



Assistance Publique  
Hôpitaux de Marseille



# Suivi après destruction percutanée par radiofréquence des tumeurs pulmonaires

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*SIT – Journée de Printemps – 9 juin 2017*

# Suivi après RF pulmonaire

- Différentes évolutions de la zone de DTP
- Suivi en imagerie: TDM et TEP
- Un enjeu: détection des récives locales (rares)
- Associer de nouvelles techniques: TDM DE, IRM, ...

# Suivi après RF pulmonaire: contexte

- Site traité « reste en place »: évolution spécifique
- Récidive locale : nécessité traitement précoce
- Pas de « gold standard » R0 en anat-path (vs chirurgie)
- Suivi oncologique: RECIST inopérant
- Doute diagnostique: rebiopsie!!

# Suivi après RF pulmonaire: étapes et moyens

- Phase précoce, initiale: avant 30 jours
- Phase intermédiaire: 1 à 3 mois
- Phase de suivi « oncologique » : après 3 mois
- TDM: référence, tous les 3 mois/1 an, puis 2 fois/ an, ...
- TEP-TDM: prudence et spécificités
- Autres ...

# Phase précoce après DTP pulmonaire – Complications

## Minor Complications in 1000 Lung Radiofrequency Ablation (RFA) Sessions, by Grade

Minor Complication, Grade	No. (%) of RFA Sessions
<b>Pneumothorax</b>	
Grade 1	224 (22.4)
Grade 2	221 (22.1)
<b>Subcutaneous emphysema</b>	
Grade 1	84 (8.4)
Grade 2	9 (0.9)
<b>Hemoptysis</b>	
Grade 1	16 (1.6)
Grade 2	44 (4.4)
<b>Total</b>	
Grade 1	321 (32.1)
Grade 2	277 (27.7)

## Common Terminology Criteria for Adverse Events (CTCAE)

Version 4.0

Published: May 28, 2009 (v4.03: June 14, 2010)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

National Institutes of Health

National Cancer Institute

# Phase précoce après DTP pulmonaire – Complications

**TABLE 3: Major Complications and Associated Risk Factors in 1000 Lung Radiofrequency Ablation (RFA) Sessions**

Major Complication, Risk Factor	Grade, No. of (%) RFA Sessions	Odds Ratio (95% CI)	<i>p</i>
Aseptic pleuritis	Grade 3, 23 (2.3)		
Puncture number (≥ 2)		4.8 (1.4–16.4)	< 0.02
Previous chemotherapy (yes)		3.3 (1.1–9.7)	< 0.05
Pneumonia	<u>Grade 3, 17 (1.7); grade 4, 1 (0.1)</u>		
Previous radiotherapy (yes)		13.4 (3.9–46.4)	< 0.001
Age (> 65 y)		6.3 (1.4–28.1)	< 0.02
Lung abscess, emphysema (yes)	<u>Grade 3, 16 (1.6)</u>	3.8 (1.3–11.0)	< 0.02
Bleeding	<u>Grade 3, 13 (1.3); grade 4, 3 (0.3)</u>		
Platelet count (≤ 180,000 cells/μL)		5.1 (1.8–13.9)	< 0.002
Tumor size (> 3 cm)		3.5 (1.3–9.4)	< 0.02
Pneumothorax requiring pleural sclerosis, emphysema (present)	<u>Grade 3, 16 (1.6)</u>	3.4 (1.2–10.0)	< 0.02
Bronchopleural fistula, NA	Grade 3, 4 (0.4)		
Nerve injury, NA	Grade 3, 3 (0.3)		
Tumor seeding, NA	Grade 3, 1 (0.1)		
Diaphragmatic injury, NA	Grade 3, 1 (0.1)		
Total	Grade 3, 94 (9.4); grade 4, 4 (0.4)		

Note—NA = not applicable.

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

T. de Baère<sup>1\*</sup>, A. Aupérin<sup>2</sup>, F. Deschamps<sup>1</sup>, P. Chevallier<sup>3</sup>, Y. Gaubert<sup>4</sup>, V. Boige<sup>5</sup>, M. Fonck<sup>6</sup>, B. Escudier<sup>5</sup> & J. Palussière<sup>7</sup>

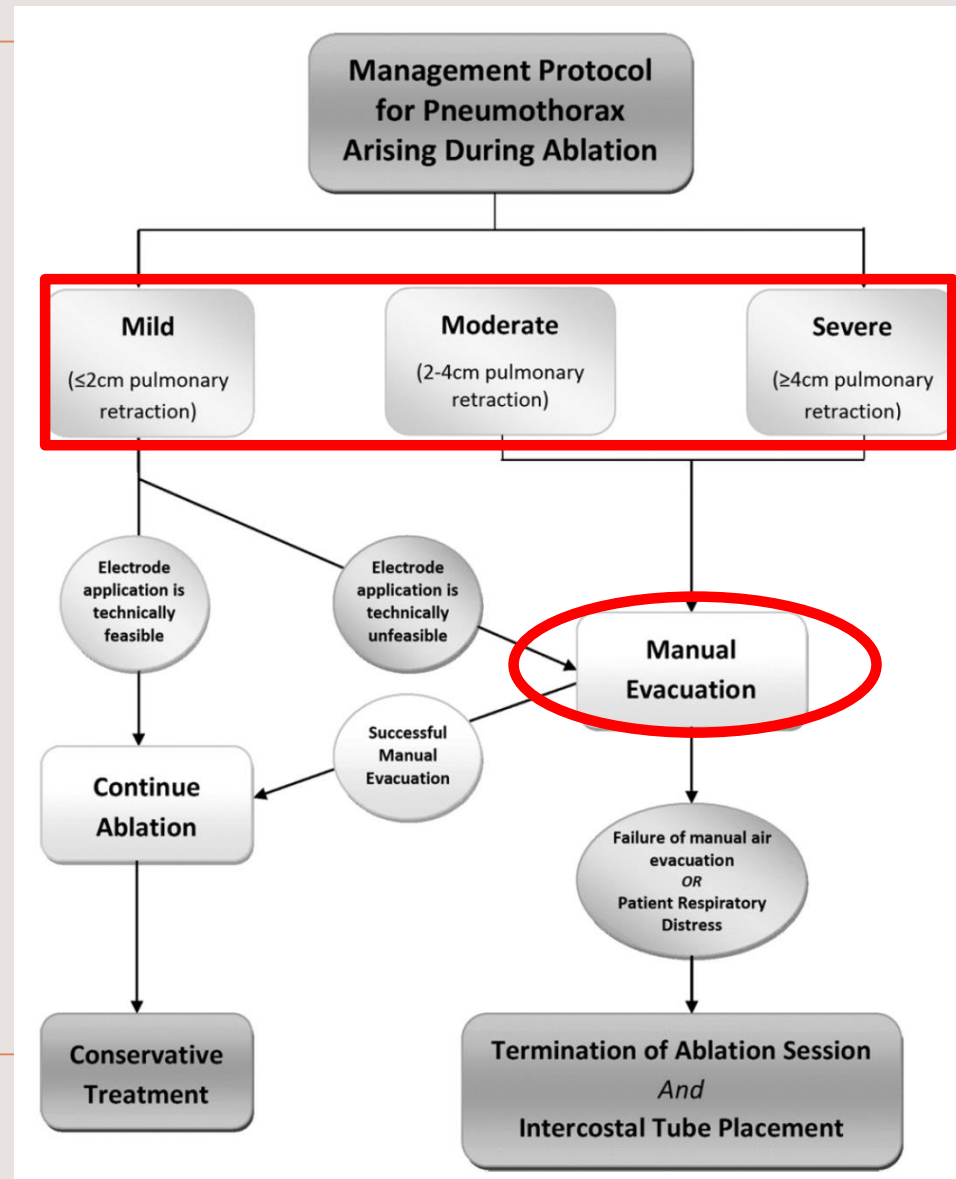
Annals of Oncology 2015

- 67% pneumothorax
- Drainage : 58% (39 % des patients)
- Exsufflation – surveillance : 14% (9% des patients)
- ..abstention thérapeutique: 28% (19% des patients)

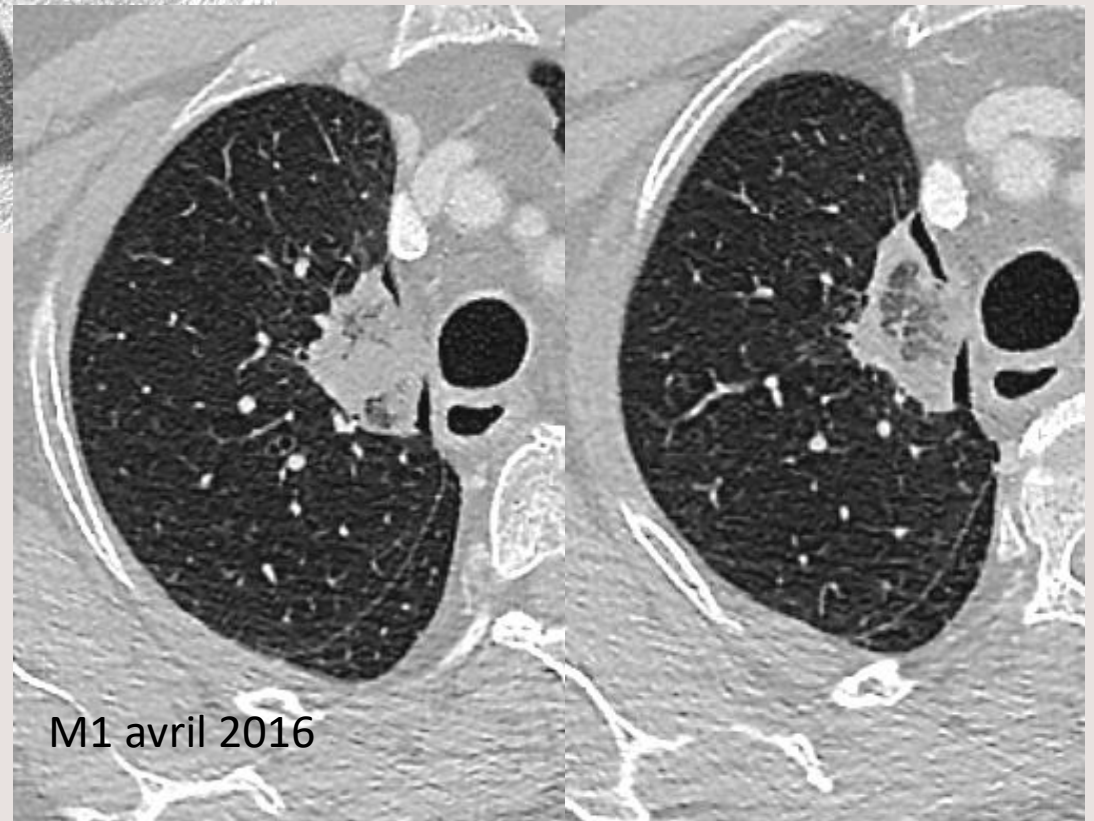
***Au sein du service d'imagerie***

# PNO après DTP pulmonaire – Prise en charge

- Exsufflation
- Drainage
- ..abstention thérapeutique





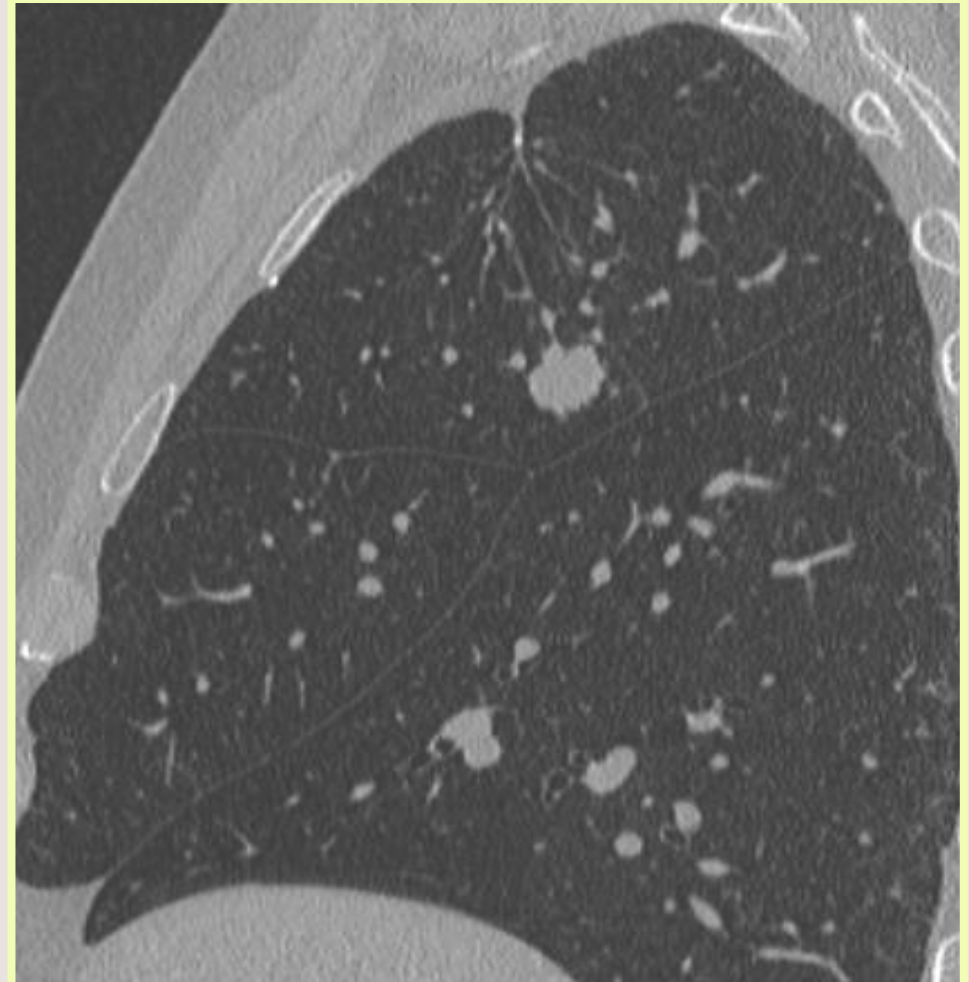
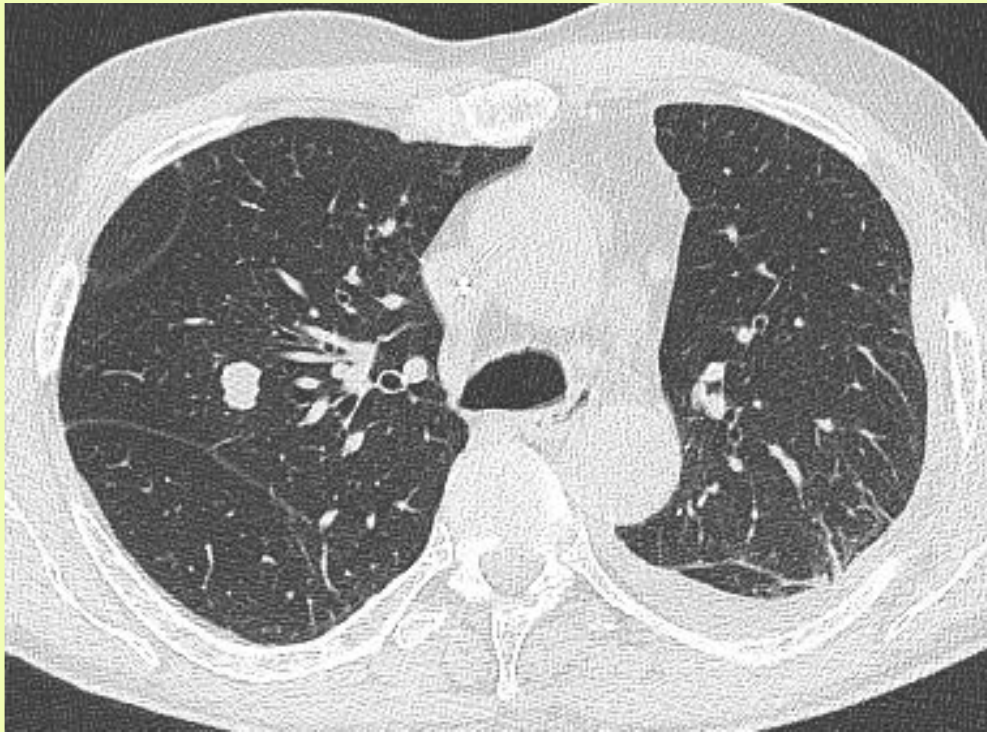


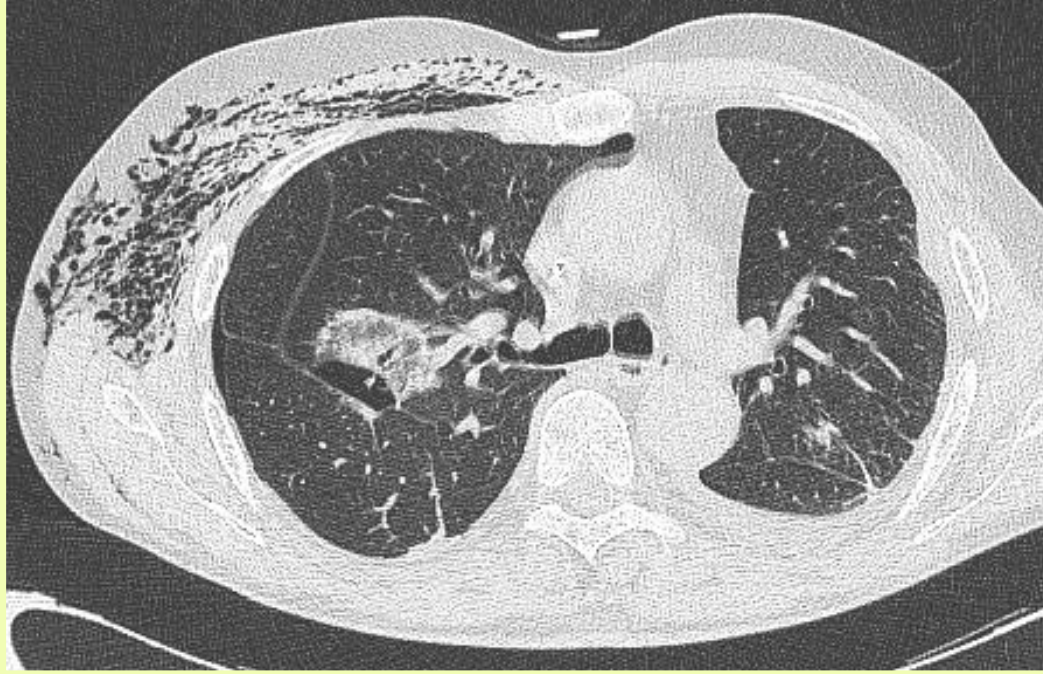
M1 avril 2016

# PNO différé

- 7/10% des procédures/patients (Clasen CVIR 2009)
  - < 5% dans la pratique
  - Peut être pauci-symptomatique
  - Délai: 48 heures...plusieurs jours
- TDM à J2 +++

- **M. C.. 65ans:** métastases de carcinome colique.
- ATCD: Multiples « wedges » des deux côtés
- Nodules 18mm du LSD, 12mm du LID

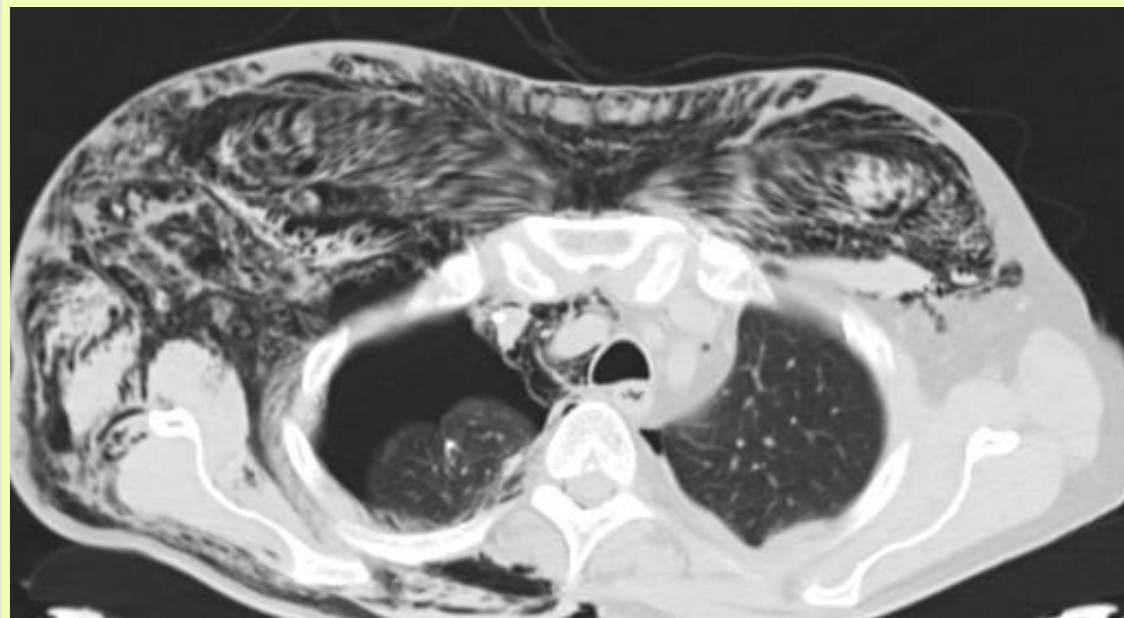
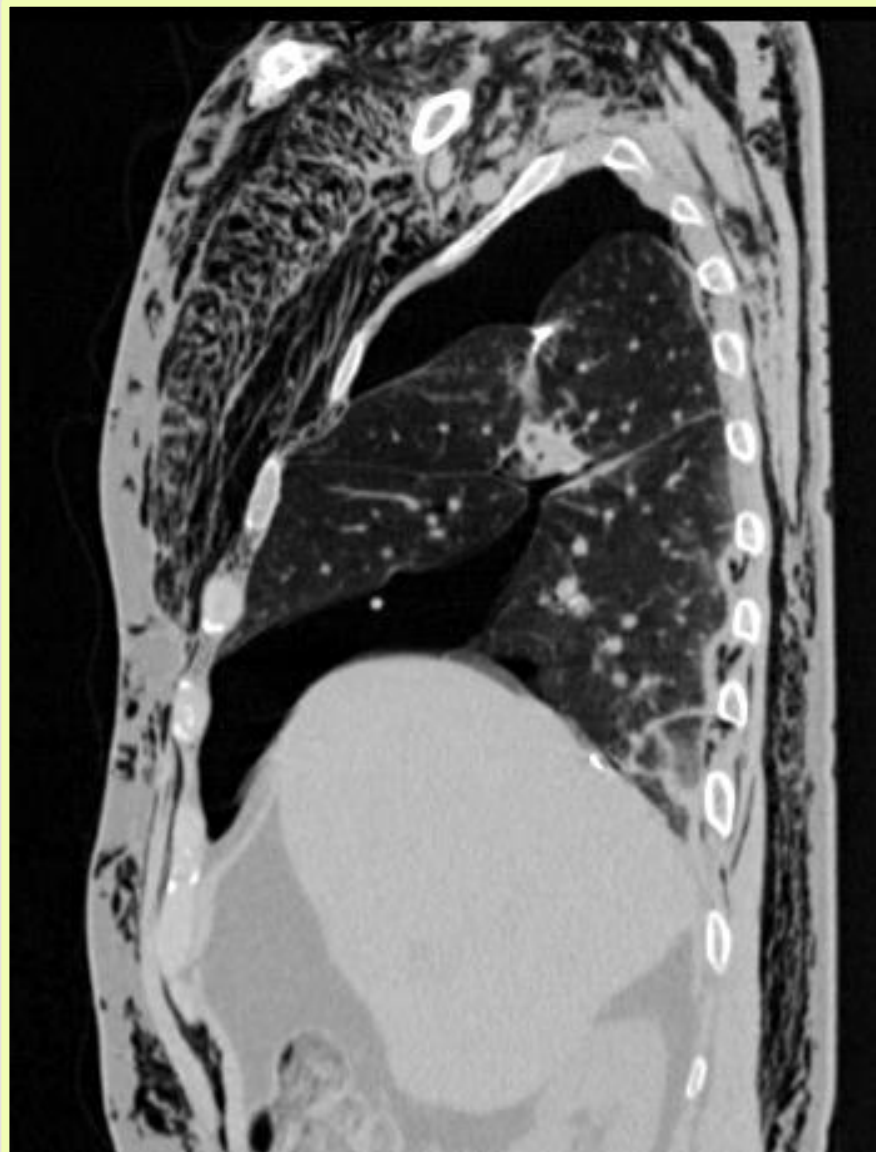




**J 2**

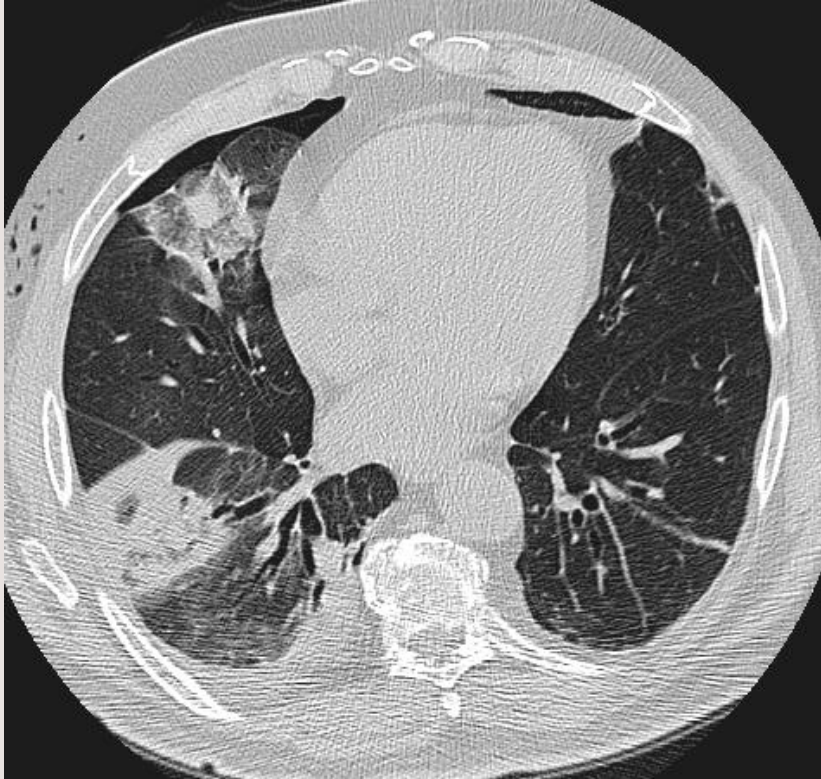


J 21

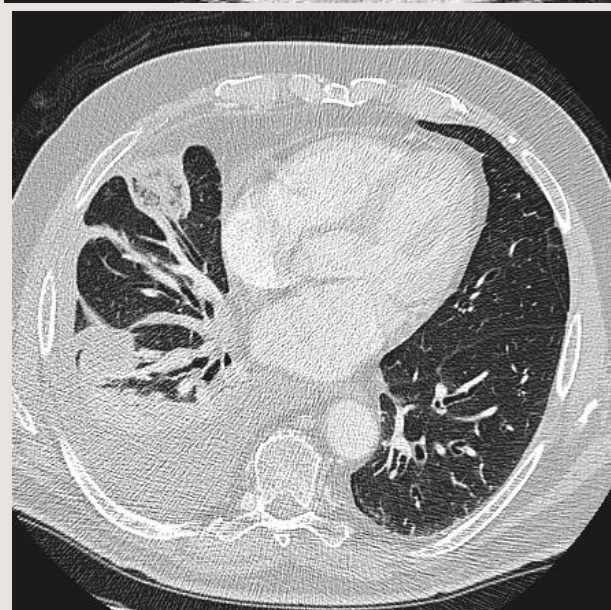
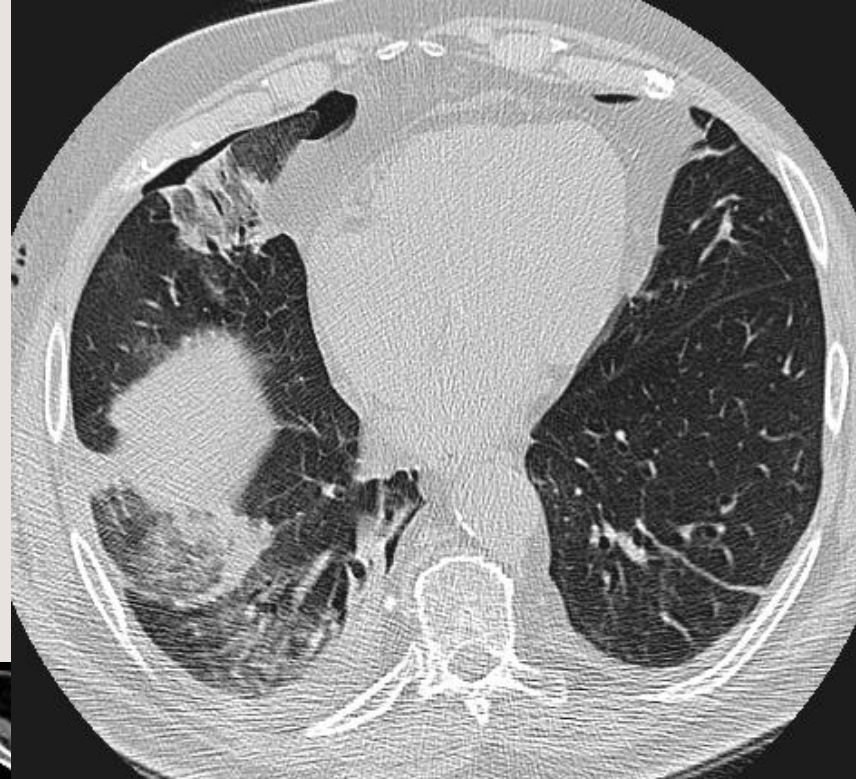


# RF et épanchements pleuraux liquidiens

- Problème des épanchements liquidiens
- Après traitement des lésions sous-pleurales
- Induit par les lésions pleurales thermiques
- Le plus souvent bien toléré (faible volume, peu de douleurs)



M1



Kinésithérapie

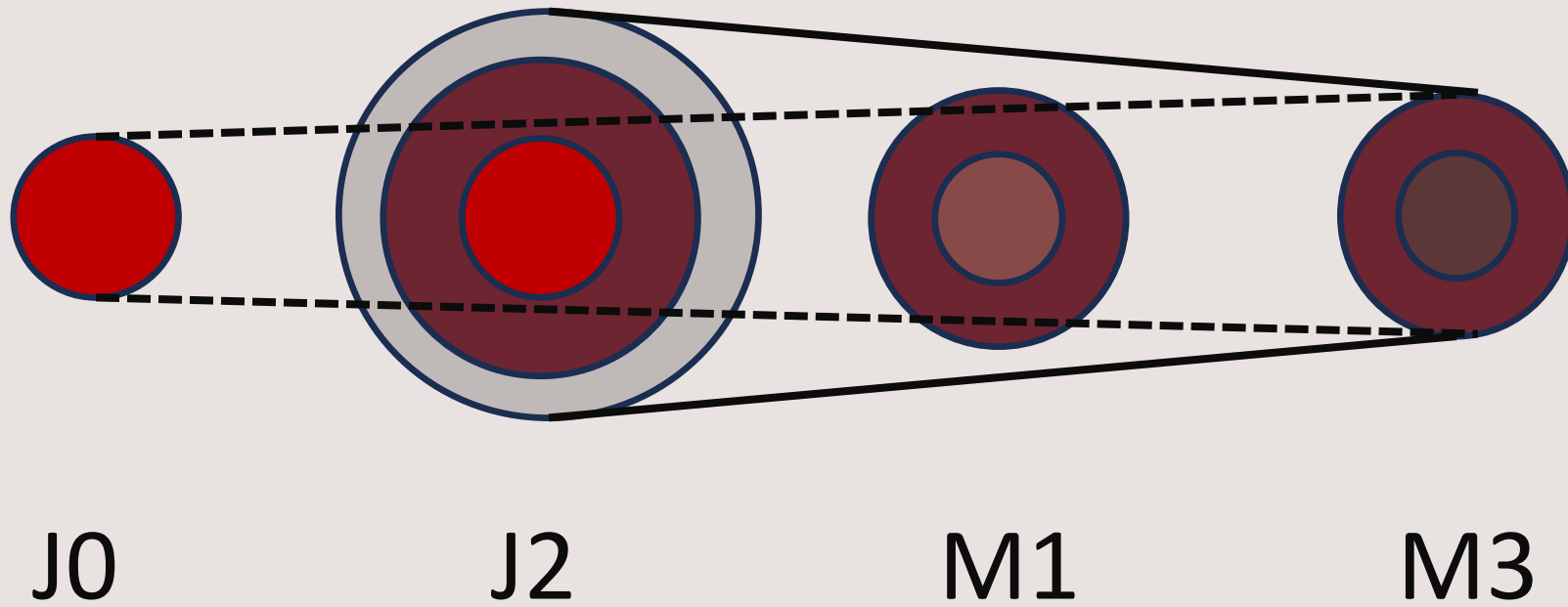


# Suivi après RF pulmonaire: étapes et moyens

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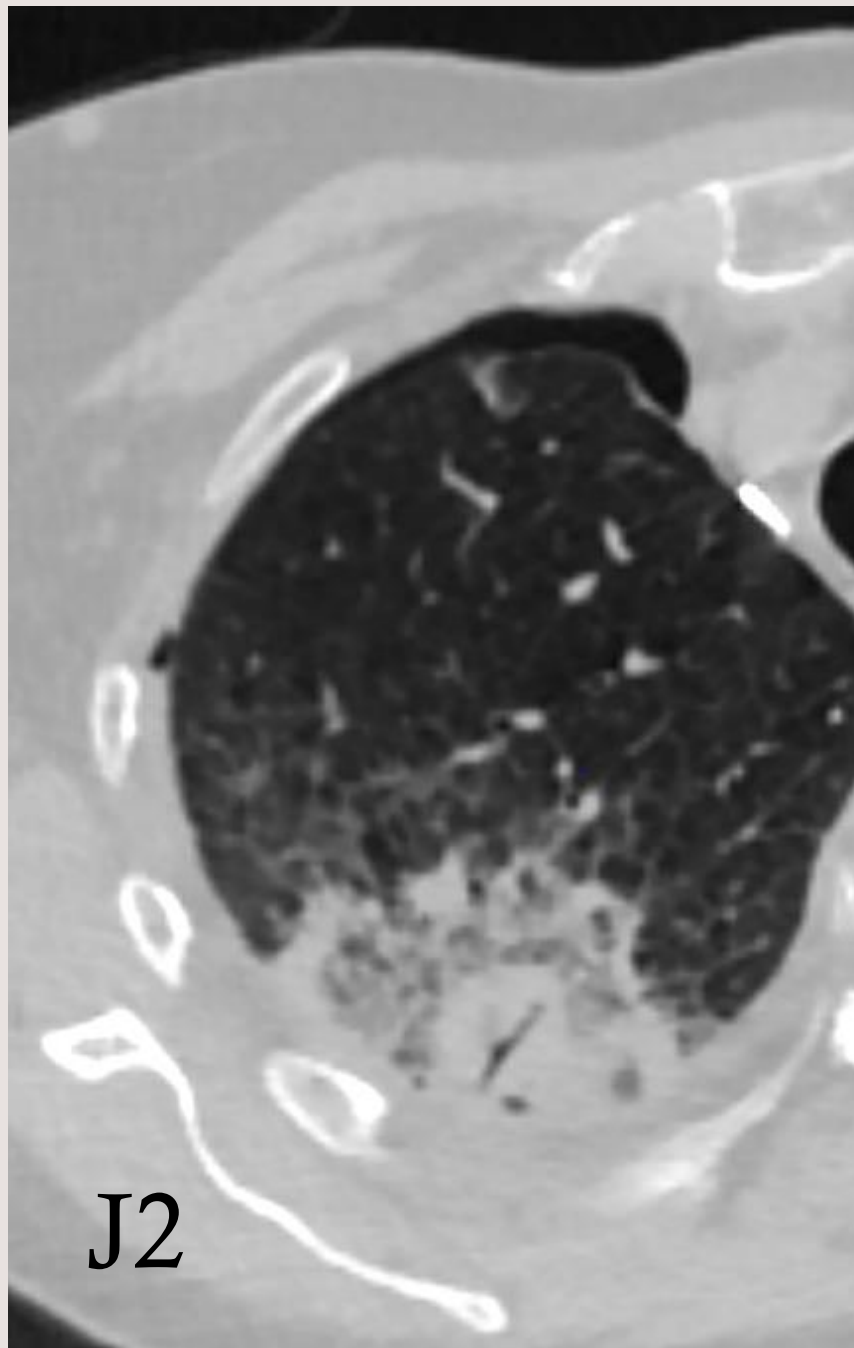
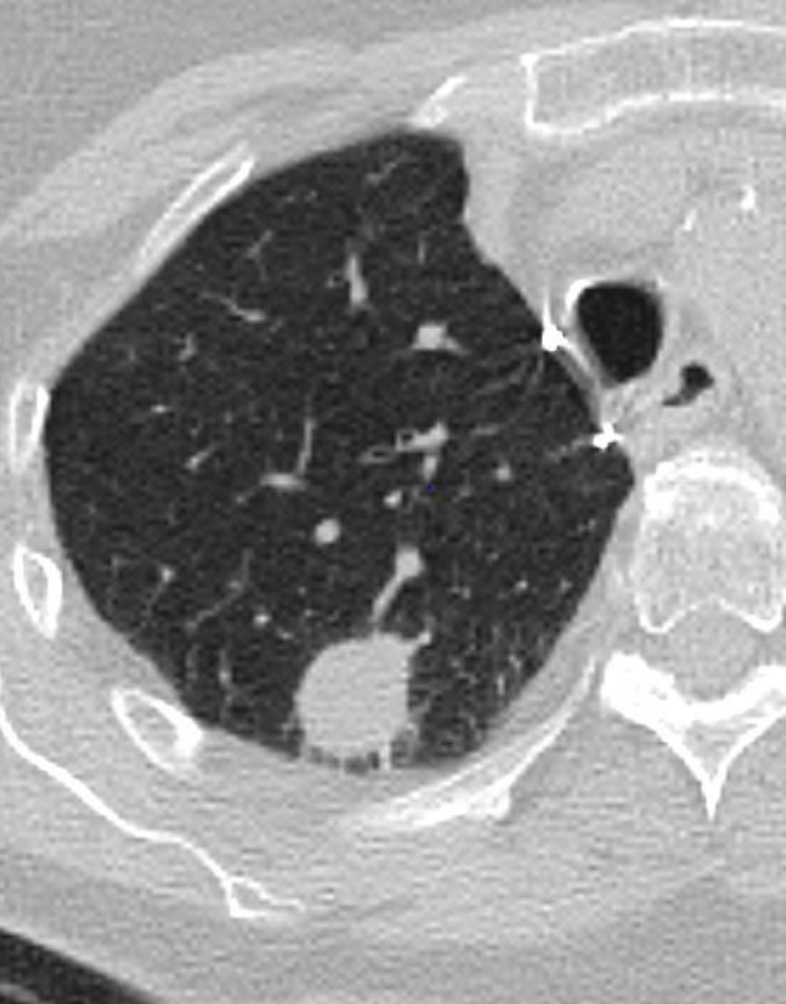
# Suivi après RF pulmonaire



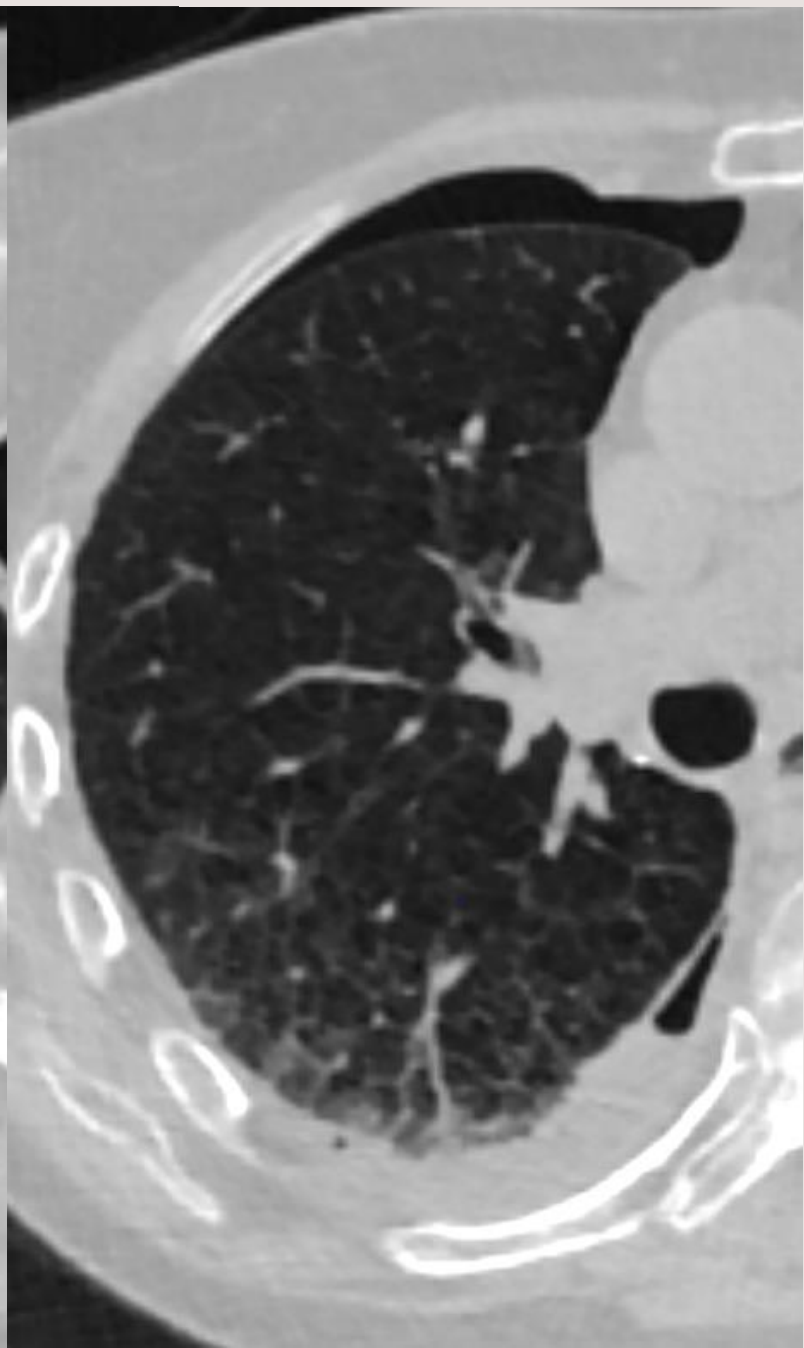
# Suivi après RF pulmonaire: phase « intermédiaire »

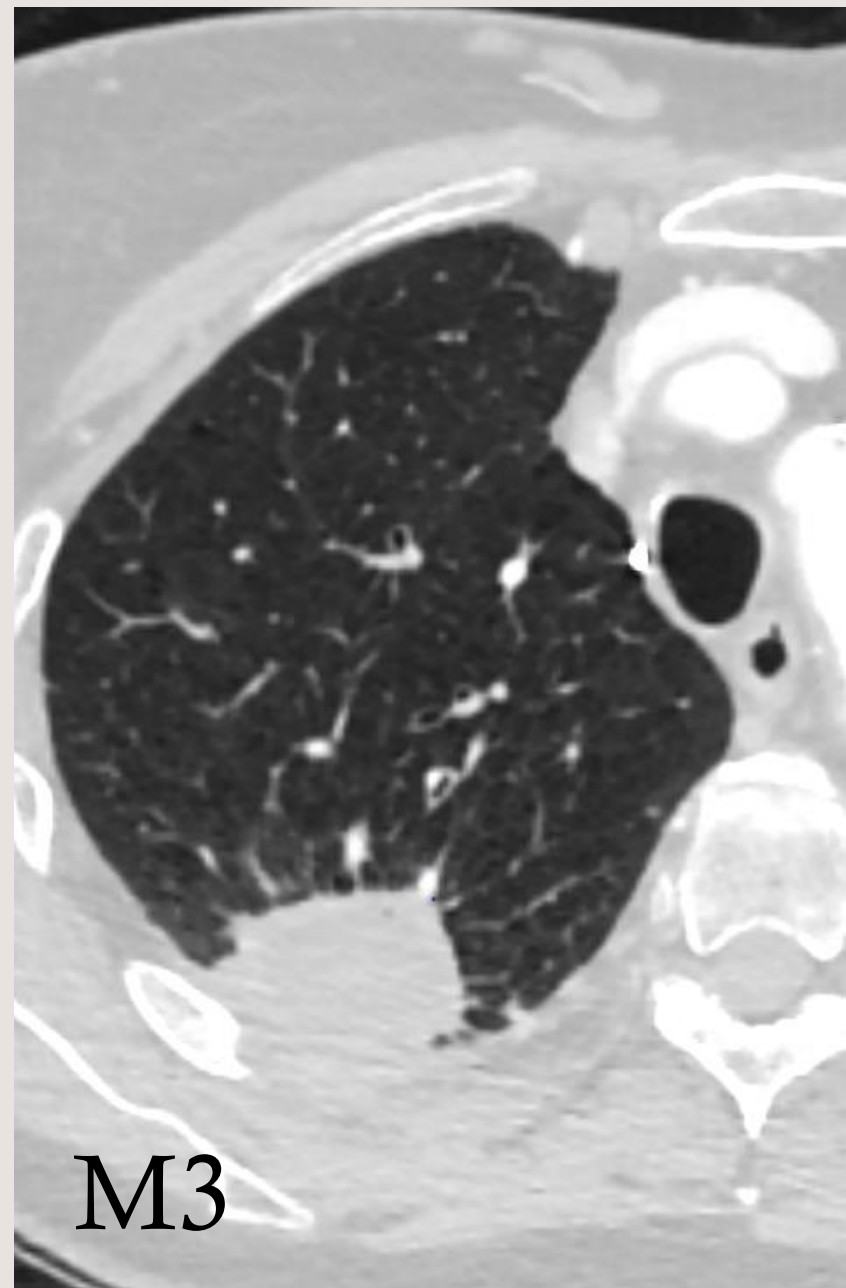
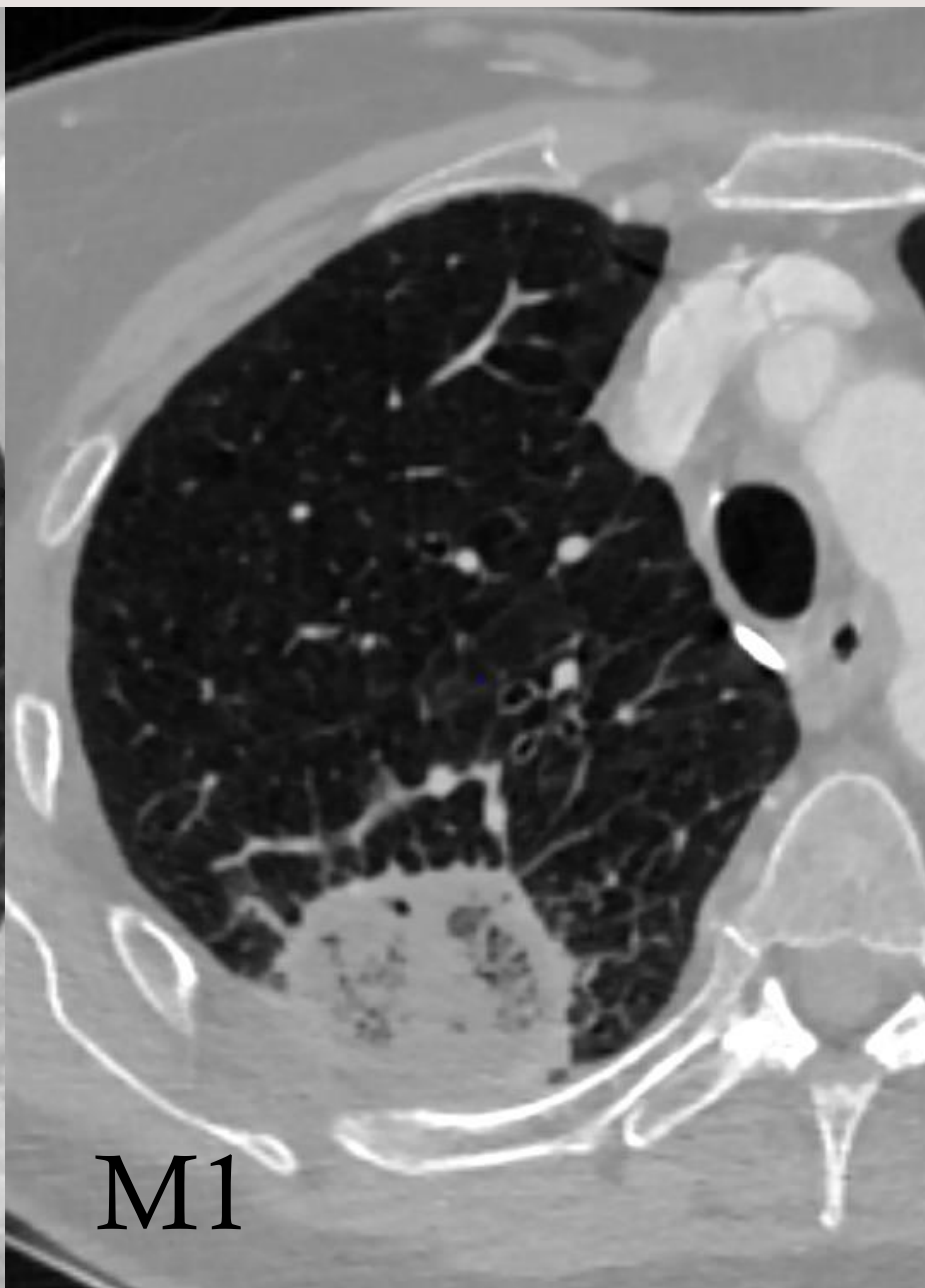
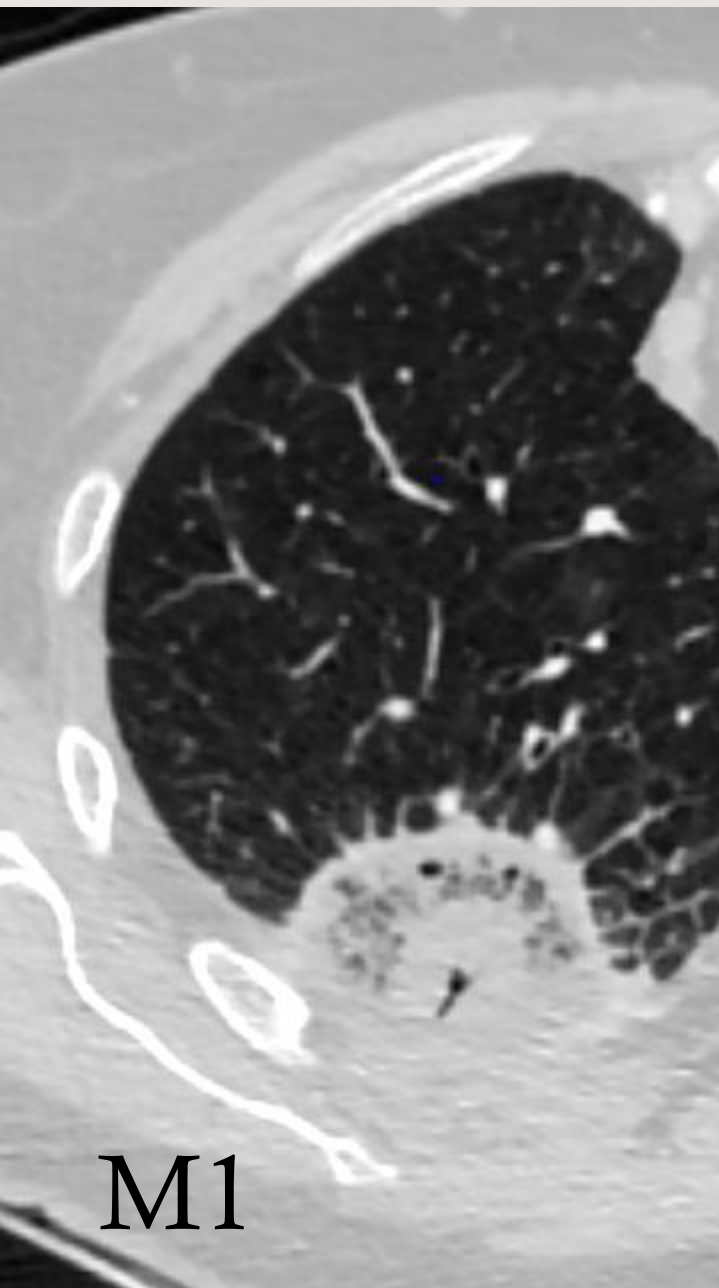
## Zone d'ablation – Evolution normale

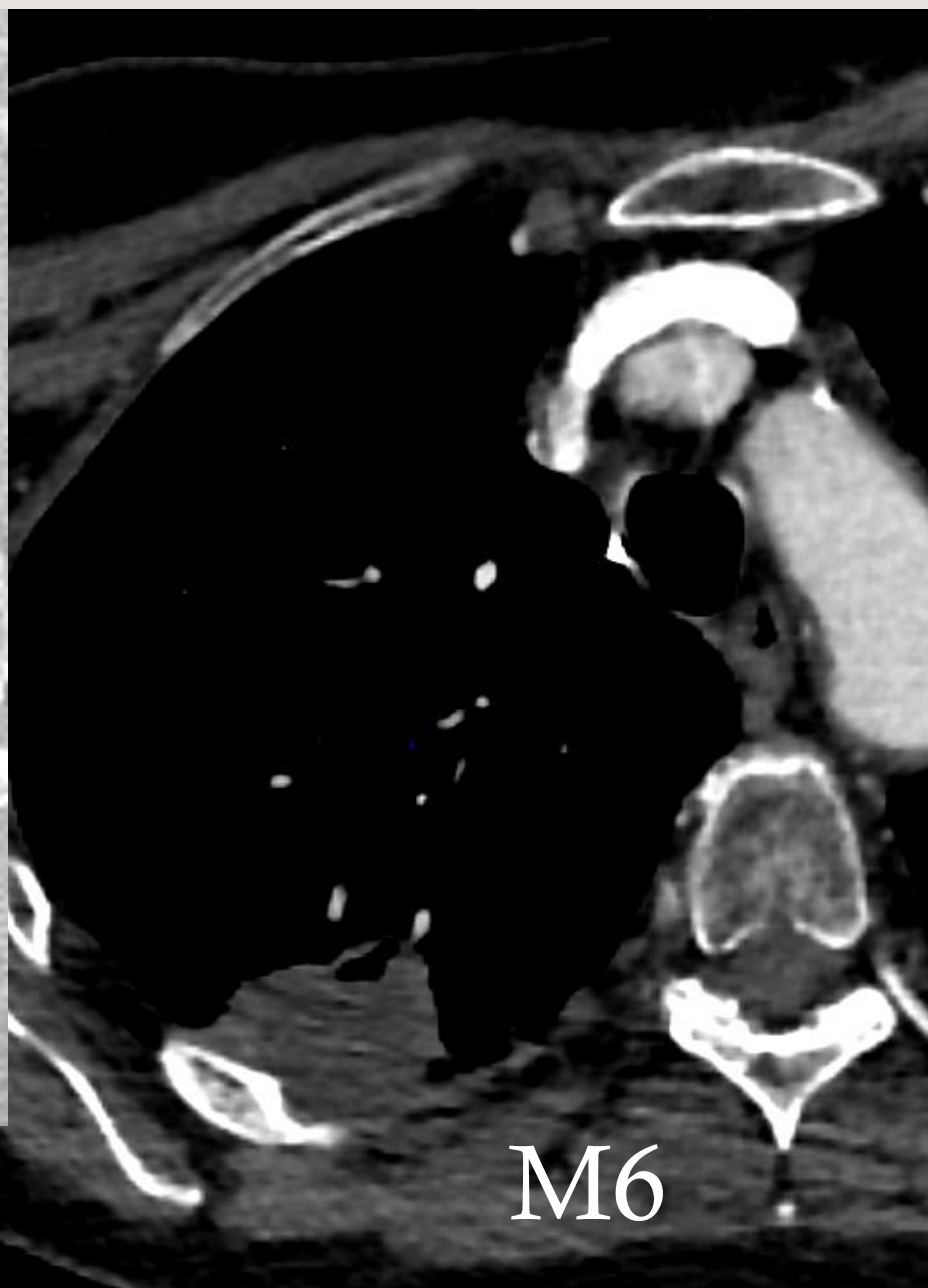
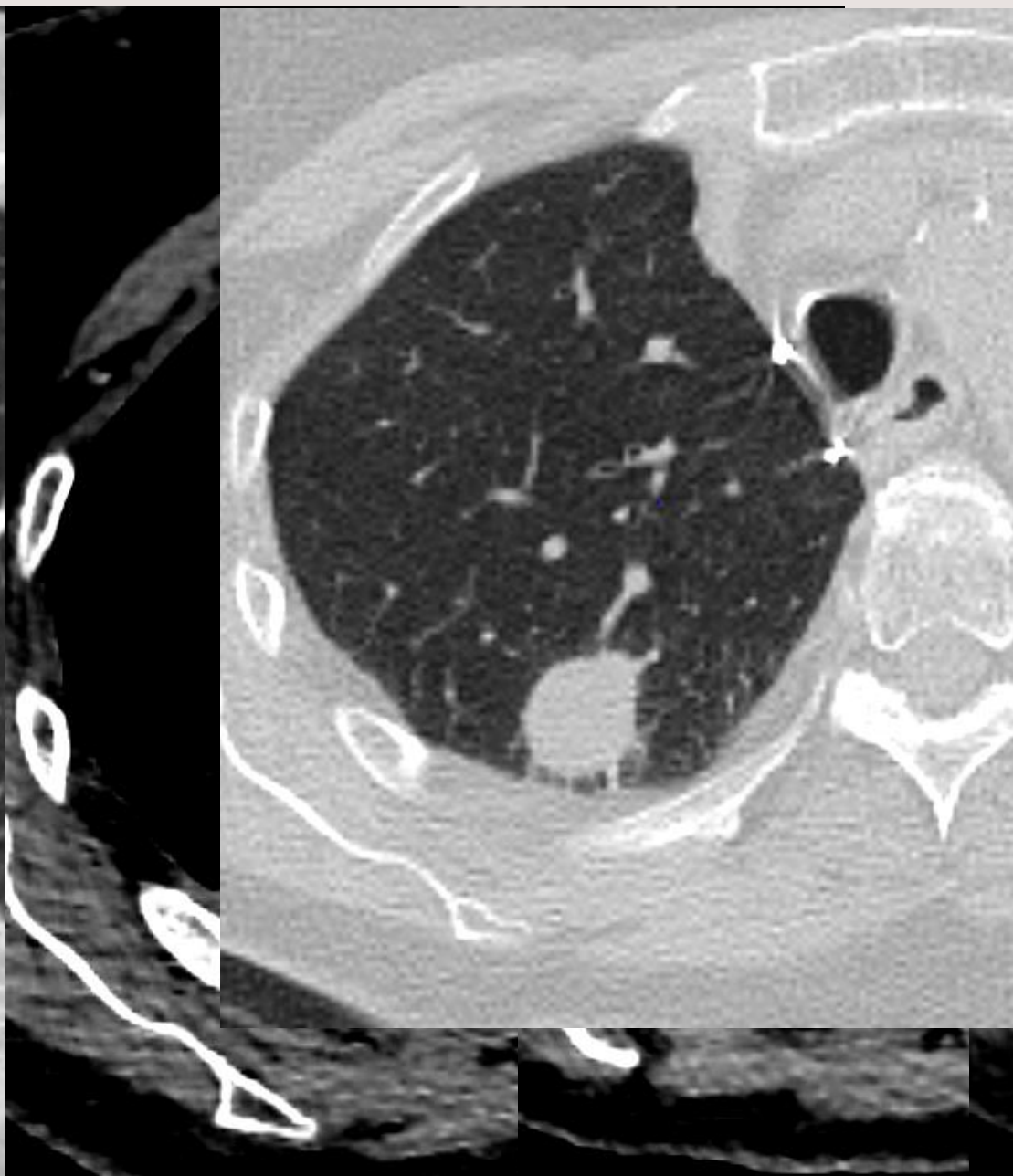
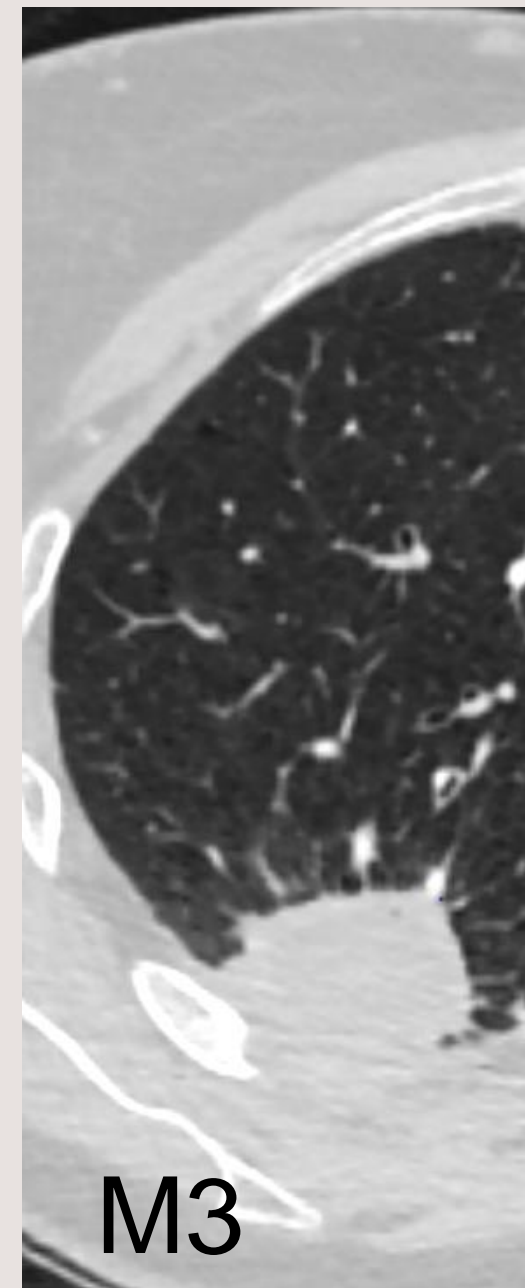
- Décroissance de taille
- Absence de prise de contraste focale
- Pas de contingent nodulaire

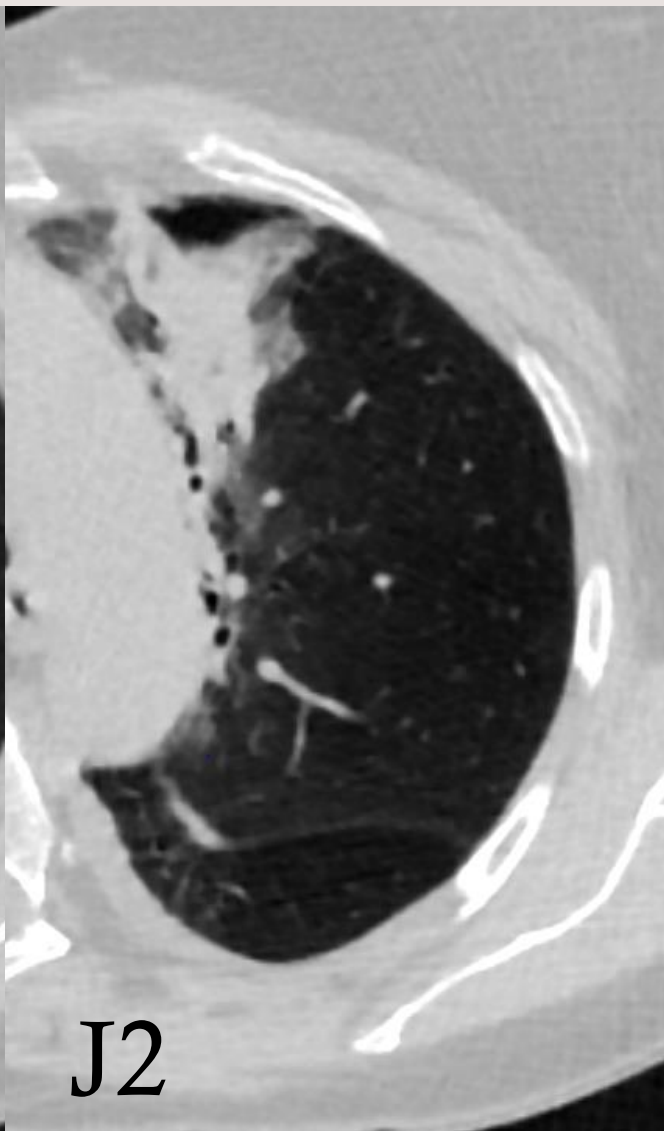
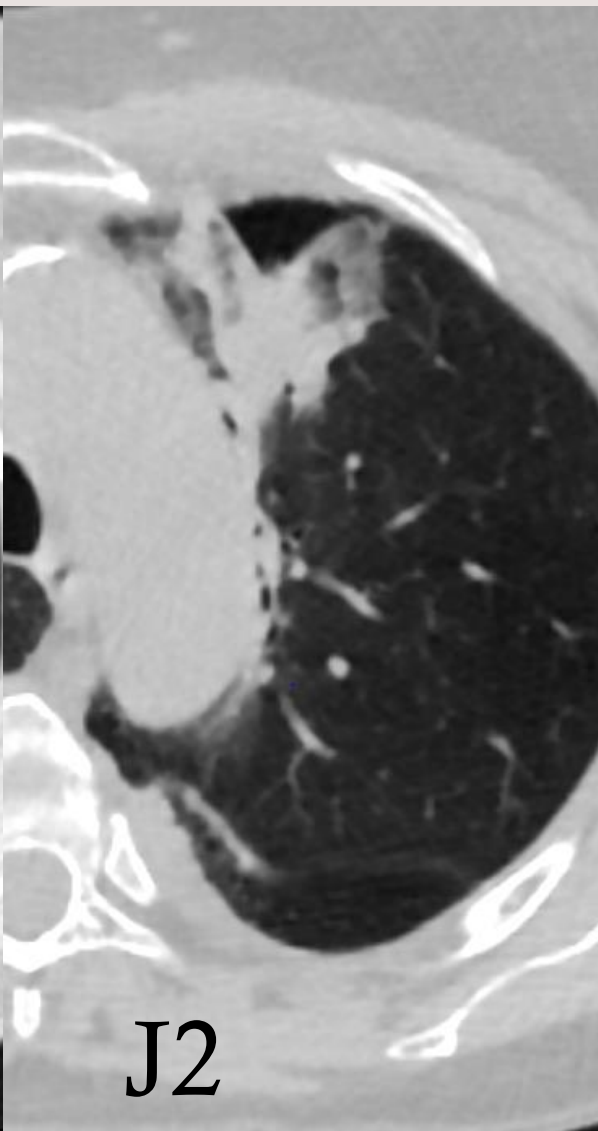
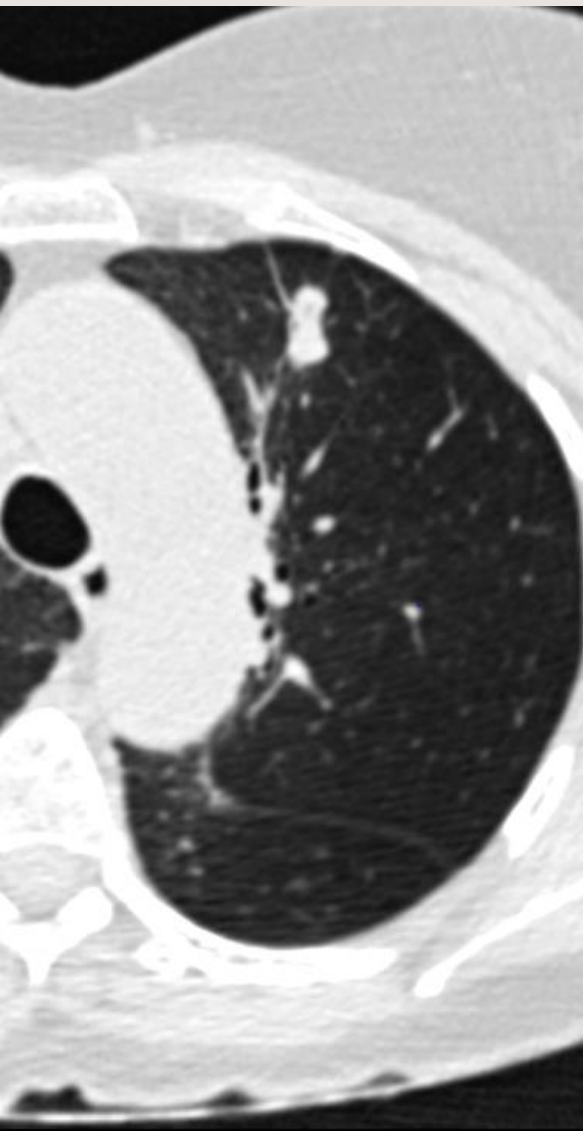


J2

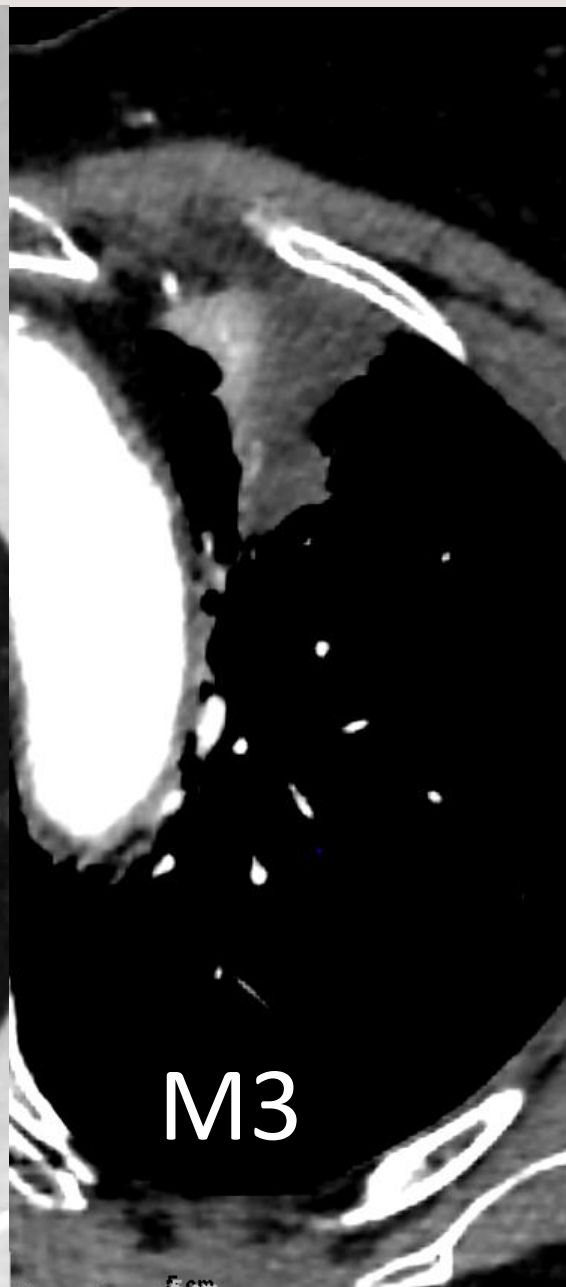
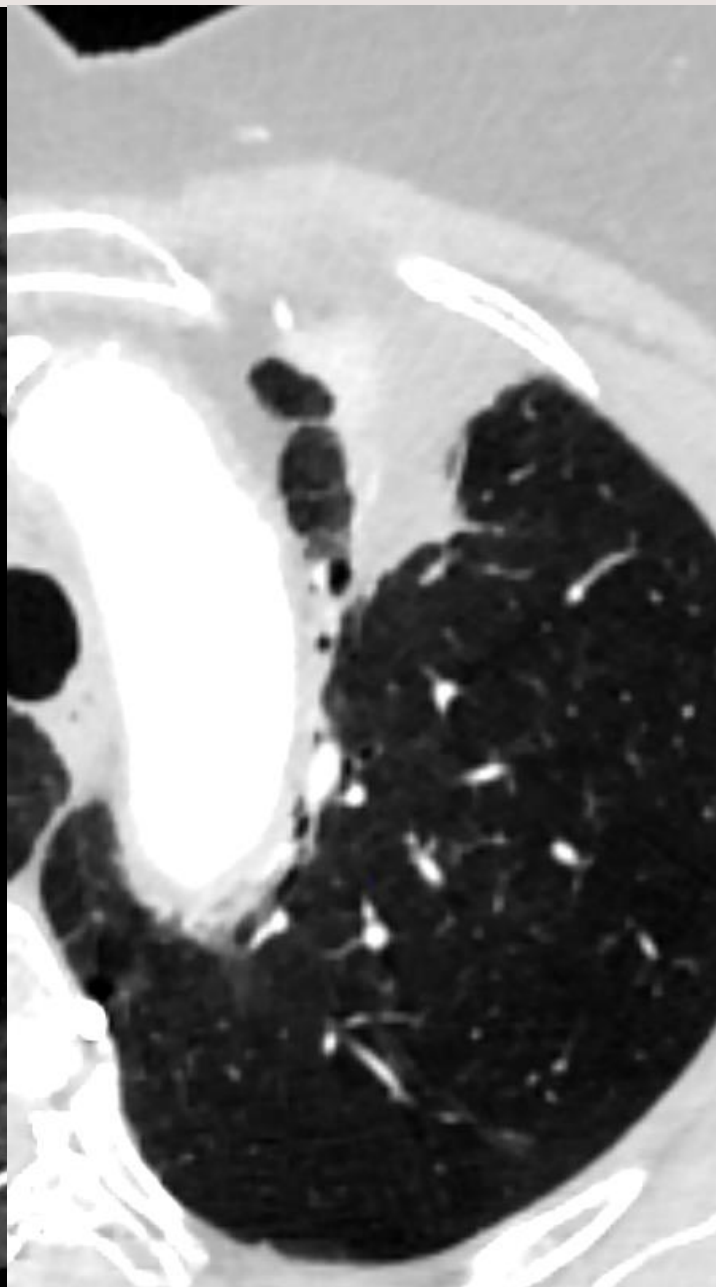
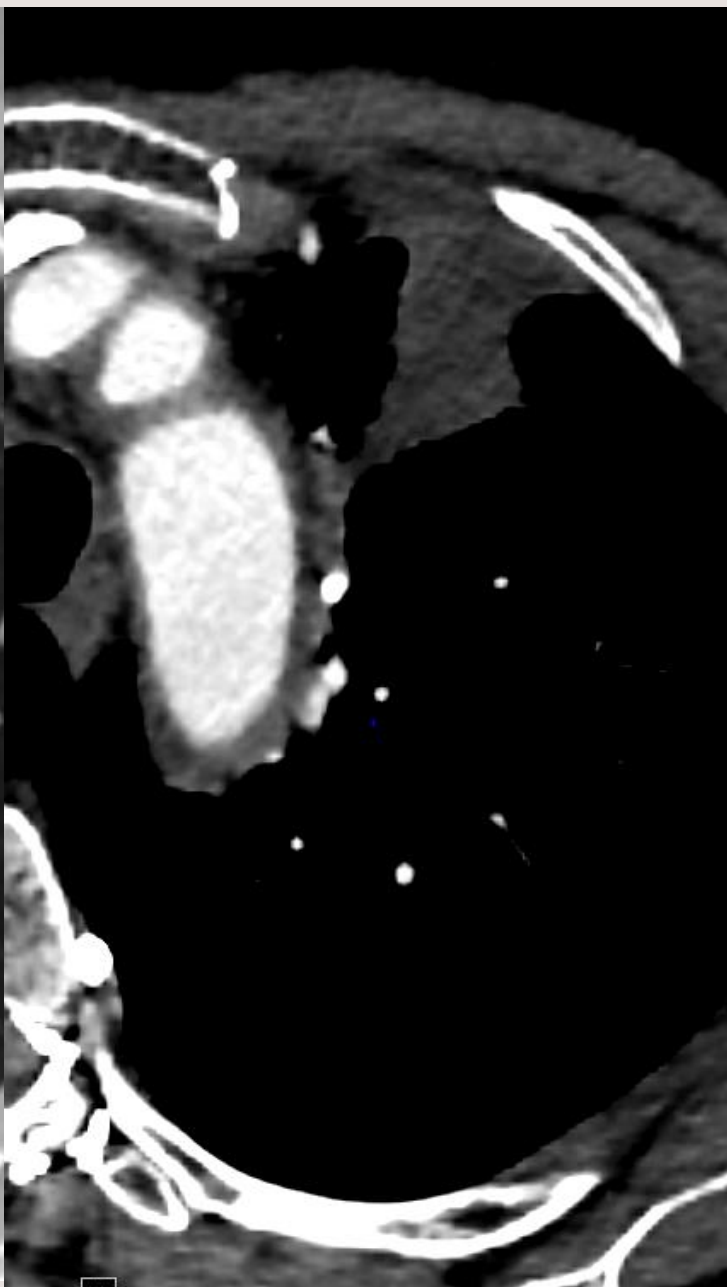
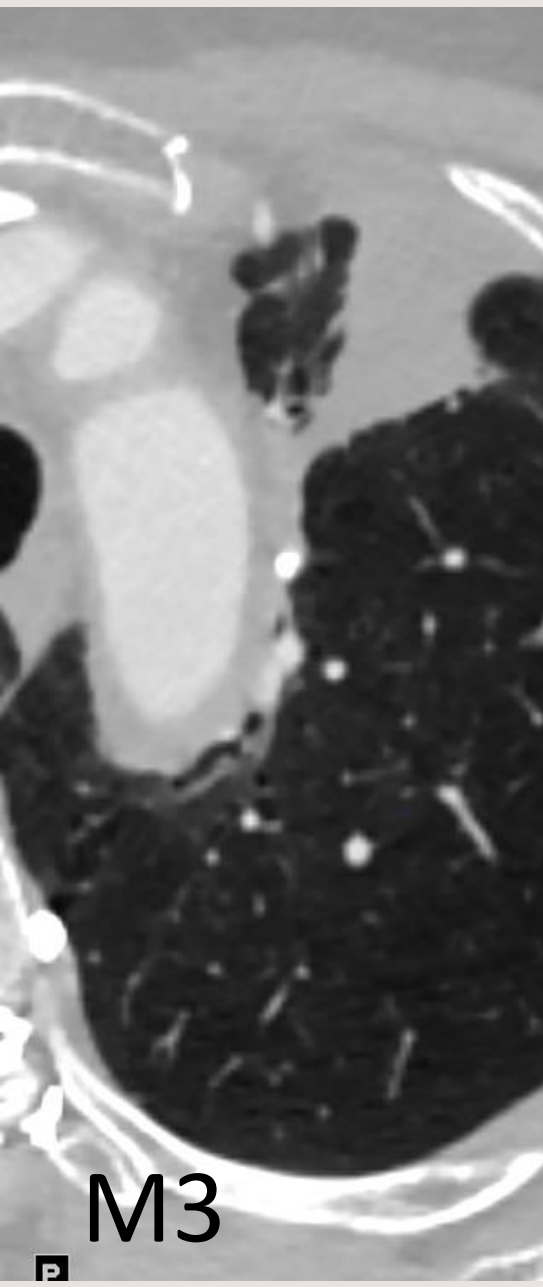


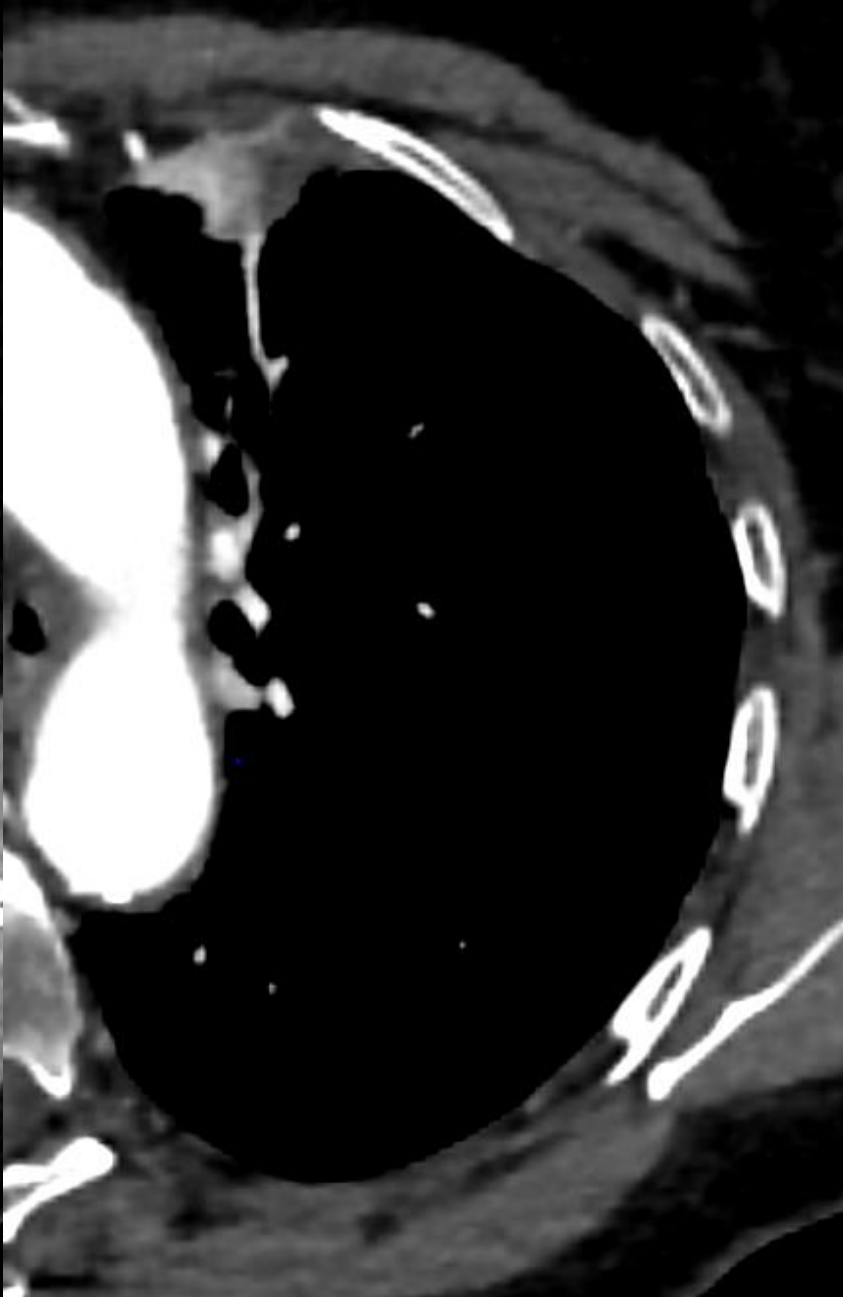
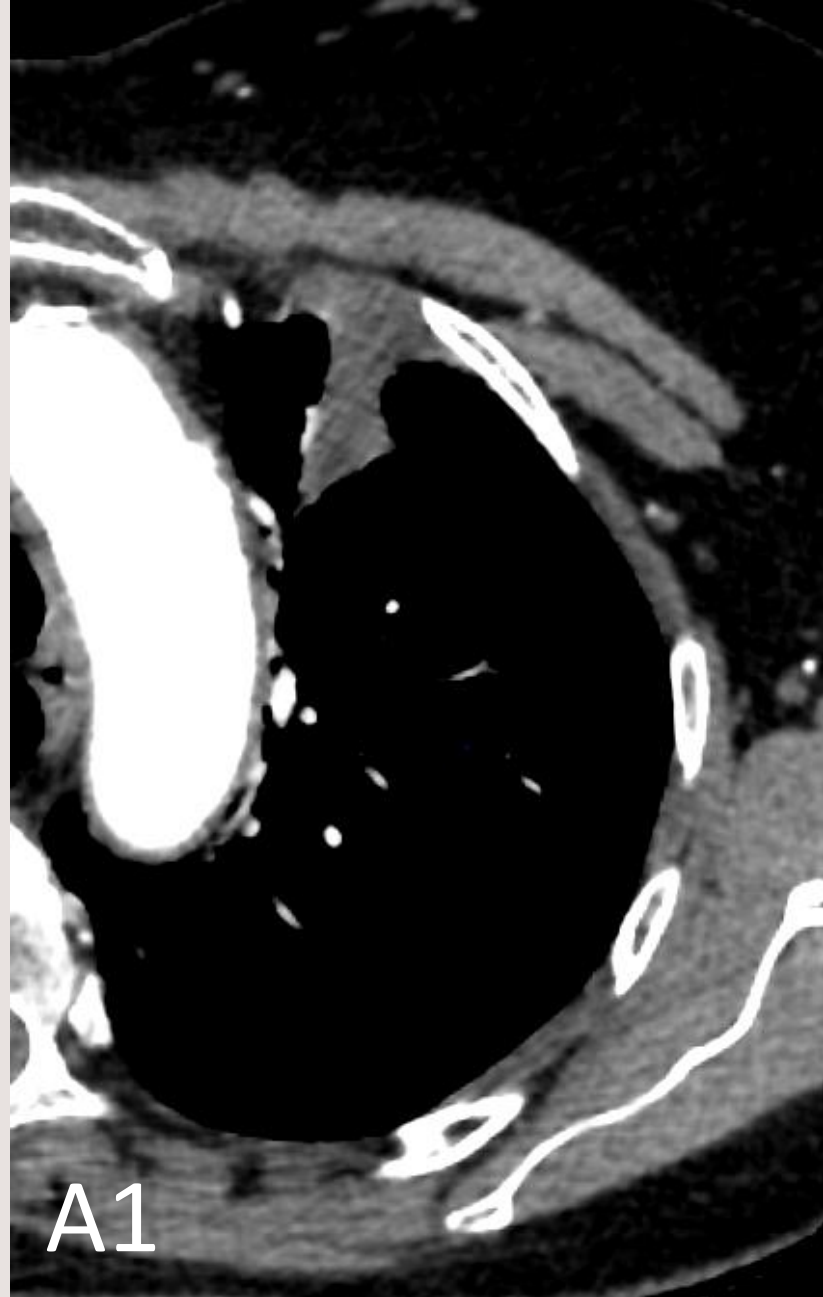






Prise de contraste?







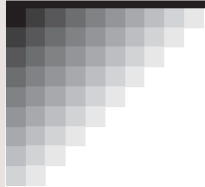
# Suivi après RF pulmonaire: phase « intermédiaire »

## Zone d'ablation – Critères de destruction incomplète

- Englobement incomplet de la lésion
- Défaut de majoration de taille de la ZA / lésion traitée
- Apparition d'une composante nodulaire périphérique
- Rehaussement:
  - supérieur à la lésion initiale
  - Central ou nodulaire > 10 mm
  - > 15 UH

CHEST IMAGING

947

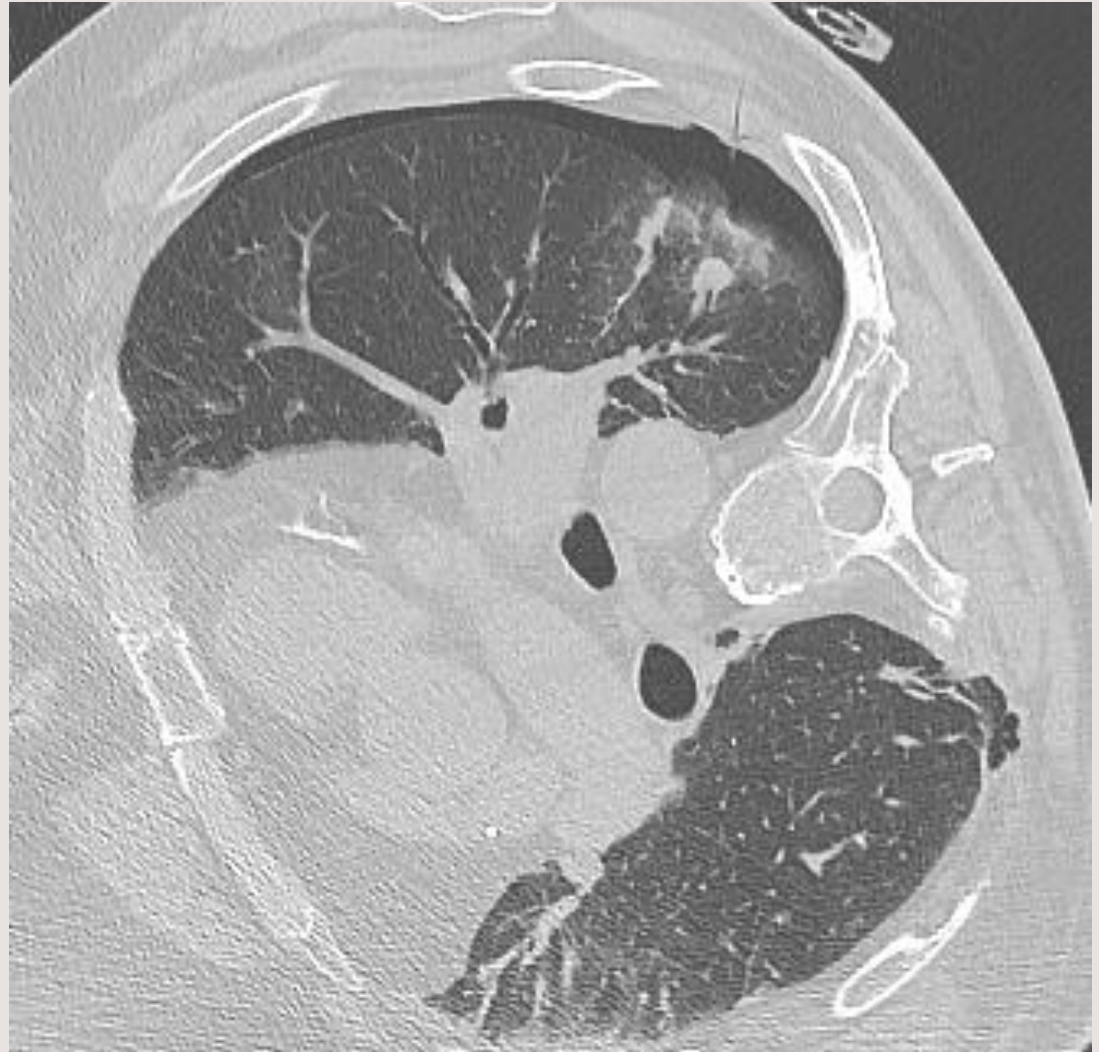


## Radiofrequency Ablation of Lung Tumors: Imaging Features of the Post-ablation Zone<sup>1</sup>

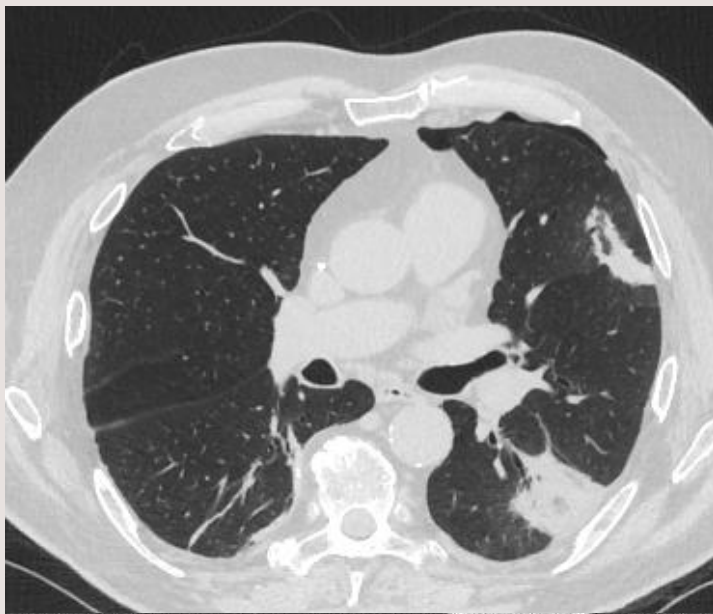
CME FEATURE

*Fereidoun G. Abtin, MD • Jilbert Eradat, MD • Antonio J. Gutierrez, MD  
Christopher Lee, MD • Michael C. Fishbein, MD • Robert D. Suh, MD*

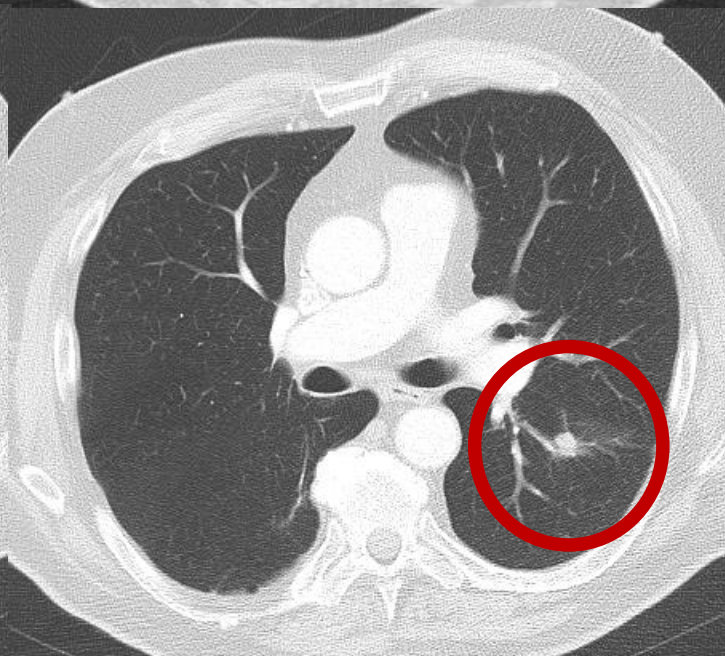
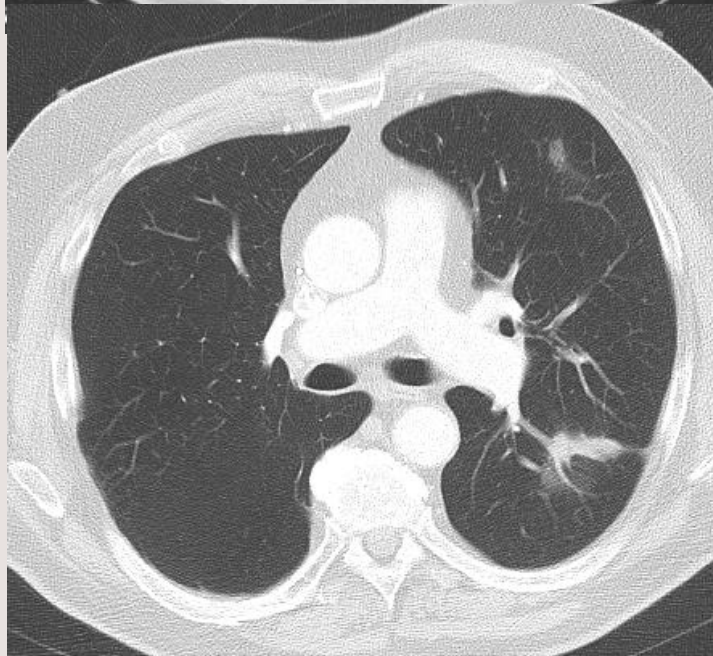
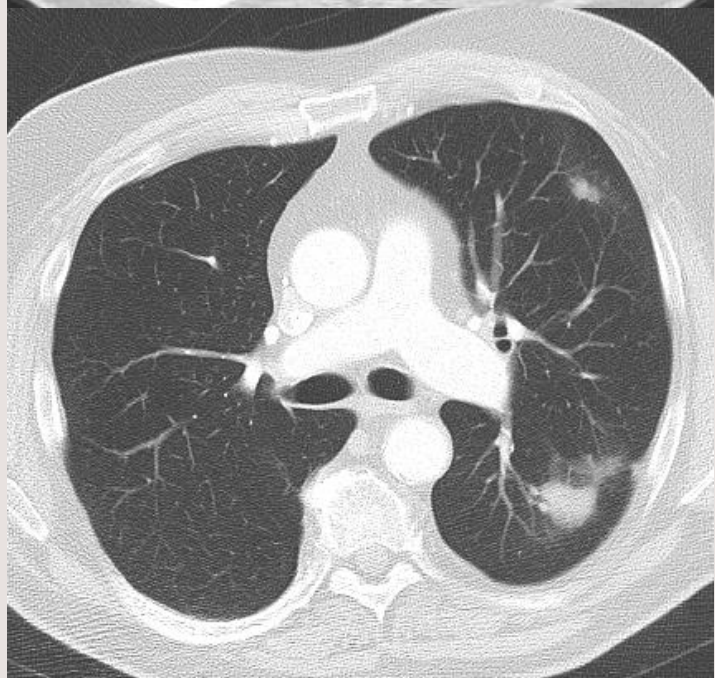
RadioGraphics 2012; 32:947-969 •



M1



M3



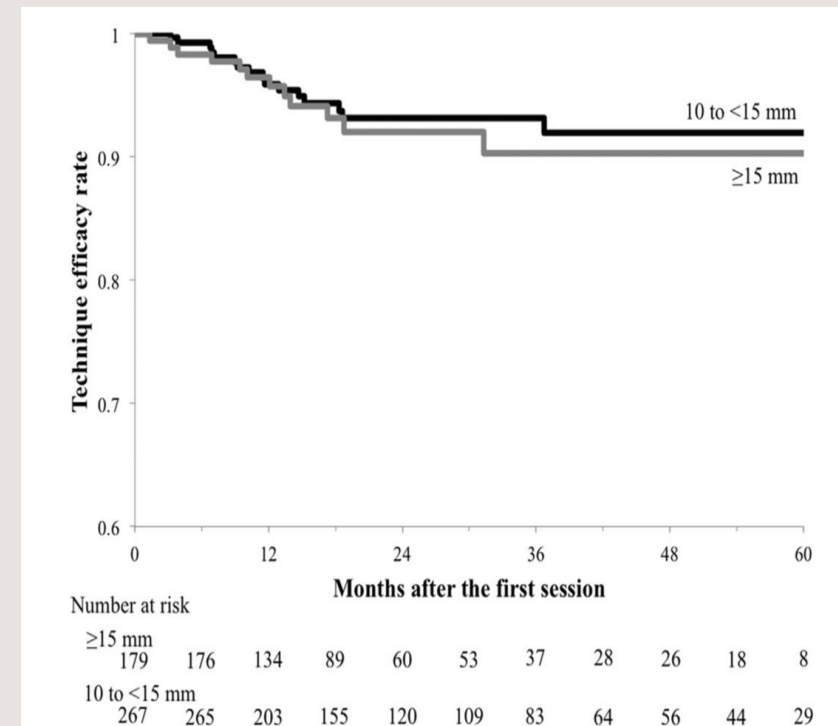
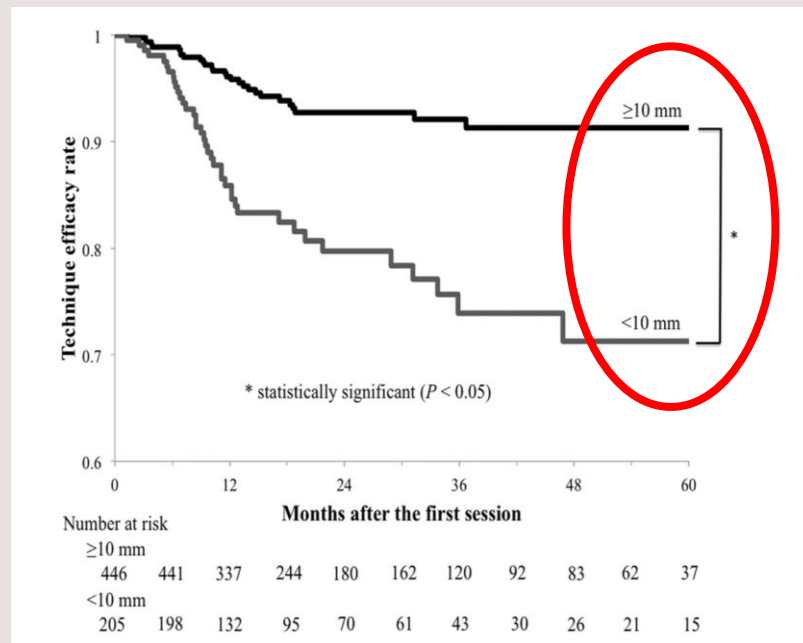
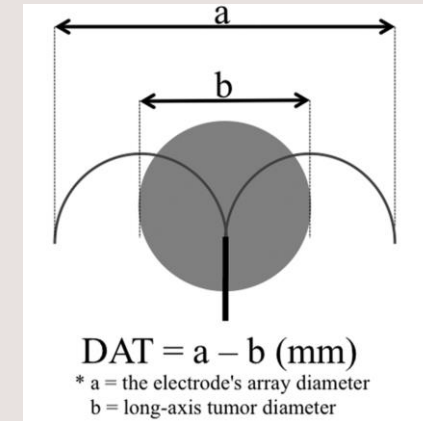
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# Radiofrequency Ablation of Lung Tumors Using a Multitined Expandable Electrode: Impact of the Electrode Array Diameter on Local Tumor Progression

Ihara H. JVIR 2016; 27:87–95

651 lung tumors ,  $12 \pm 7$  mm (range, 2–42 mm)  
 The difference between electrode array diameter and tumor diameter (DAT) median DAT 12 mm



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

T. de Baère<sup>1\*</sup>, A. Aupérin<sup>2</sup>, F. Deschamps<sup>1</sup>, P. Chevallier<sup>3</sup>, Y. Gaubert<sup>4</sup>, V. Boige<sup>5</sup>, M. Fonck<sup>6</sup>,  
B. Escudier<sup>5</sup> & J. Palussière<sup>7</sup>

Annals of Oncology

Jan 2002 - Juillet 2010 (prospective database) :  
566 patients dont 188 CCR  
1037 métastases 4 à 70 mm (med=15)

**Median follow up 35,5 m**  
Median OS 62 m  
4-year local efficacy 89%  
4-year lung disease control rate 44,1%,  
with patient retreated safely up to four times

# Radiofrequency Ablation of Stage IA Non-Small Cell Lung Cancer in Medically Inoperable Patients: Results From the American College of Surgeons Oncology Group Z4033 (Alliance) Trial

Damian E. Dupuy, MD<sup>1</sup>; Hiran C. Fernando, MBBS<sup>2</sup>; Shauna Hillman, MS<sup>3</sup>; Thomas Ng, MD<sup>1</sup>; Angelina D. Tan, BS<sup>3</sup>; Amita Sharma, MD<sup>4</sup>; William S. Rilling, MD<sup>5</sup>; Kelvin Hong, MBBS<sup>6</sup>; and Joe B. Putnam, MD<sup>7</sup>

Objectifs : Survie globale à 2 ans  
Contrôle local  
Complications  
Retentissement sur la fonction respiratoire



Age, median (range), y	76.0 (60.0-89.0)
Sex, No. (%)	
Male	23 (45.1)
Female	28 (54.9)
Histology, No. (%)	
Squamous	19 (37.3)
Adenocarcinoma	24 (47.1)
Bronchoalveolar	1 (2.0)
Other non-small cell carcinoma	4 (7.8)
Other, specified <sup>a</sup>	3 (5.9)
Tumor stage T1, No. (%)	51 (100.0)
N stage N0, No. (%)	51 (100.0)
M stage M0, No. (%)	51 (100.0)
Stage IA, No. (%)	51 (100.0)
Size of nodule, median (range), cm	2.0 (0.8-3.0)
Maximum tumor dimension, median (range), cm	2.1 (0.8-3.0)
Tumor SUV, median (range)	6.0 (0.6-15.1)



## Suivi

CT scan 3, 6, 9, 12, 18, and 24 mois.

FDG PET scans 6, 12, 18, and 24 mois.

Fonction pulmonaire 60 jours avant RFA 3 et 24 mois après RFA.

*Récidive locale* récidive dans le même lobe ou hilare (N1) ou progression sur la zone d'ablation

## Suivi

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***Récidive régionale*** : récidive pulmonaire du même côté que la RF ou N2

## Suivi

CT scan 3, 6, 9, 12, 18, and 24 mois.

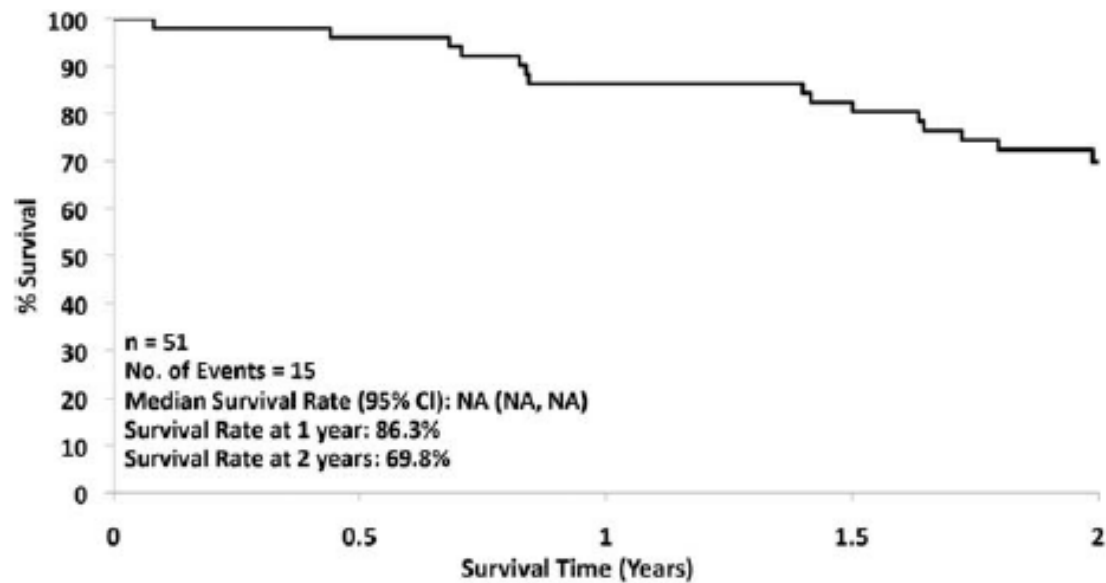
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***Récidive locale*** récidive dans le même lobe ou hilare (N1) ou progression sur la zone d'ablation

***Récidive régionale*** : récidive pulmonaire du même côté que la RF ou N2

***Récidive à distance*** controlat, N3 ou métastases

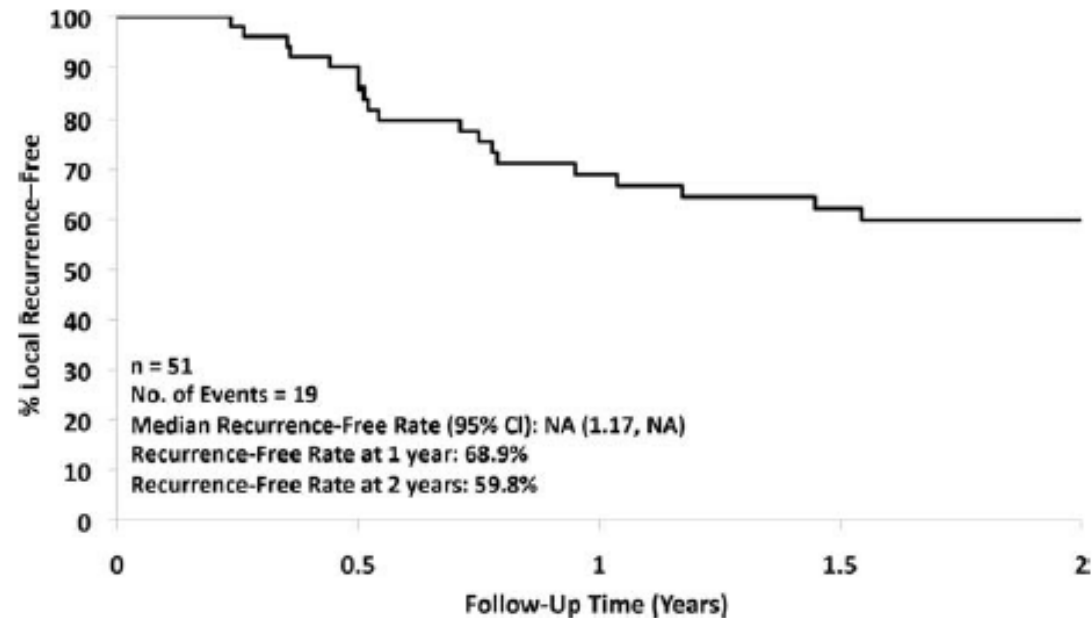


**n = 51**  
**No. of Events = 15**  
**Median Survival Rate (95% CI): NA (NA, NA)**  
**Survival Rate at 1 year: 86.3%**  
**Survival Rate at 2 years: 69.8%**

**Figure 2.** Overall survival of eligible patients with 2 years of follow-up. CI indicates confidence interval; NA, not available.

Survie globale

## Taux de succès



**Median Recurrence-Free Rate (95% CI): NA (1.17, NA)**  
**Recurrence-Free Rate at 1 year: 68.9%**  
**Recurrence-Free Rate at 2 years: 59.8%**

**Figure 3.** Time to local recurrence with 2 years of follow-up. CI indicates confidence interval; NA, not available.

**TABLE 3.** Summary of Recurrence (n = 51)

Type of Recurrence	No. (%)
None	29 (56.9)
Local	15 (29.4)
Regional	1 (2.0)
Distant	2 (3.9)
Local/regional	2 (3.9)
Local/distant	2 (3.9)

# Suivi après RF pulmonaire: suivi oncologique

- Poursuite décroissance de taille ou (stabilité)
- 5 présentations en TDM

- Fibrose

- Nodule

- Cavitation

- Atélectasie

- « disparition »

**Table 2** Different features after RFA of tumors  $\leq 2$  cm

RFA zones	Time of follow-up (mo)				
	2 (n = 211)	4 (n = 201)	6 (n = 190)	9 (n = 175)	12 (n = 162)
No. of fibroses (%)	24 (11.4)	56 (27.9)	85 (44.7)	88 (50.3)	95 (58.6)
No. of nodules (%)	144 (68.2)	125 (62.2)	93 (48.9)	76 (43.4)	59 (36.4)
No. of cavitations (%)	25 (11.8)	12 (6)	5 (2.6)	5 (2.9)	4 (2.5)
No. of GGOs (%)	13 (6.2)				
No. of atelectases (%)	5 (2.4)	6 (3)	4 (2.1)	3 (1.7)	2 (1.2)
No. of disappearances (%)	0	2 (1)	3 (1.6)	3 (1.7)	2 (1.2)

# ATELECTASIE



RF

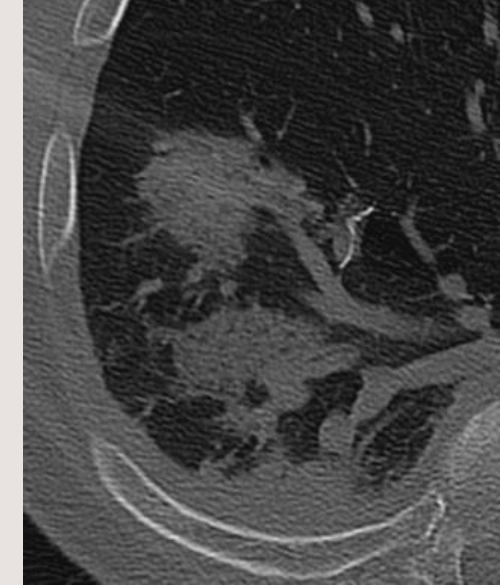
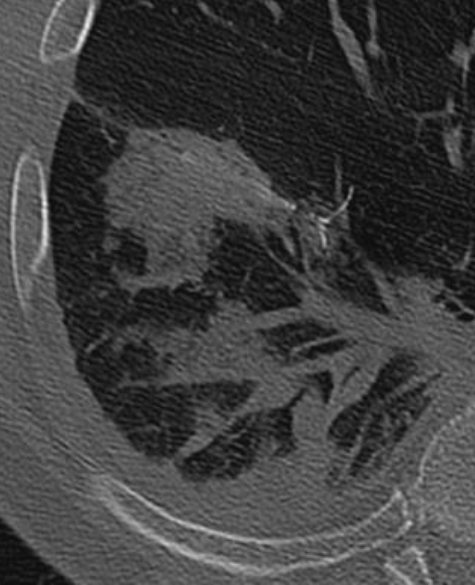
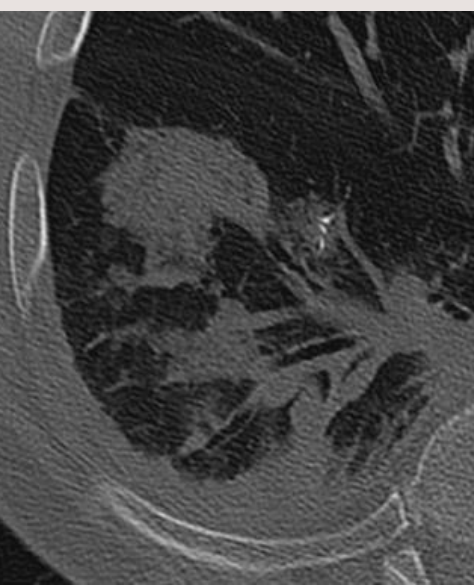
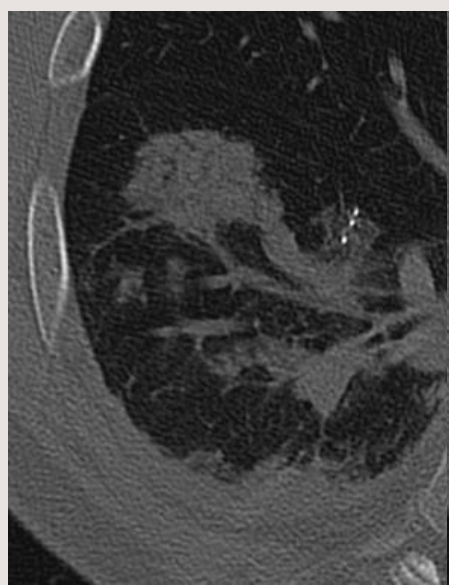
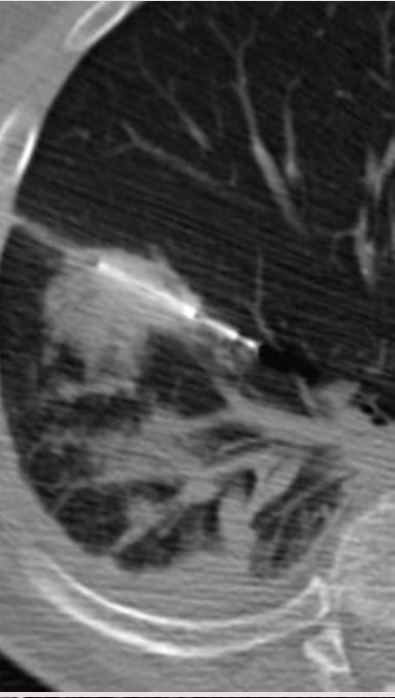
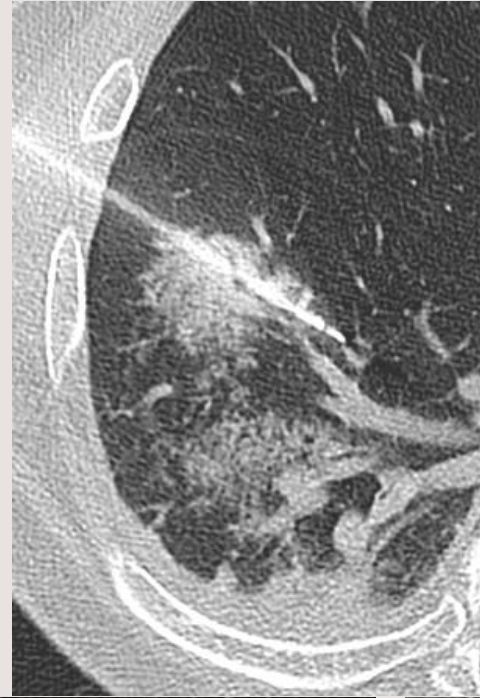
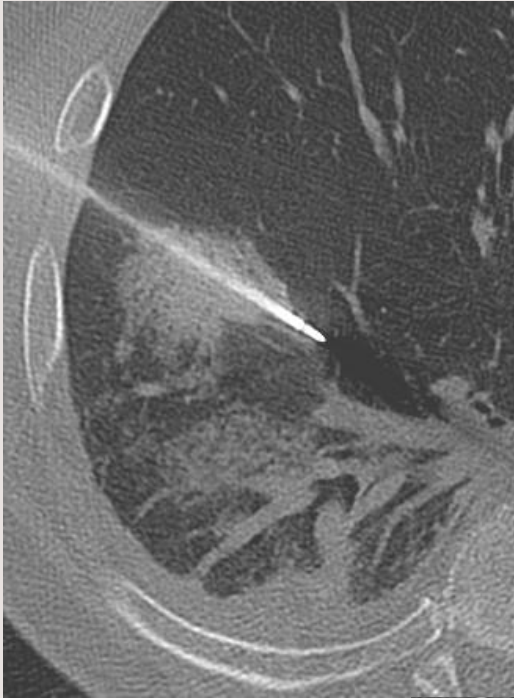
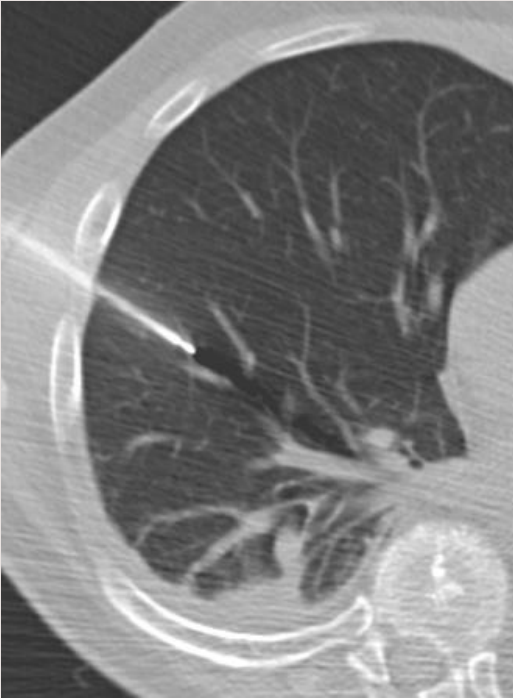
48 H

1 MOIS

6 MOIS

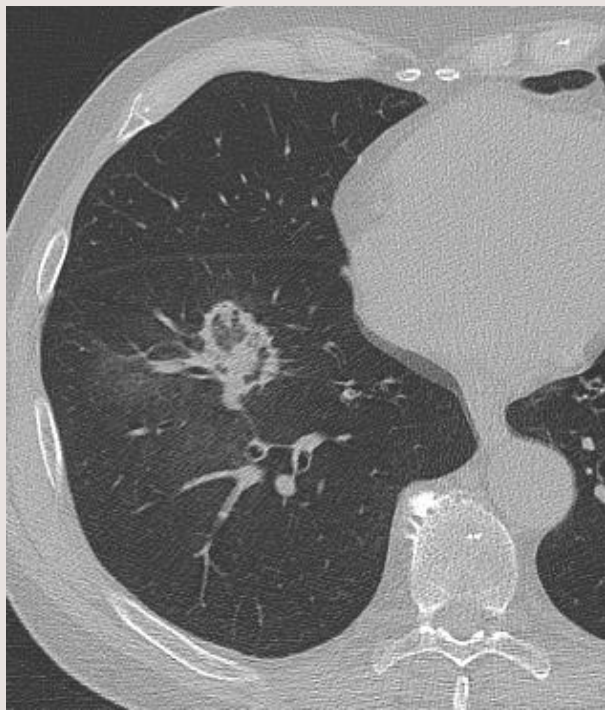
9 MOIS

cicatrice de RF chez un patient de 54 ans, présentant une lésion secondaire d'un liposarcome

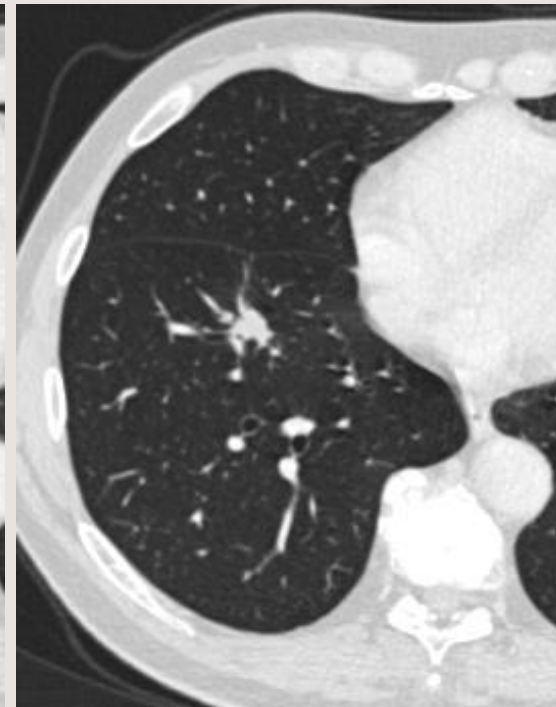
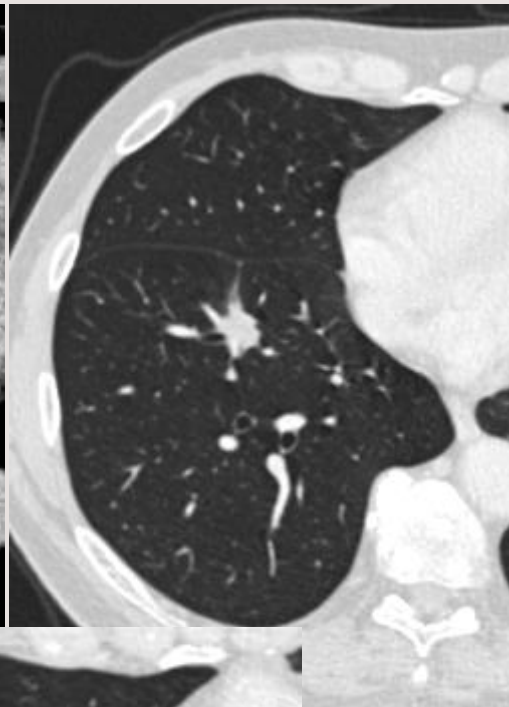
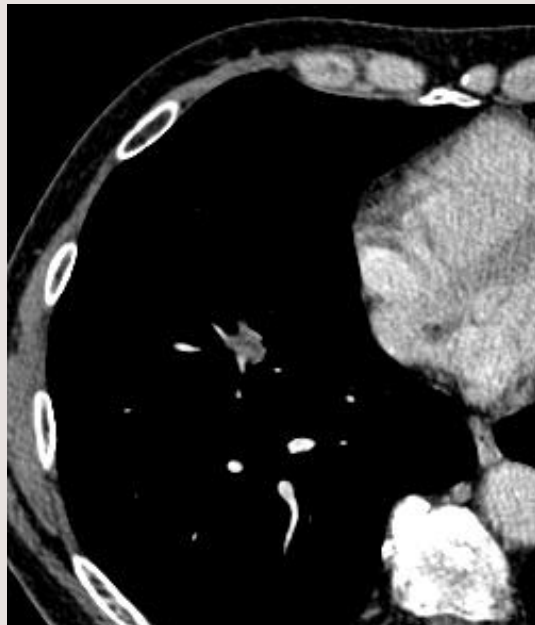




J2

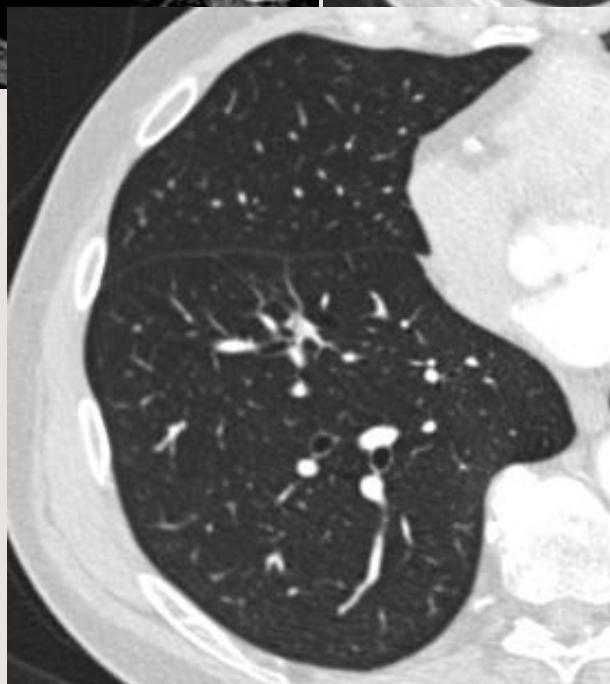
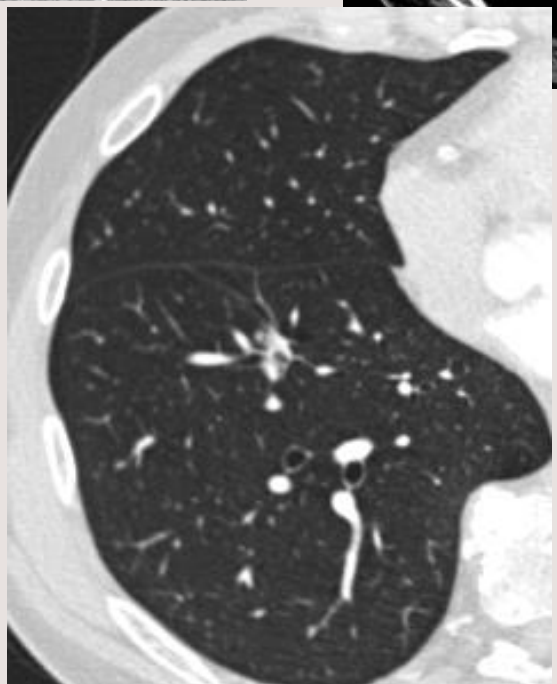


FIBROSE

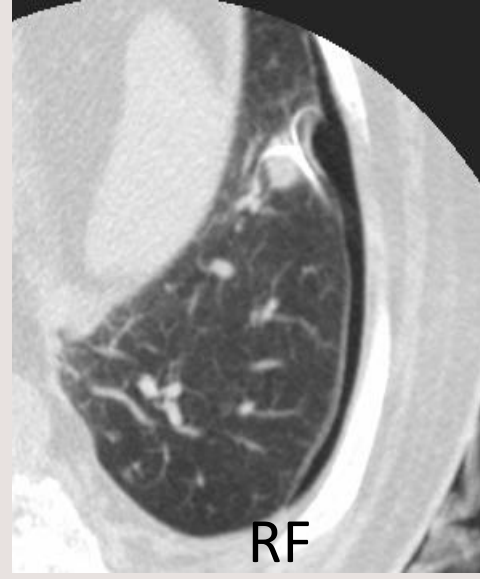


M 3

M 18



# NODULE

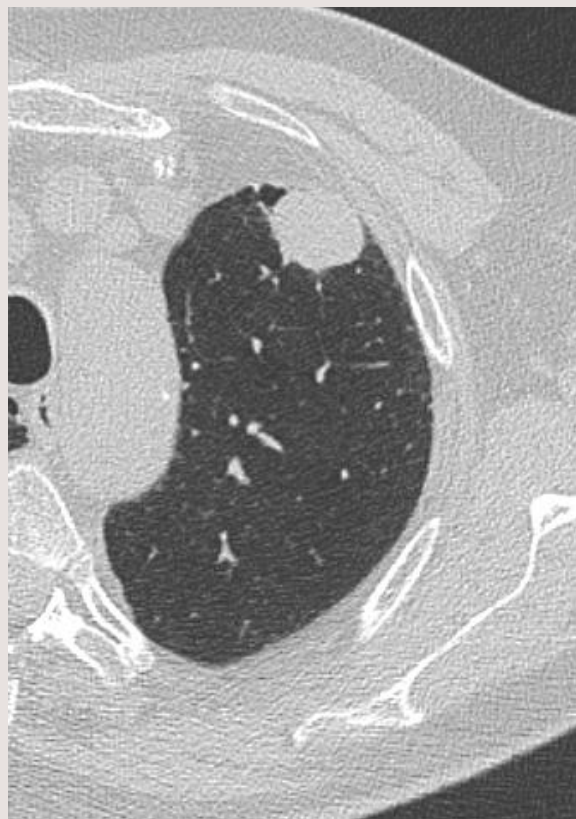


M 6

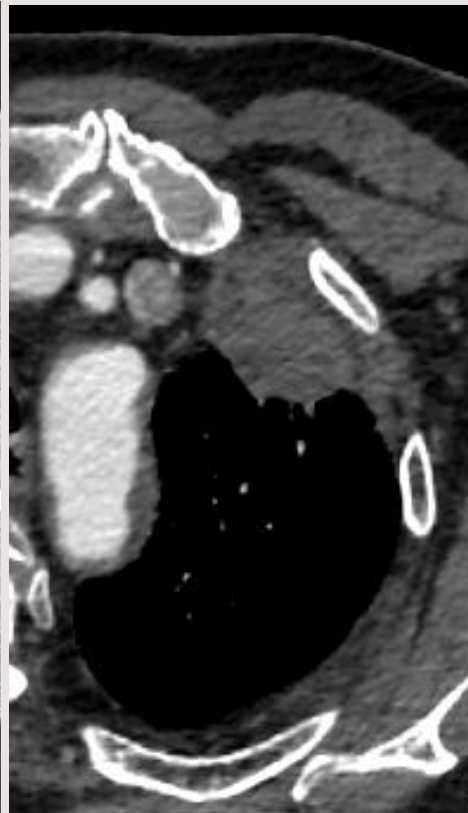
M 9

M 12

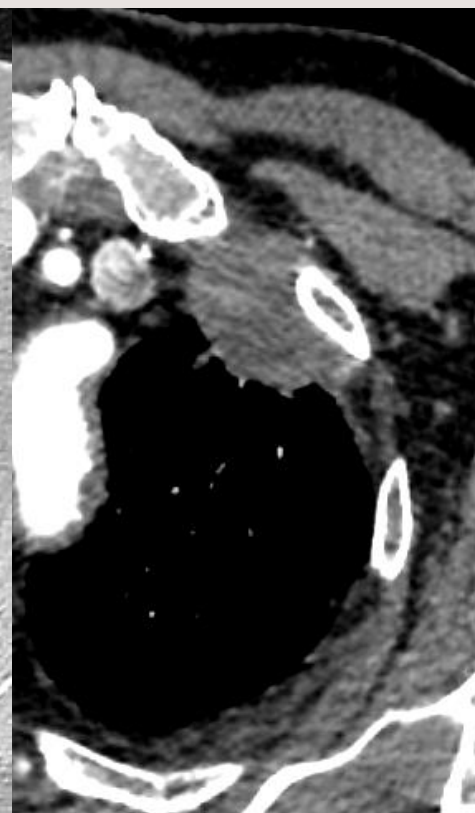
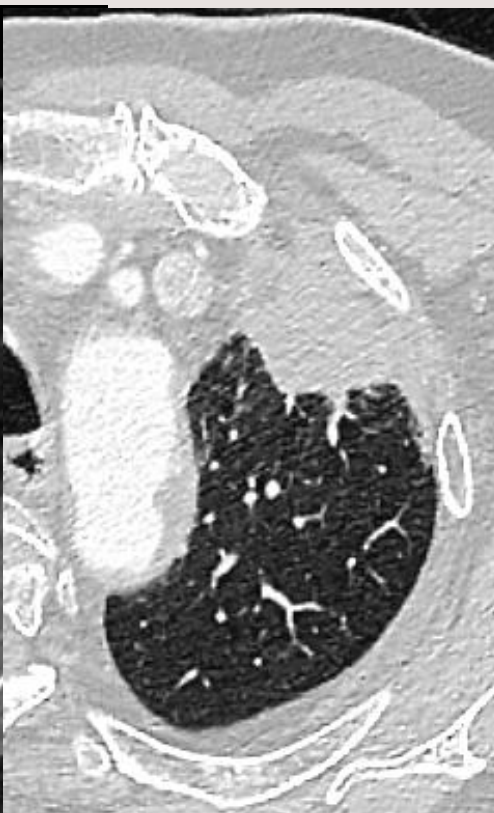
A1 après RF T. primitive lobe sup gauche restant  
Condensation ss pleurale pseudo nodulaire



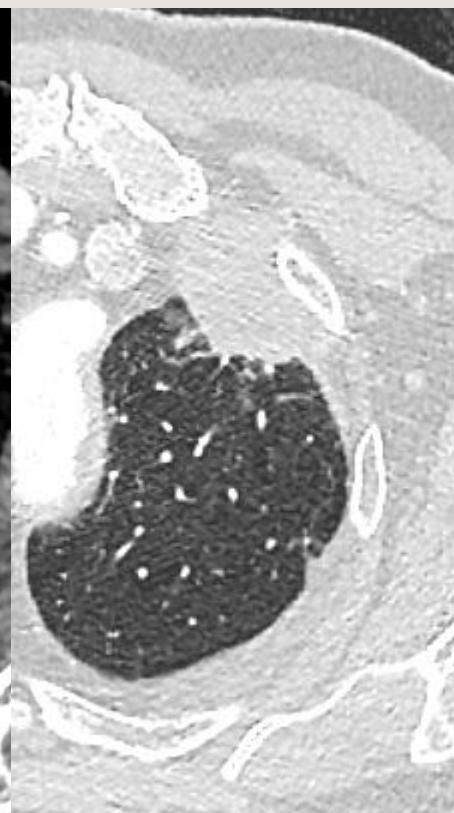
mars 2015



aout 2015

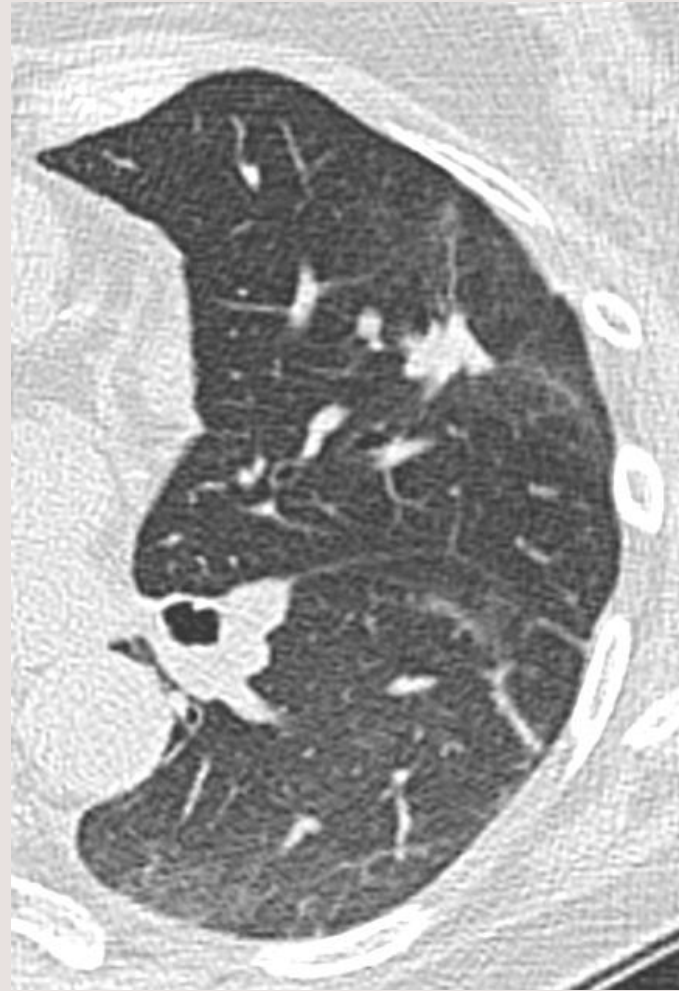


mars 2016

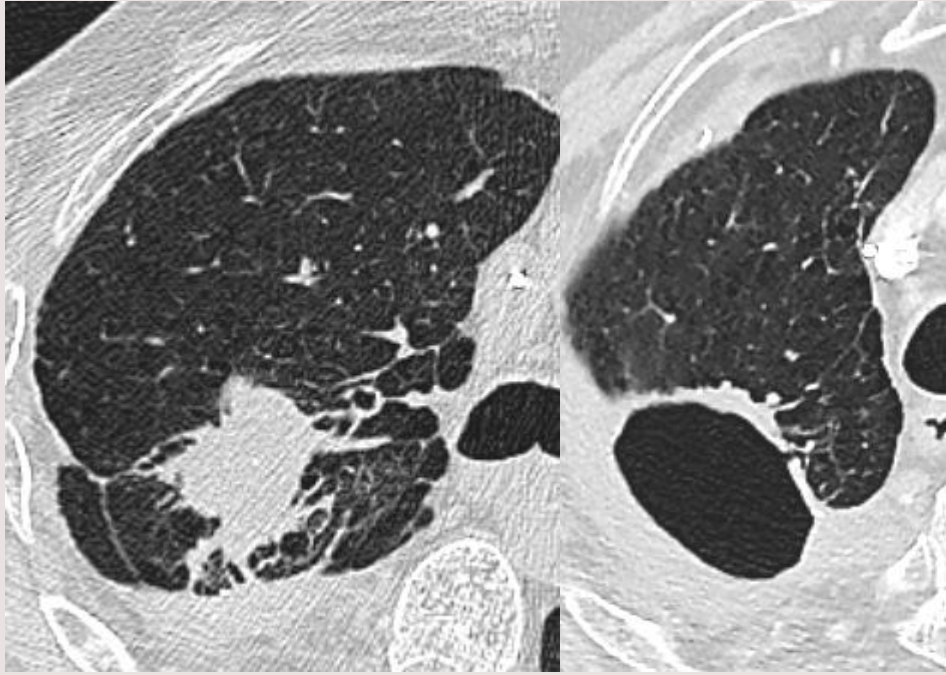




3 mois

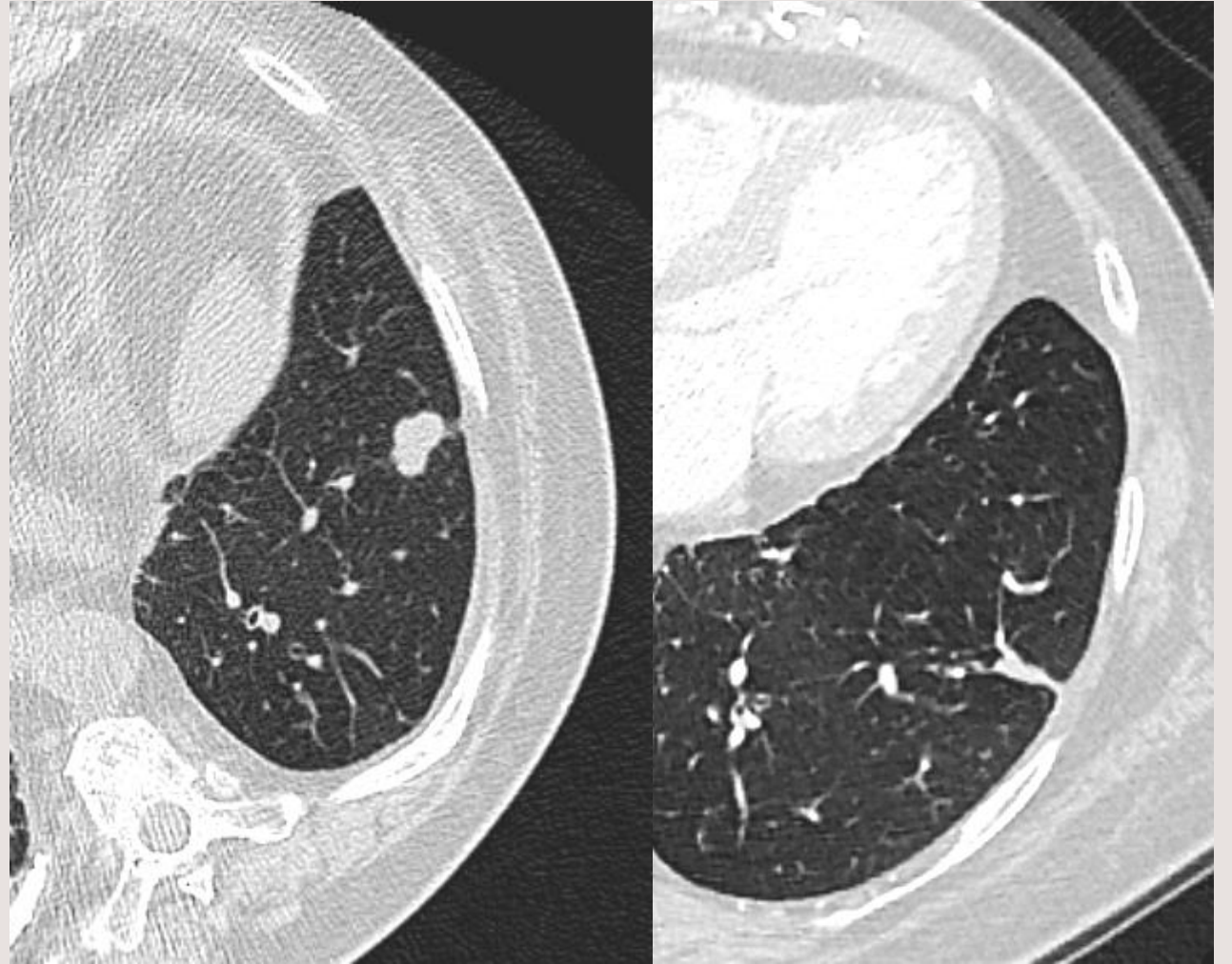


18 mois



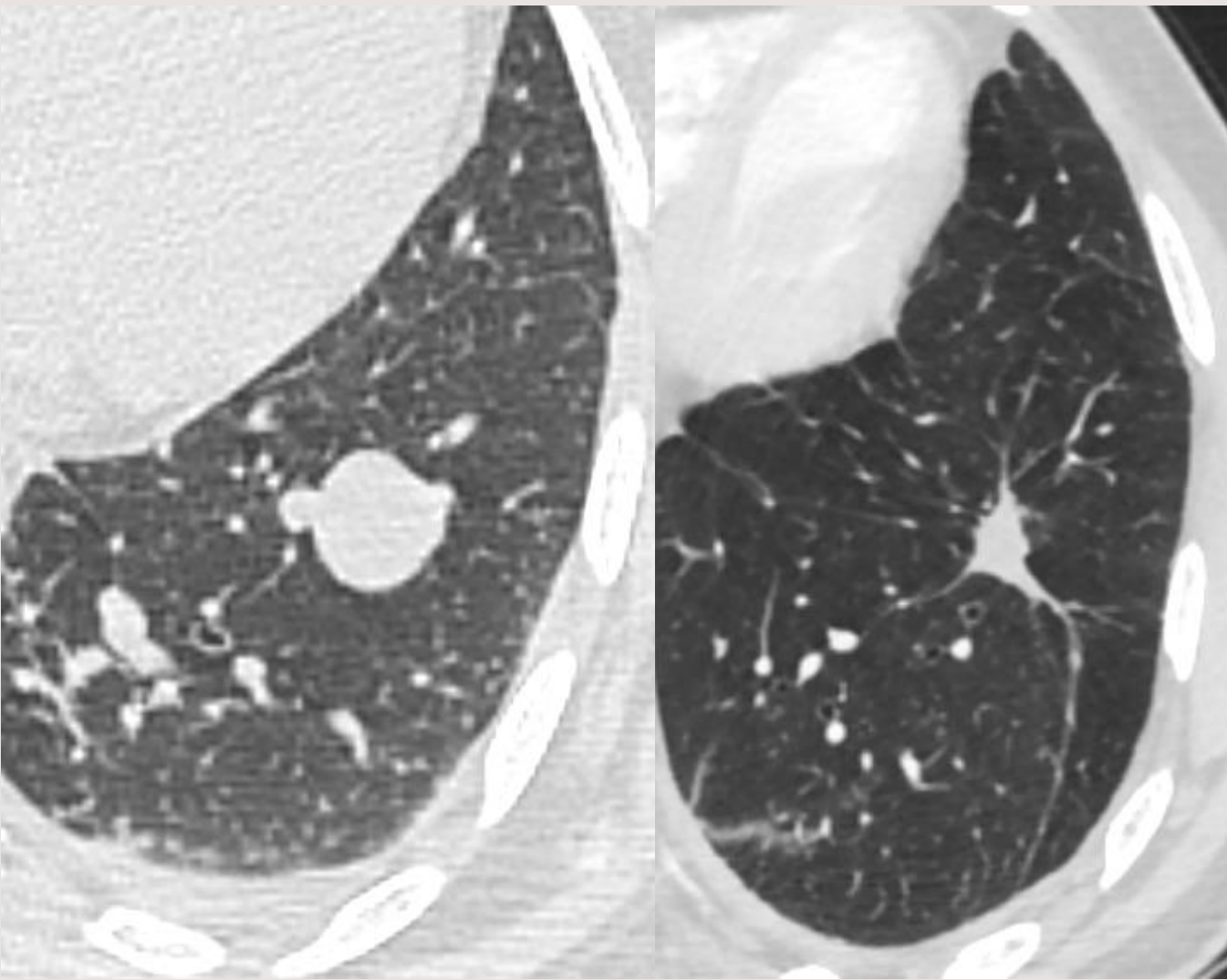
7,5 ans

CAVITE



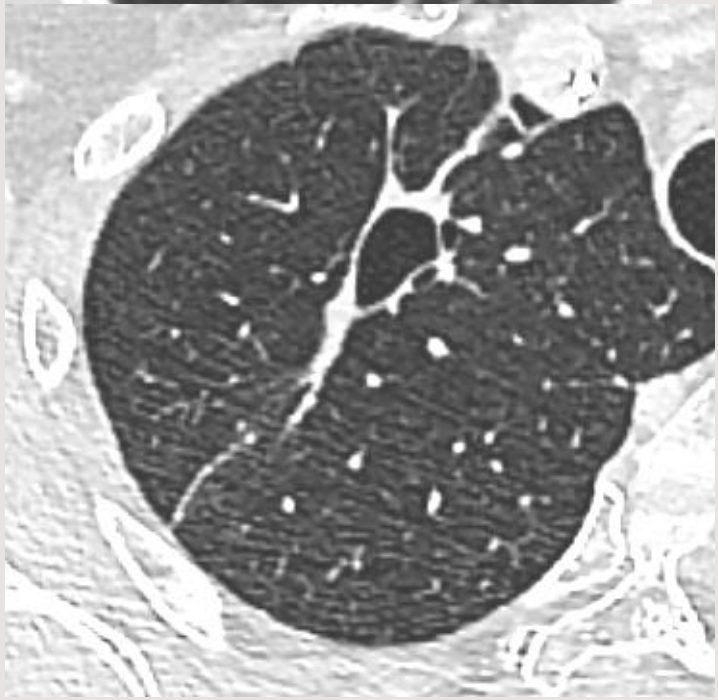
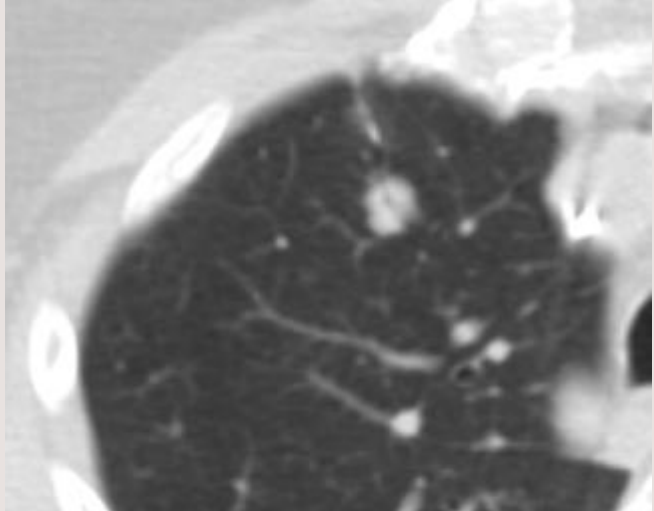
7 ans 3 mois

FIBROSE

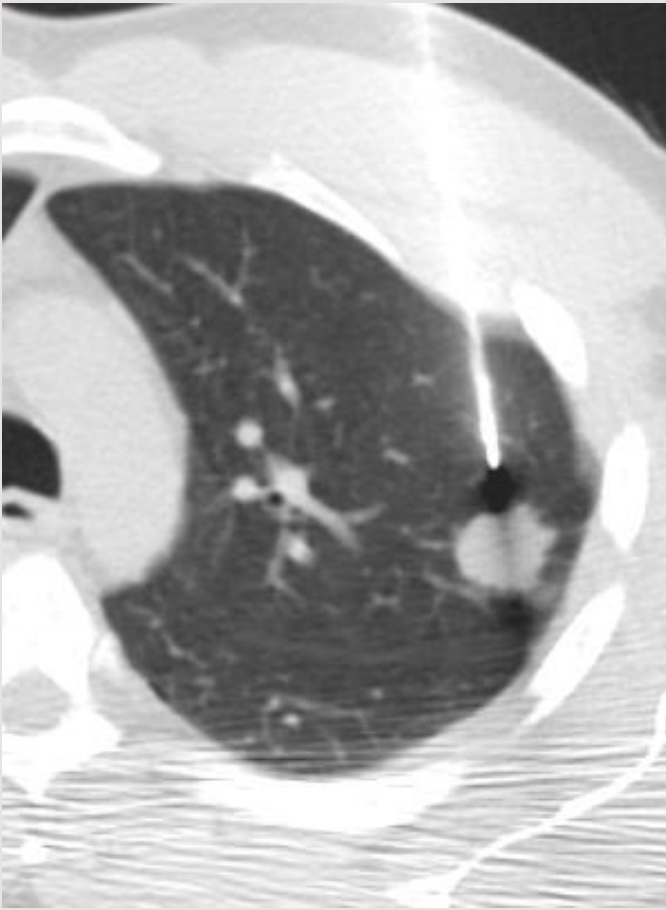


5 ans 3 mois

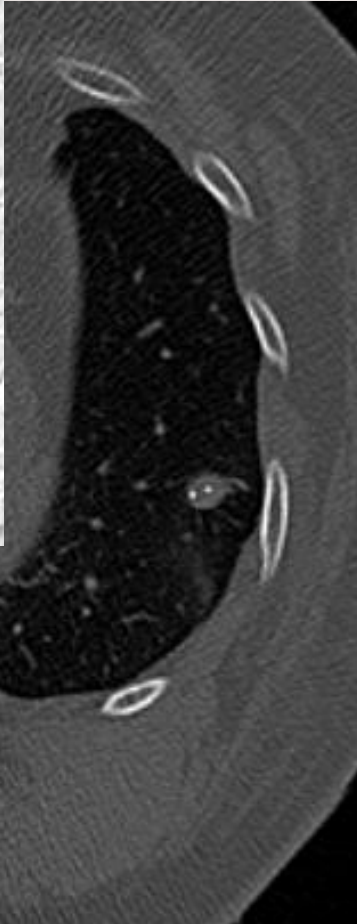
NODULE



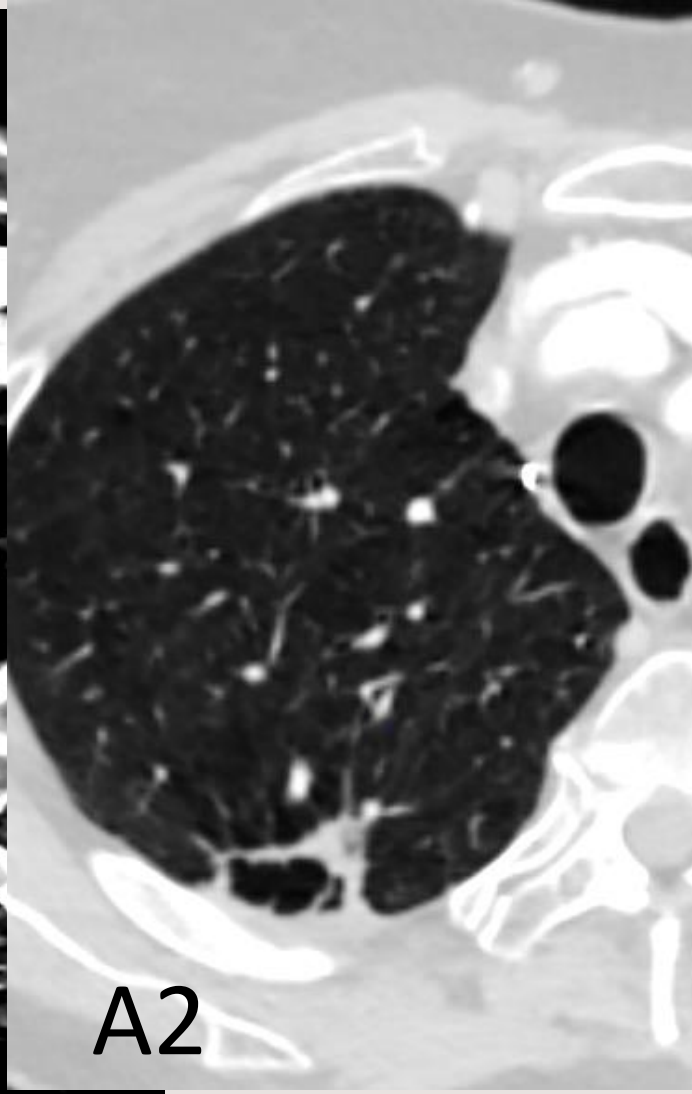
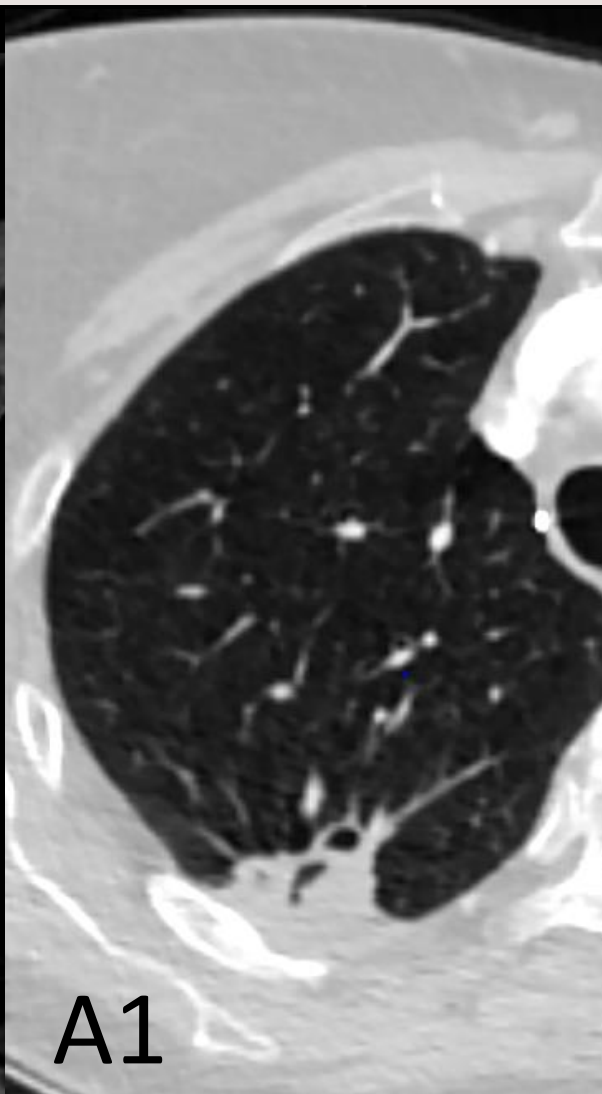
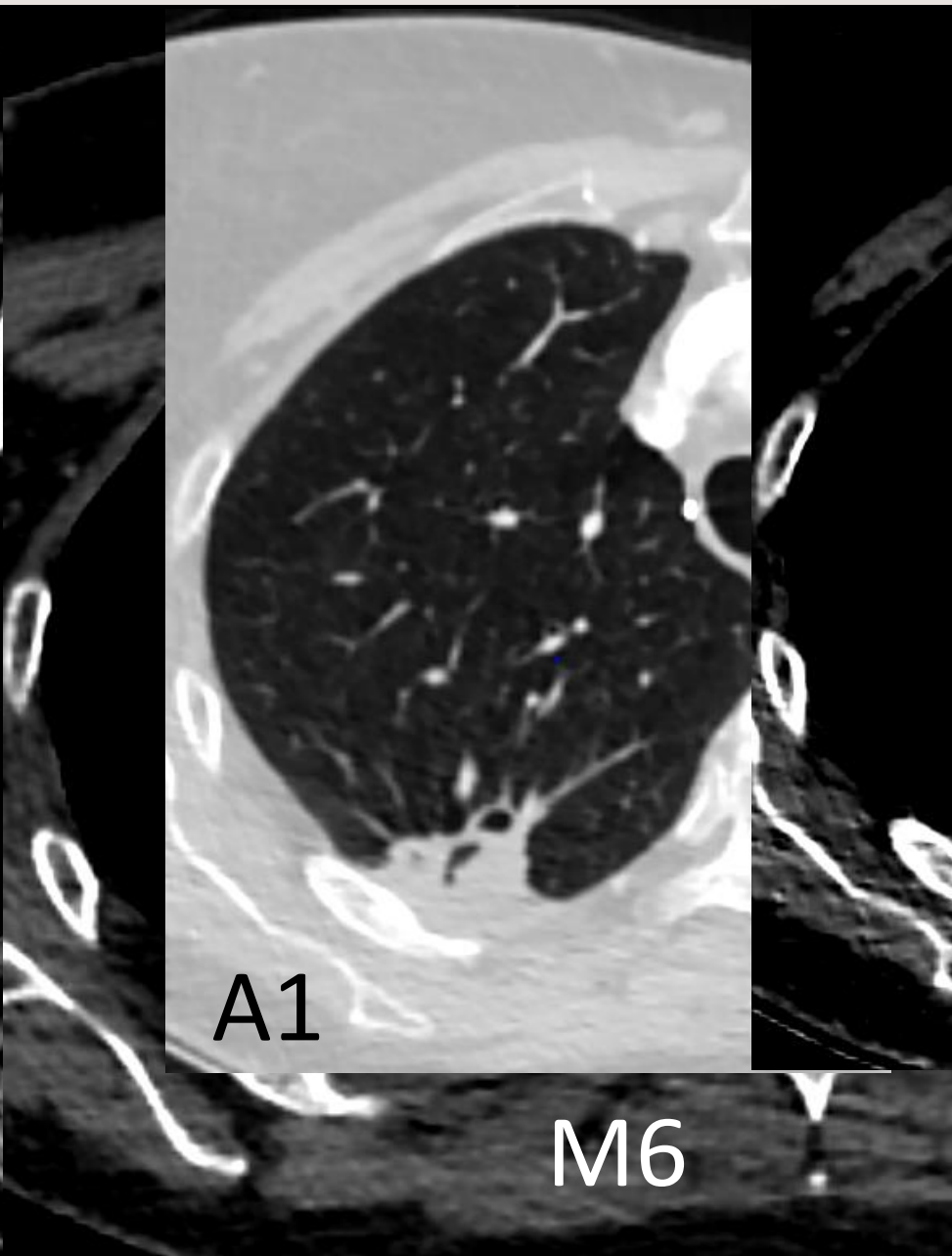
2 ans et 3 mois



2 ans et 4 mois

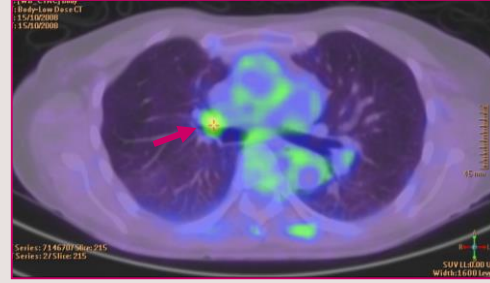
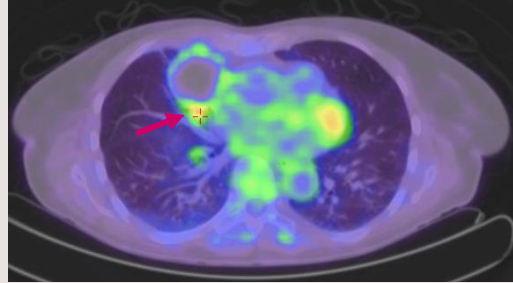
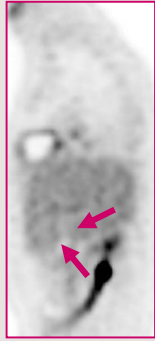


5,5 ans





# TEP: faux positifs (F. Bonichon et al, CIRSE 2010)

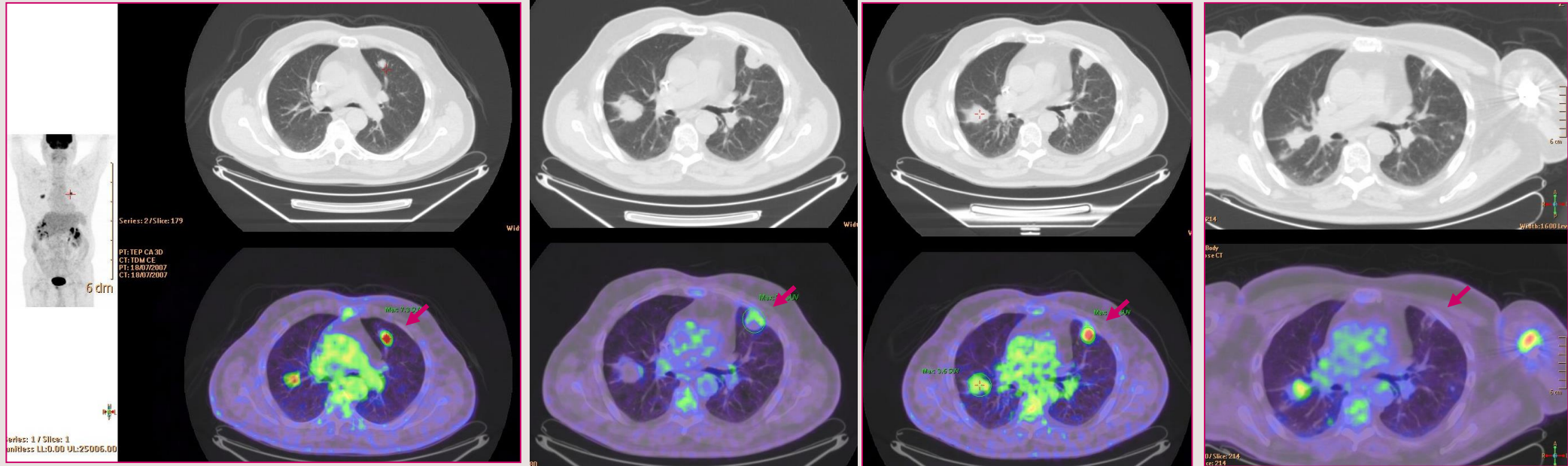


♀ 65 y

Uterine sarcoma

Alive without relapse 34 months later

Hilar node uptake: inflammation ?



M0

SUVMax 10.3

M1

2.6

M3

6.6

M12

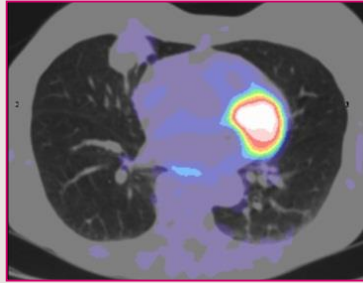
0.9

♂ 77 y 2 lung metastases from colonic carcinoma; biopsy at M3 negative

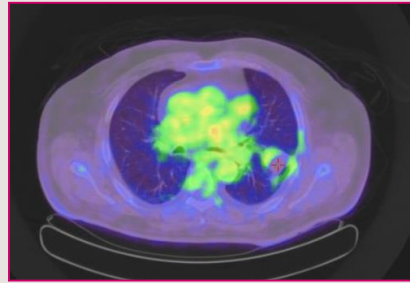
# RF pulmonaire et TEP

En fonction de sémiologie

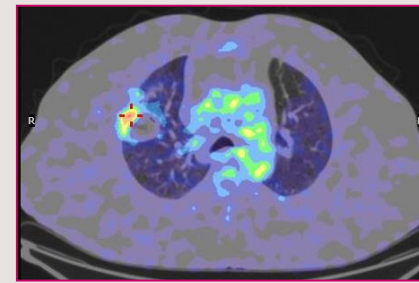
Données favorables



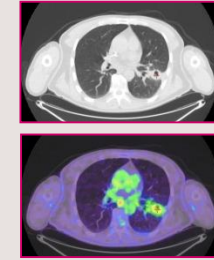
Pas de captation  
1rec/30



Couronne +/- régulière  
et hyperM modéré  
2rec/13

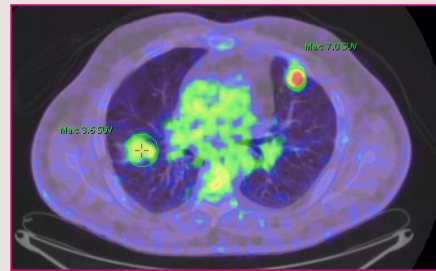


Couronne +/- complète et  
hyperM sous- pleural  
2 rec/23

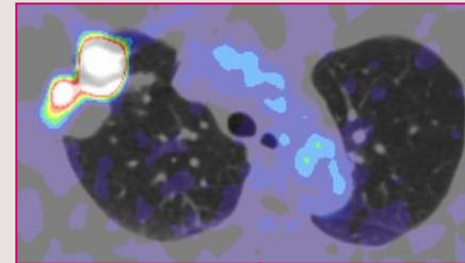


Cavitation  
1rec/5

Aspects défavorables

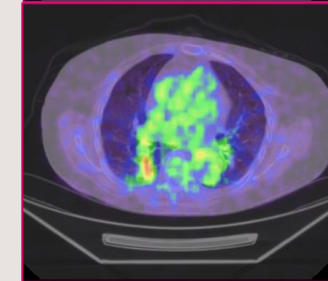
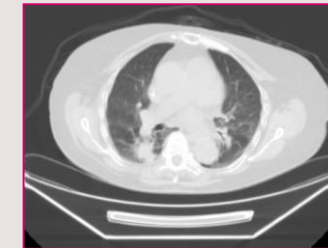


HyperM nodulaire intense  
0 rec/6



Couronne et nodule  
intense en son sein ou à  
côté

5 rec/11



# RF pulmonaire et TEP

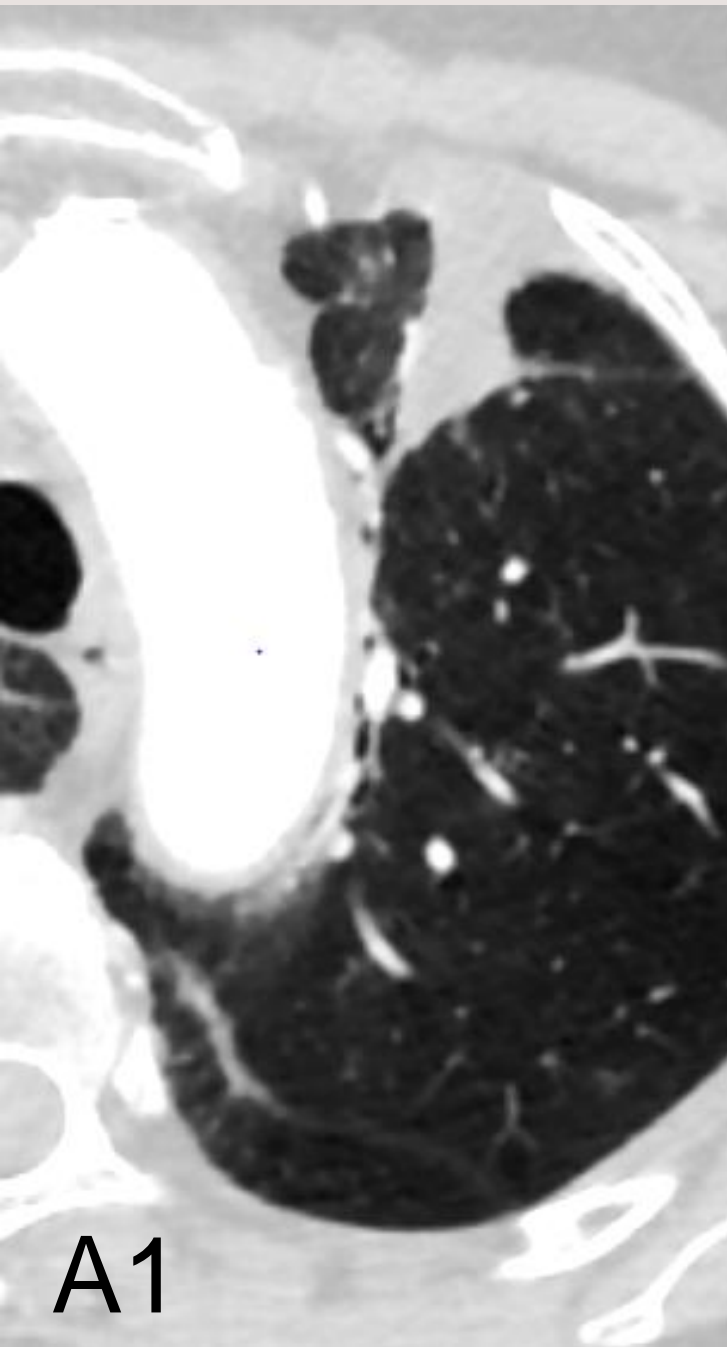
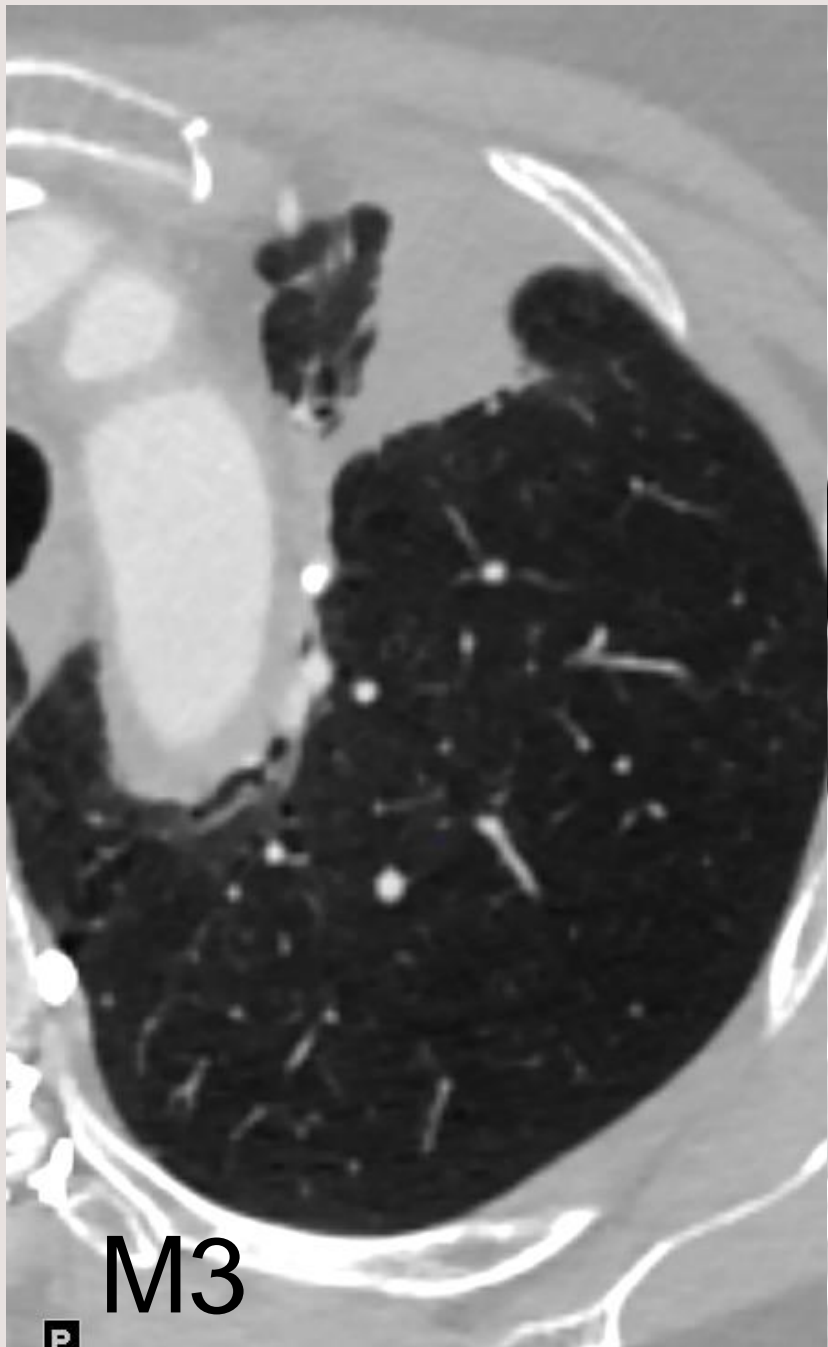
## TEP et ses limites

- Lésions ne fixant pas le FDG
- Progression lente
- Quand traiter? Surveiller?
- Spécificité perfectible:
  - inflammation précoce peut persister
  - TEP précoce ne résout pas tout
- Taille réduite des lésions résiduelles
- Nouveaux traceurs?

Doute TDM et TEP



Biopsie ++



# Suivi après RF pulmonaire: autres techniques

- TDM DE: détection précoce des récurrences (M1), haute valeur prédictive négative
- IRM de diffusion...

Role of dual-energy computed tomography in detecting early recurrences of lung tumours treated with radiofrequency ablation

Jean Izaaryene, Vincent Vidal, Jean-Michel Bartoli, Anderson Loundou & Jean-Yves Gaubert

International Journal of Hyperthermia 2017

# Suivi après RF pulmonaire: conclusion

- Spécificités: suivi adapté par l'oncologue interventionnel
- TDM: examen de référence
- TEP à partir de 6 mois
- Indications sélectionnées
- Marges de sécurité optimales
- Apport de nouvelles méthodes: DE, IRM, perfusion...