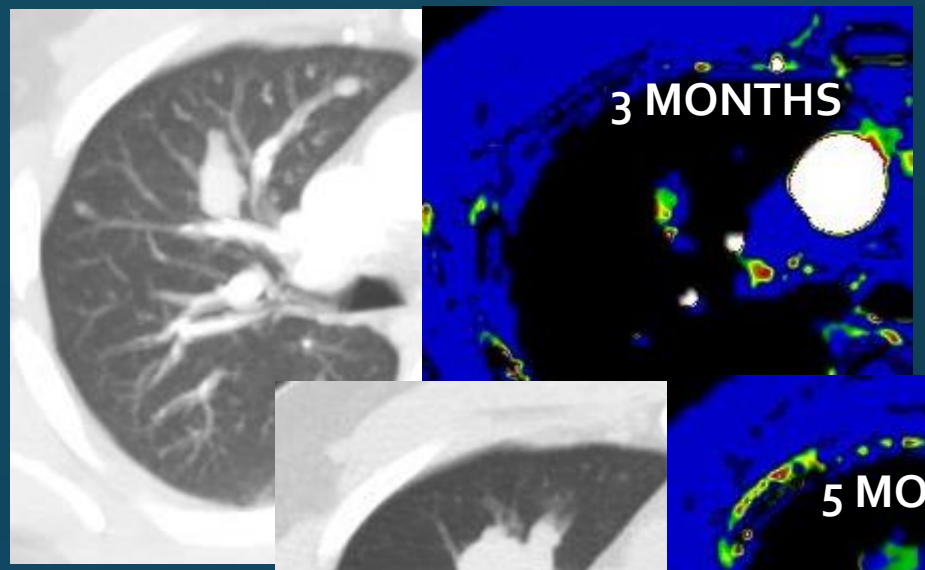
BEFORE MWA



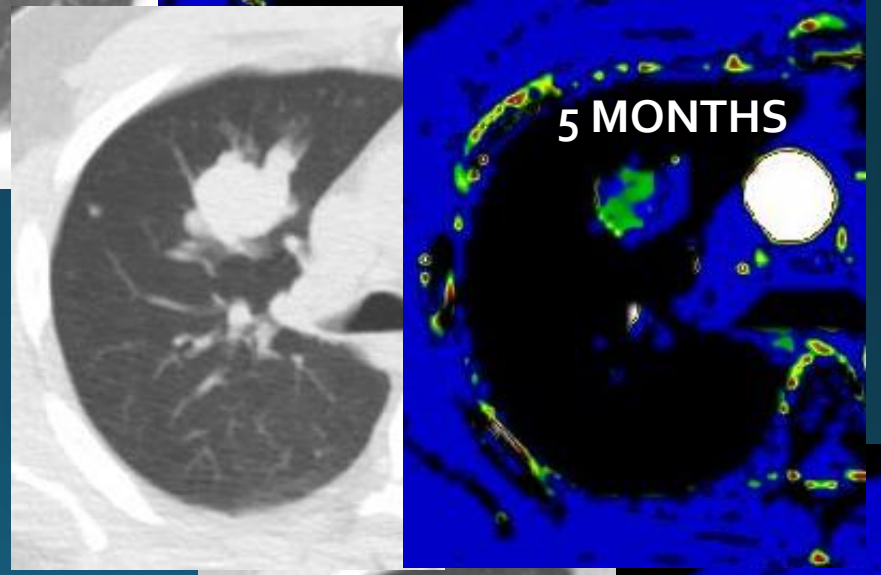
1 WEEK



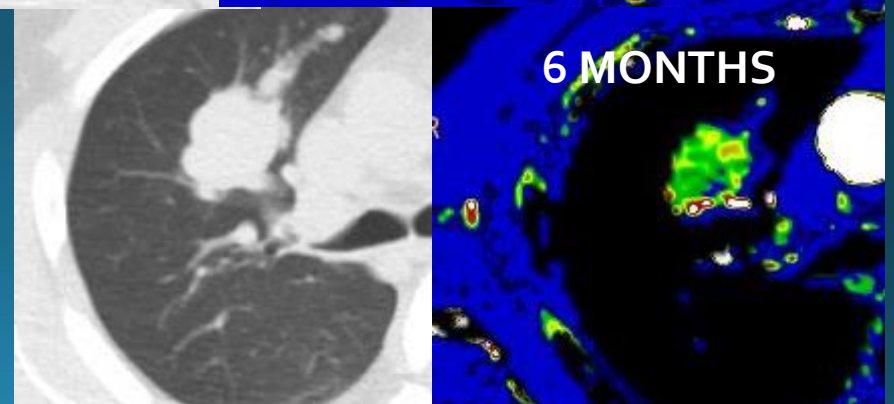
1 MONTH



3 MONTHS



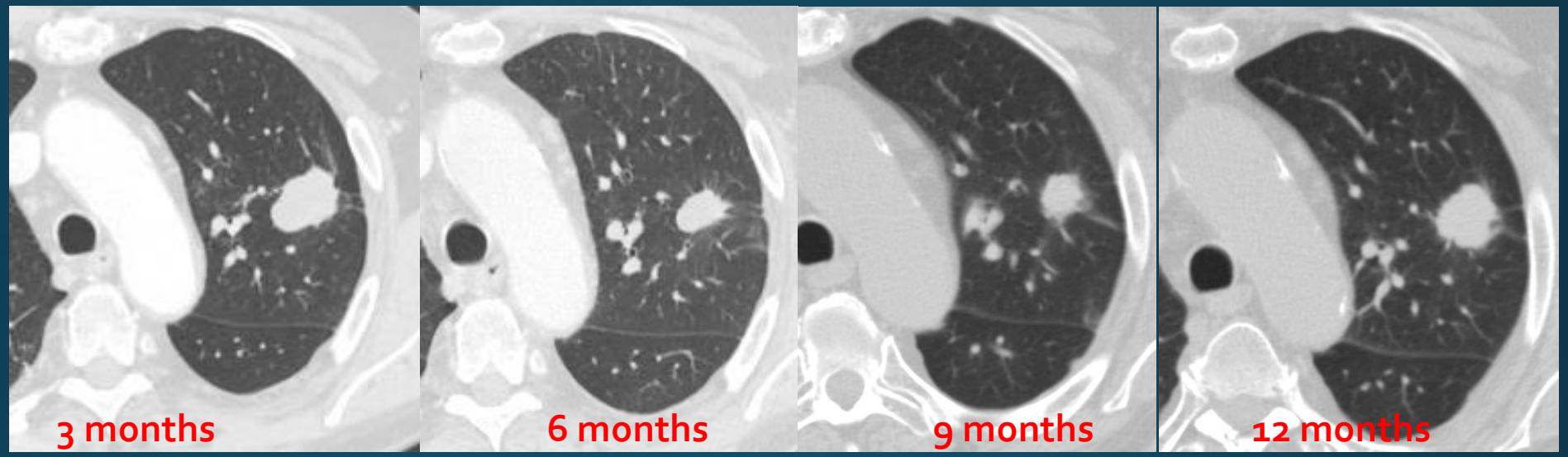
5 MONTHS

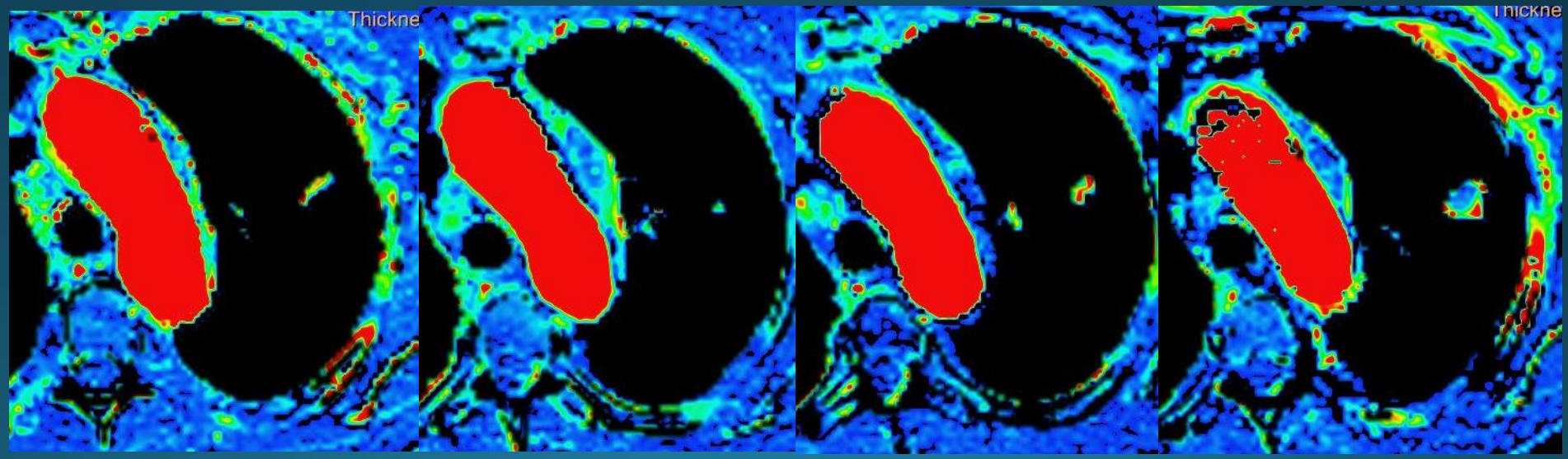


6 MONTHS

10 mm lesion.
Met. from leiomyosarcoma
5 min. 75W
Exp. Necrosis min 3,4 cm

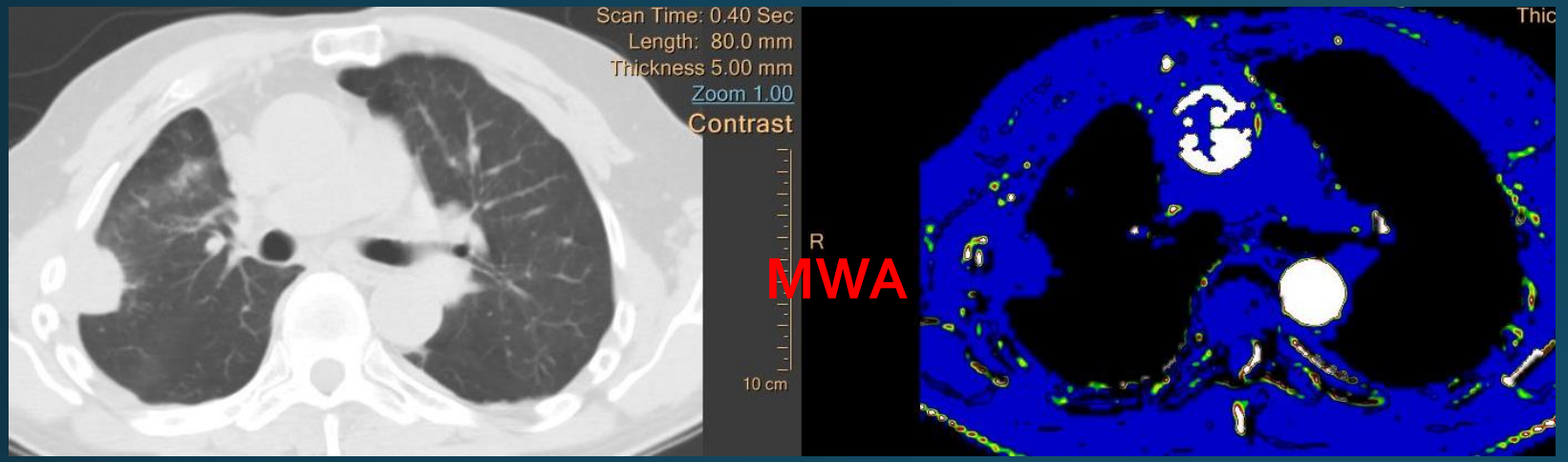
Recurrence at the tumor bed

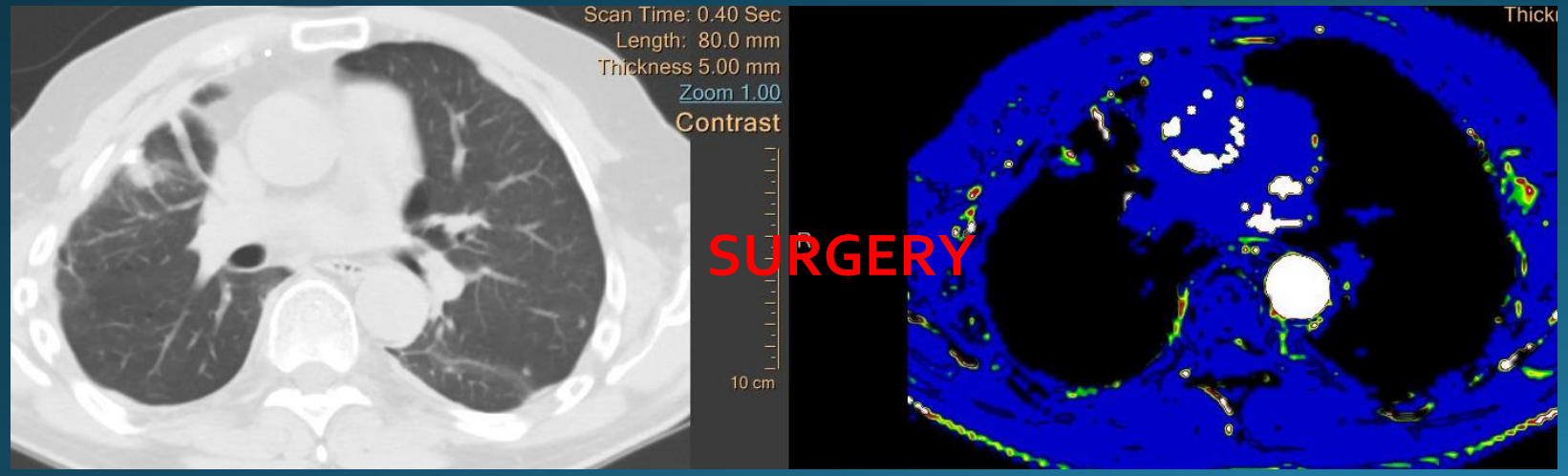


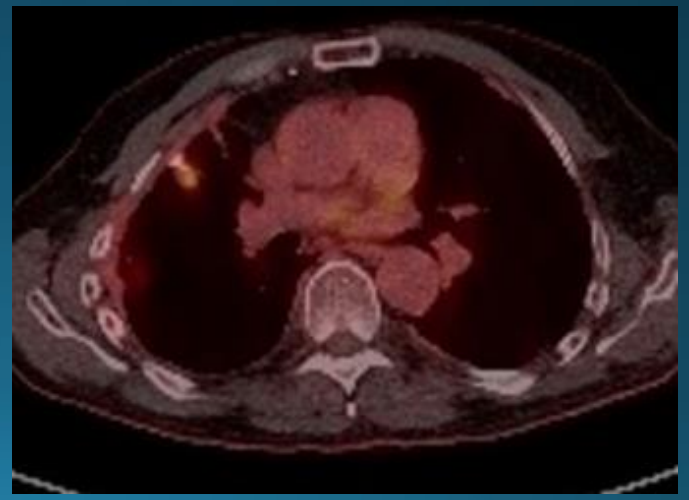


CASE:

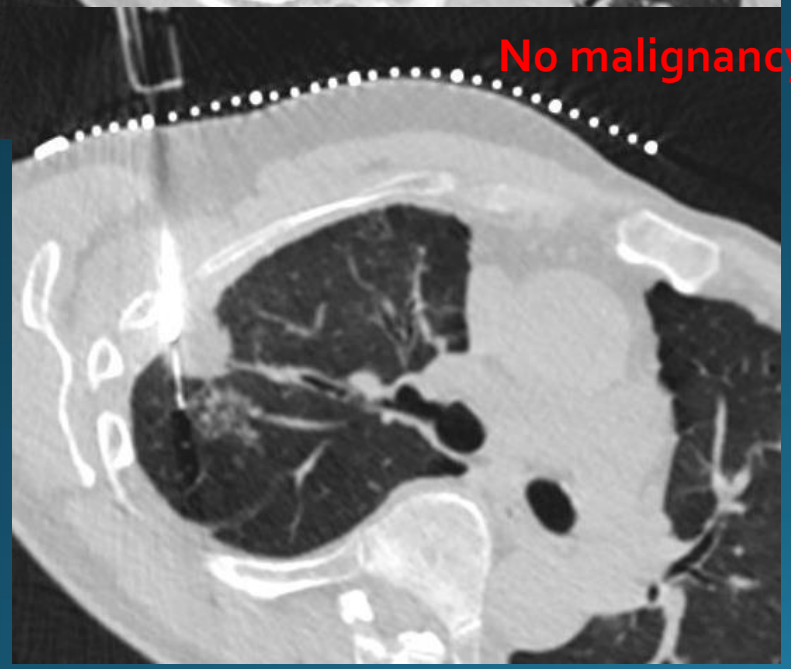
58 Y O Male, sublobar-resection of a squamous cell carcinoma . A adenocarcinoma appeared 9 months later and MWA was conducted . Perfusion and PET 6 months after MWA

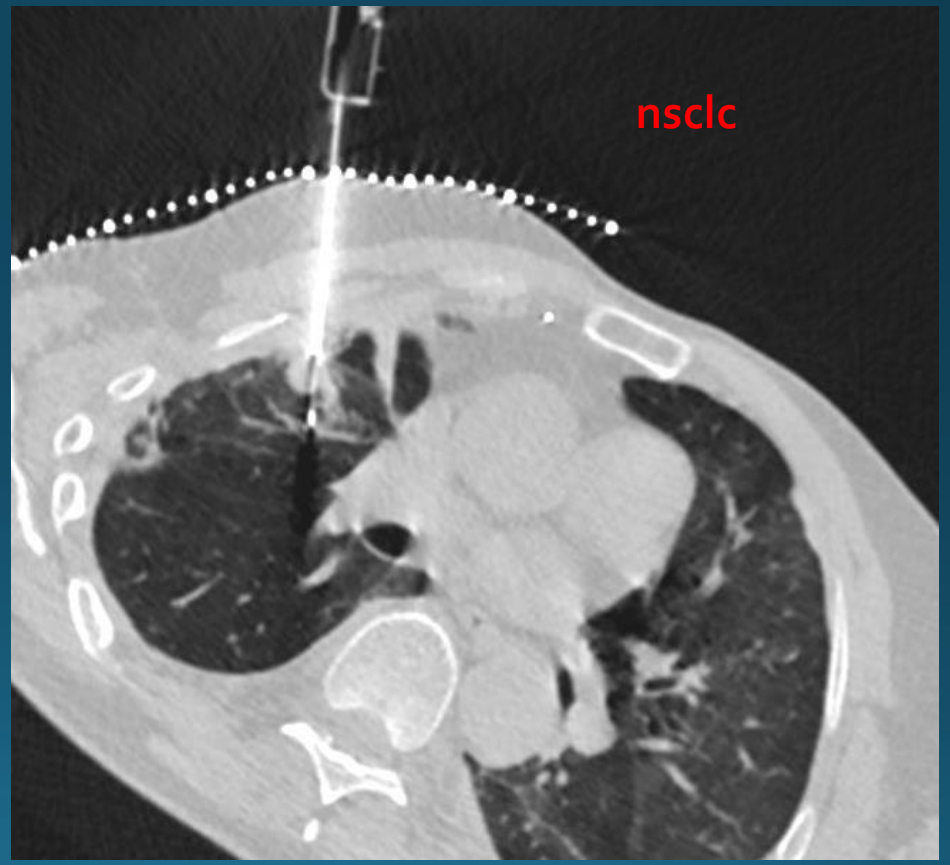




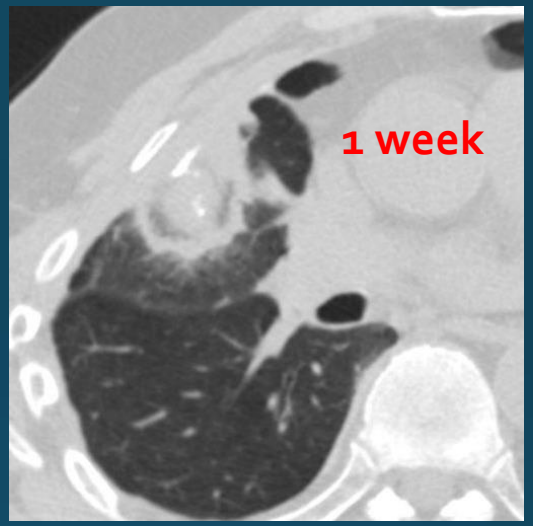


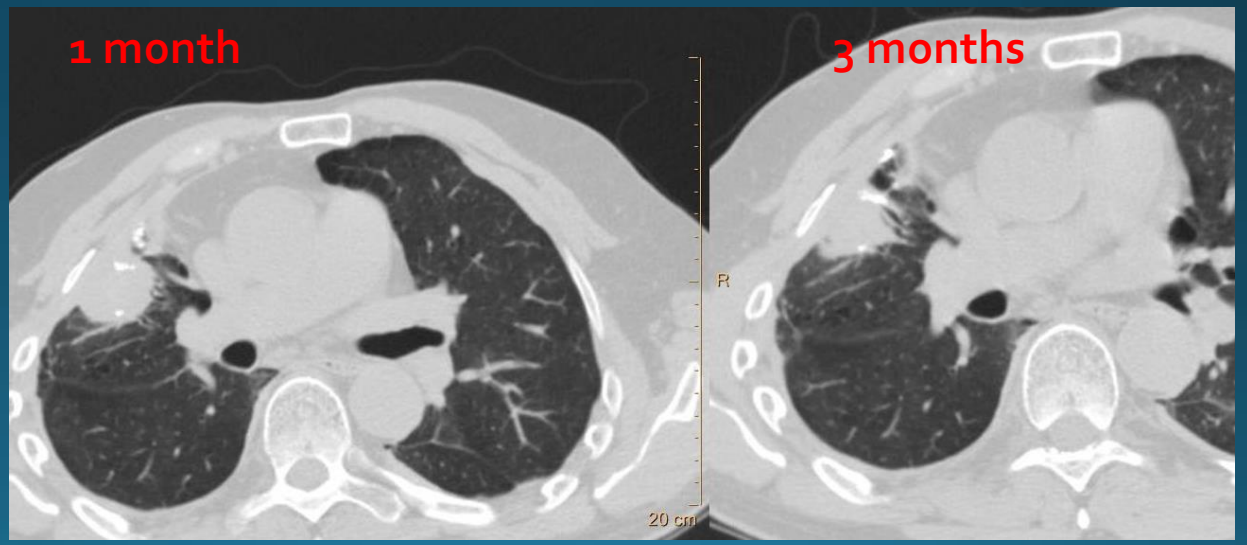
Each, two biopsies from different tumor areas





MWA





Own experience, 3 YEARS:

~60% METASTASIS
~40% PRIMARY LUNG CANCER

	range	median	Mean
Primary	0,7-3,0 cm	1,5 cm	1,7 cm
secondary	0,5-2,3 cm	1,0 cm	1,0 cm

TUMOR CONTROL IN THE TUMOR BED: 90-95% RANGE.

COMPLICATIONS FNA/MWA

Literature:
Pneumothorax: 9-67%
Specific mortality rate: 0.4 – 2.6%

2007 -2011, USA, National In-patient Sample

Patients	Primary lung cancer / metastases	Pneumothorax	infection	Pleural effusion	Surgical re-intervention	In-hospital mortality
3344	2072 / 1277	38.4%	5.4%	4.0%	0.9%	1.3%

Welch B et al. JVIR, June 2015

Major complications in 1000 RFA.
Rate: 9.8%

CRYO 15-20%
HEMORRHAGE

Japan	
Mortality, 3 interstitial pneumonitis, 1 hemothorax	0.4%
Aseptic pleuritis	2.3%
Pneumonia / lung absces	1.8 / 1.6%
Pneumothorax requiring pleural sclerosis	1.6%
Bronchopleural fistula	0.4%
Brachial nerve injury	0.3%
Tumor seeding	0.1%
Diaphragma injury	0.1%

Kashima M et al AJR 2011;197:W576-W580

COMPLICATIONS
CRYOABLATION

SIMILAR TO FNA/MWA, BUT A HIGHER INCIDENCE OF HEMOPTYSIS (17%)

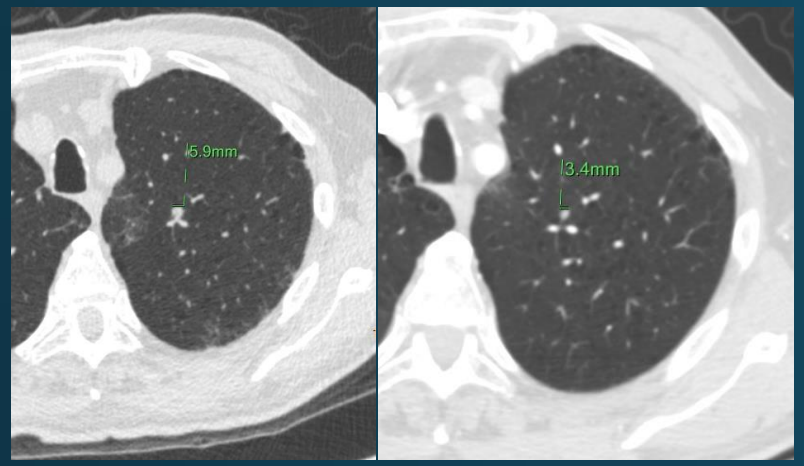
J VASC INTERV RADIOL 2016;27:1371-79

HOSPITALISATION FOLLOWING MWA – own data:

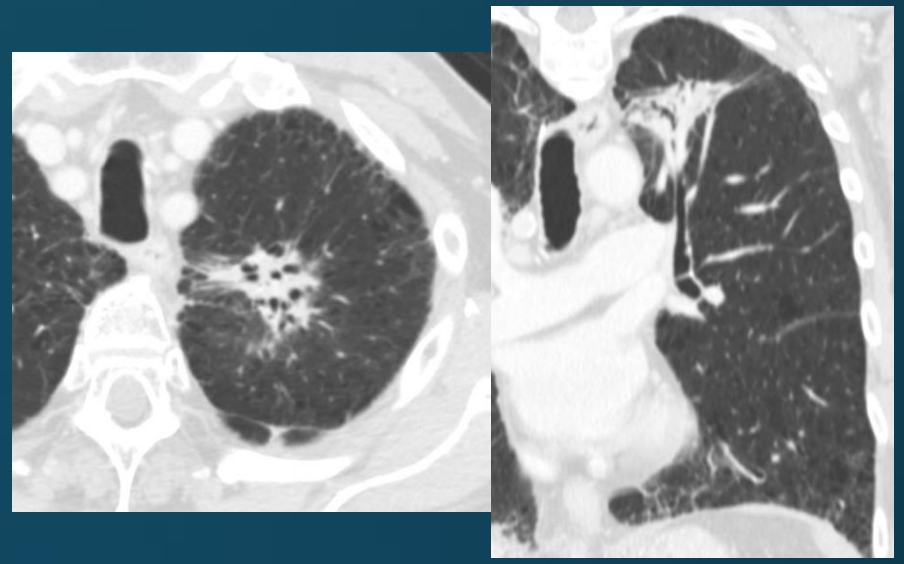
DAYS	%	ACUMMULATED %	PROLONGED HOSPITALISATION
1	67	67	//////
2-3	17	84	///////
4-7	7	92	///////
8-14	4	96	**SHOULDER PAIN, INFECTION** **SHOULDER PAIN, INFECTION** **PNEUMOTHORAX, SUBCUTANEOUS EMPHYSEMA,** **1 WEEK LATER: LUNG EMBOLUS**
15-21	2	98	**PNEUMOTHORAX** **PLEURAL DRAINAGE, INFECTION, SHOULDER PAIN**
>22	2	100	**ABSCES AND EMPYEMA** **PNEUMOTHORAX AND INFECTION**

< 4 days 75%,
de Baere, 566 ptt.

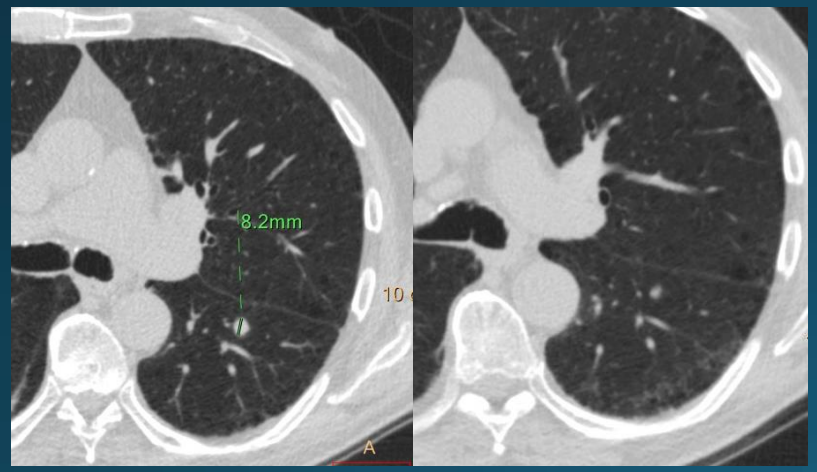
Stage 1 NSCLC, 54 ptt.
Sublobar resection: 6 days
RFA: 1.8 days
Zemlyak A J Am Coll Surg 2010;211(1):68-72



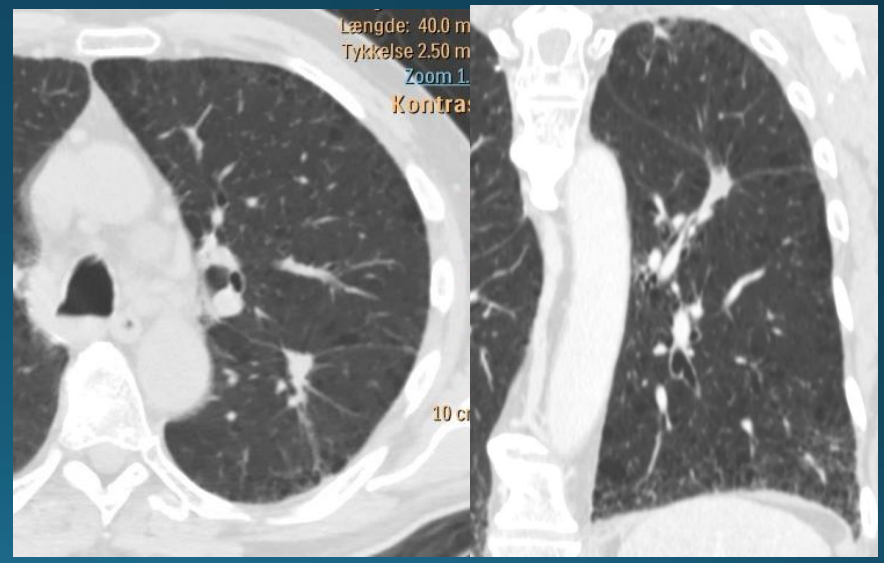
SBRT



6 MONTHS BEFORE



MWA



MWA BENEFITS: # NO LOSS OF LUNG FUNCTION #LOW RISK OF RIB FRACTURES IN PERIPHERAL LOCATED TUMORS # FAST # CHEAP #REPEATABLE

CONCLUSIONS

- A MINIMAL INVASIVE OPTION FOR A SELECTED GROUP OF PATIENTS WITH EARLY STAGE PRIMARY LUNG CANCER AND PULMONARY METASTASES WHICH IS A SAFE, FAST, IN-EXPENSIVE AND REPEATABLE PROCEDURE THAT PRESERVES LUNG FUNCTION WITH A LOW PROCEDURAL RISK OF RIB FRACTURES IN PERIPHERAL LOCATED TUMORS.

<u>STRICT PATIENT SELECTION:</u>

- BEST OUTCOME IN EARLY-STAGE-LUNG-CANCER:

  ≤ 2-3 CM WITH 5Y OS up till 60%.

  EXPECT 80-90% TUMOR BED CONTROL OF THE ABLATION SITE IF TUMOR ≤ 3 AND UP TILL 95% IF TUMOR ≤ 2 cm.

- IN OLIGOMETASTATIC DISEASE TO THE LUNG, BEST OUTCOME:

  < 3 METASTASES, ≤ 2-3 CM, LOW EXTEND OF EXTRA PULMONARY DISEASE, DISEASE FREE INTERVAL ≥ 12 MONTHS AND LOCATION OF PRIMARY TUMOR IN COLON OR KIDNEY.