INTERET DES TRAITEMENTS DANS LE CONTRÔLE LOCAL DES CANCERS

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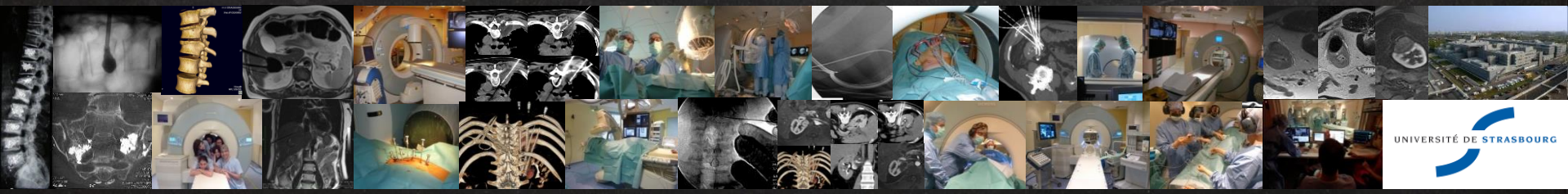
Service d'imagerie interventionnelle



IMAGERIE INTERVENTIONNELLE :

Utilisation des techniques d'imagerie (scopie, échographie, scanner, IRM, PET scan) pour guider des gestes percutanés à visée diagnostique ou thérapeutique.

L'imagerie interventionnelle regroupe des techniques considérées comme mini-invasives.

IMAGERIE

INTRODUCTION

Quelle modalité d'imagerie pour guider le radiologue dans le poumon?

- Scanner


MAQUET
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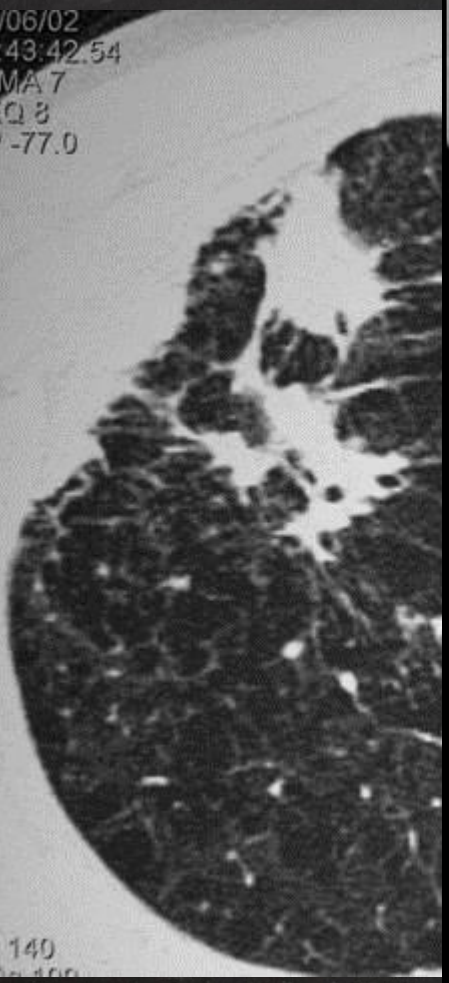
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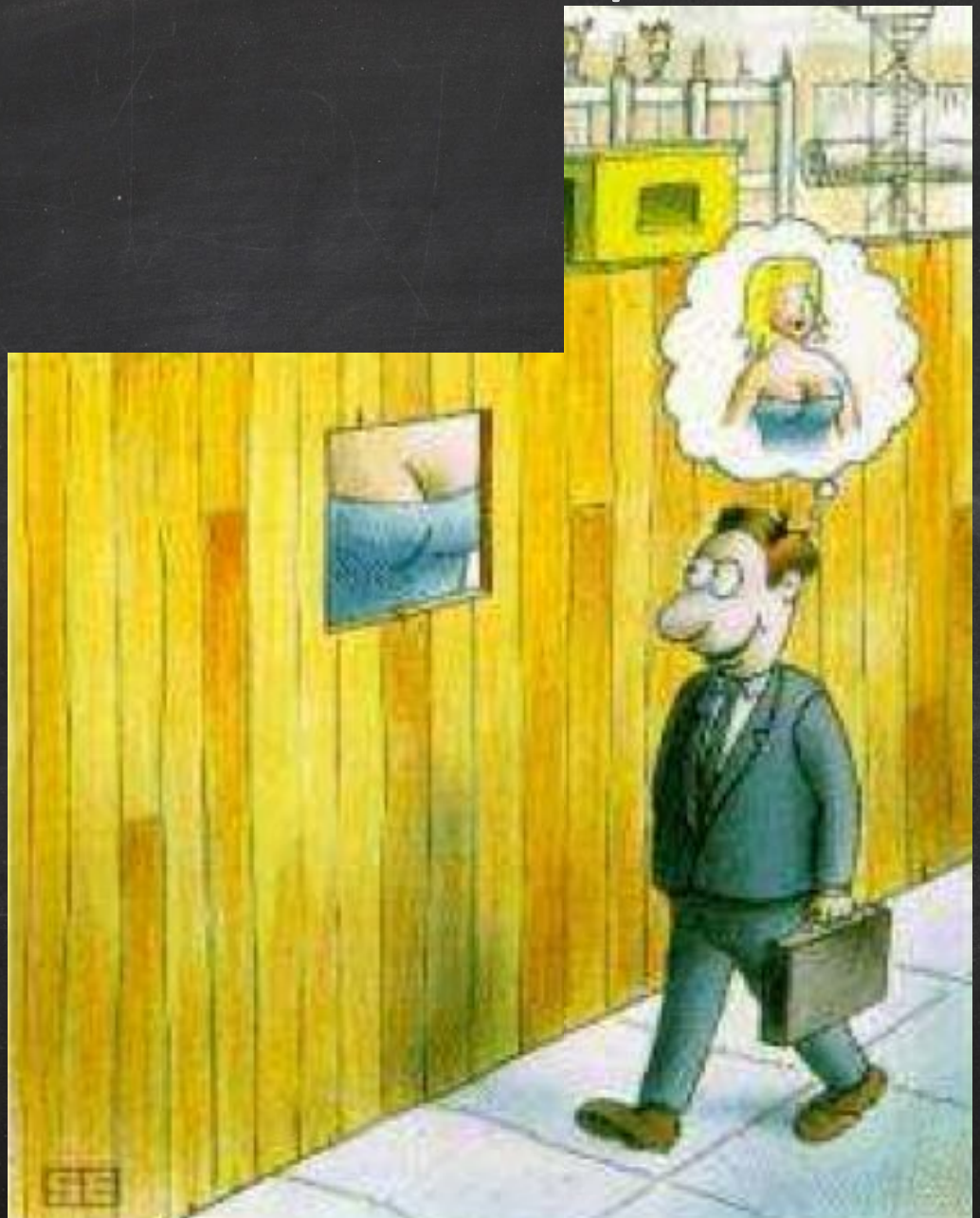
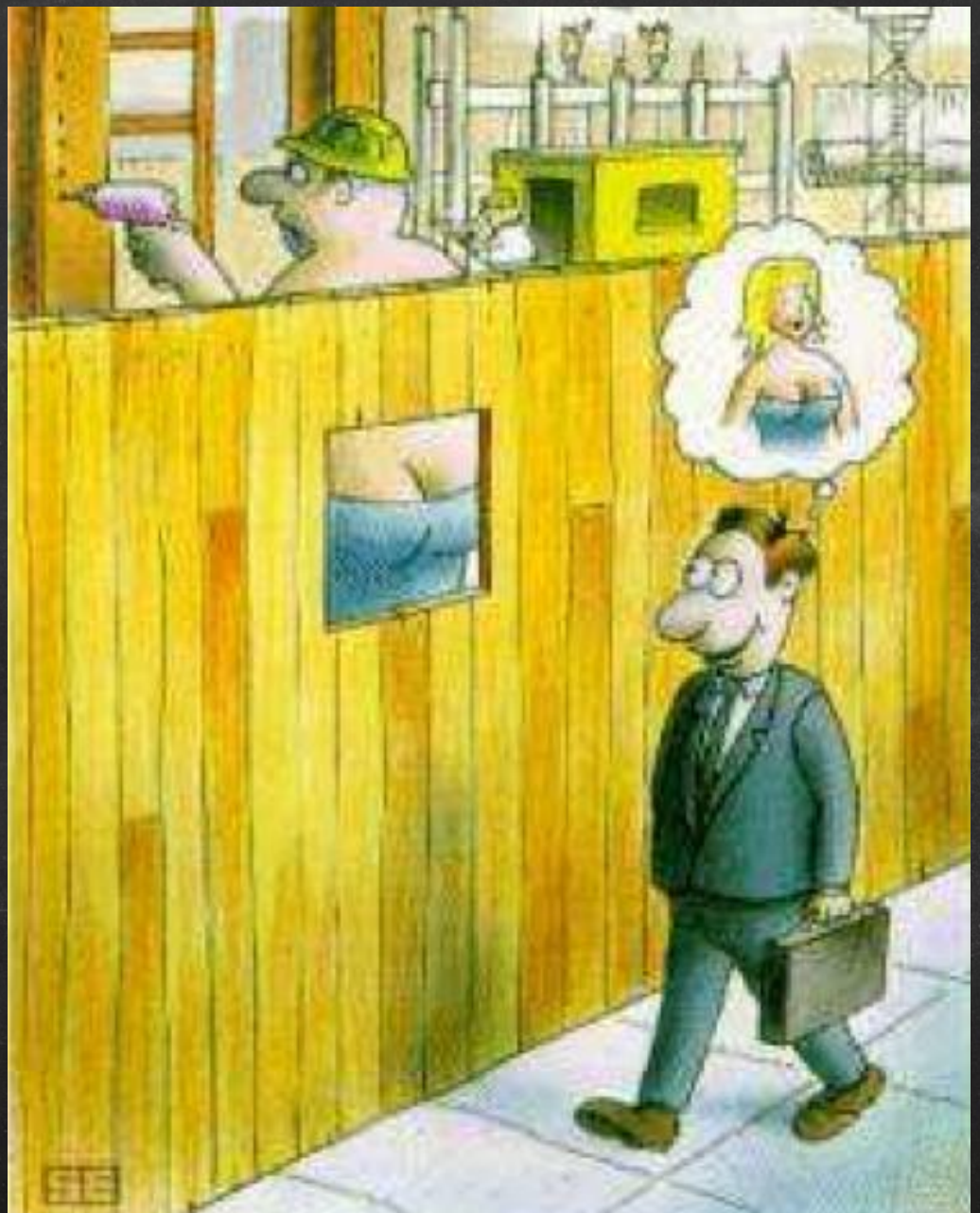
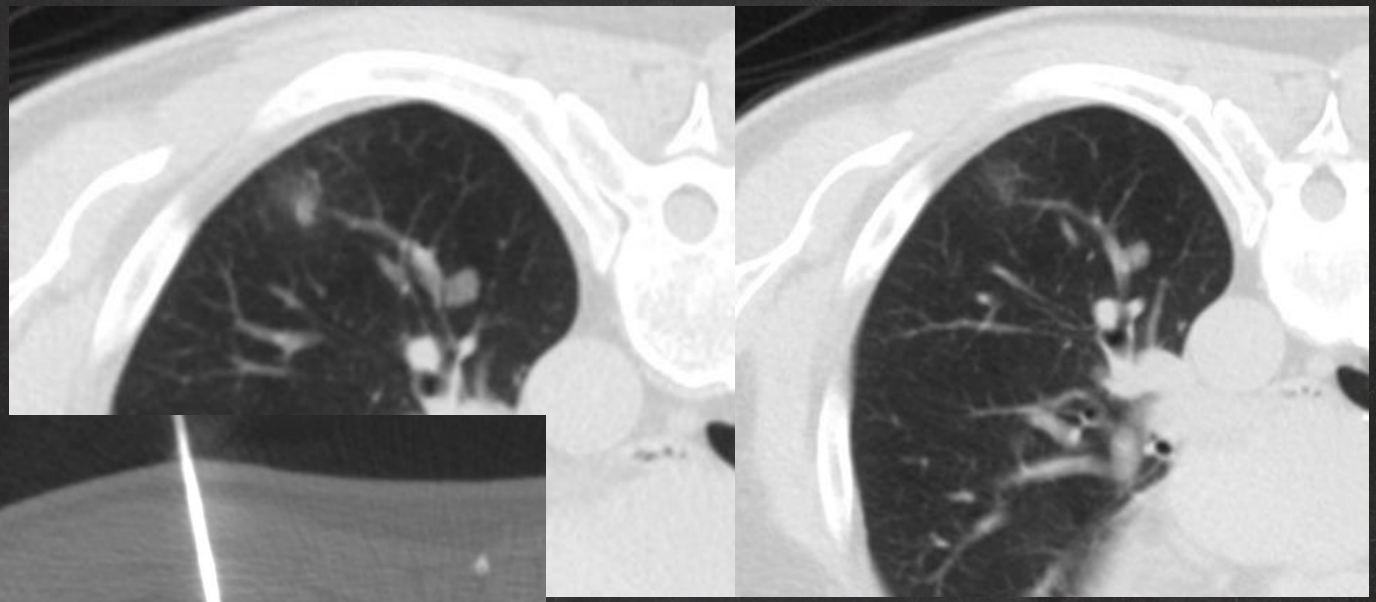
Contrôle multiplanaire



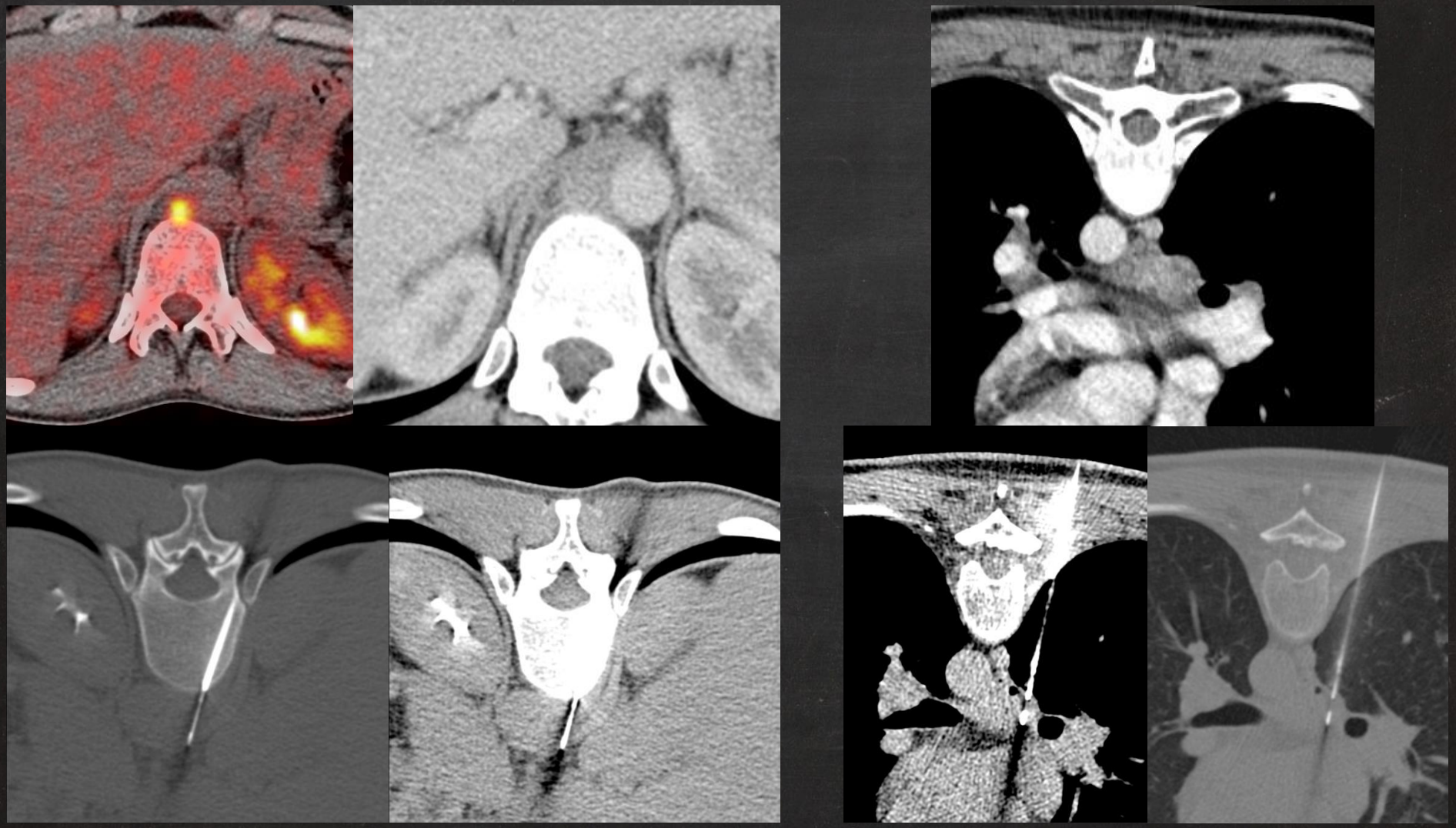
Contrôle multiplanaire



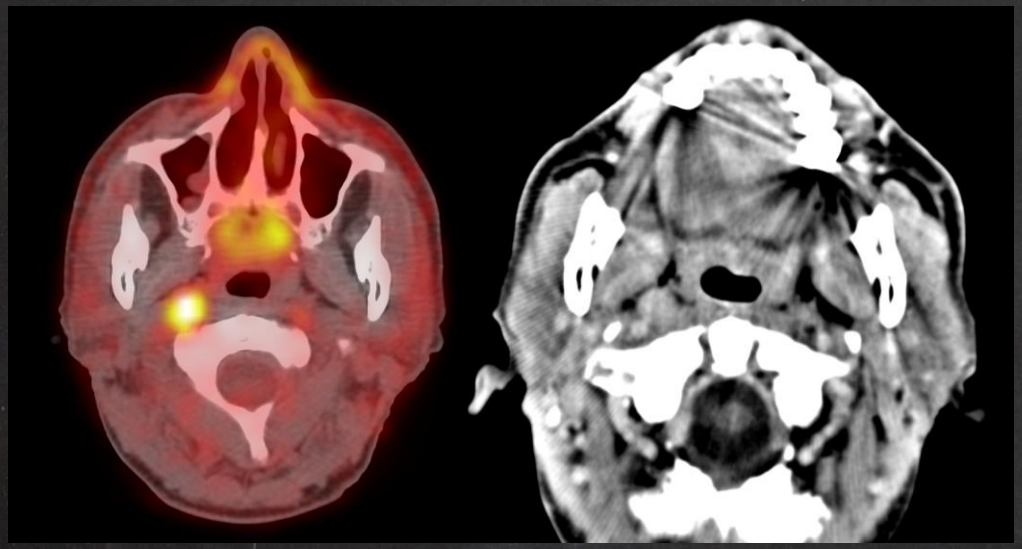
Contrôle multiplanaire

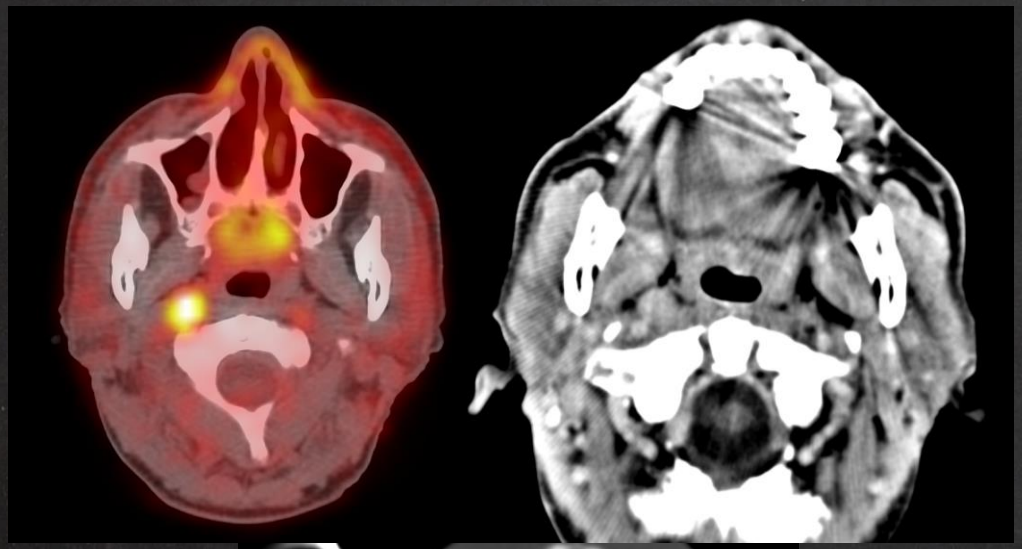


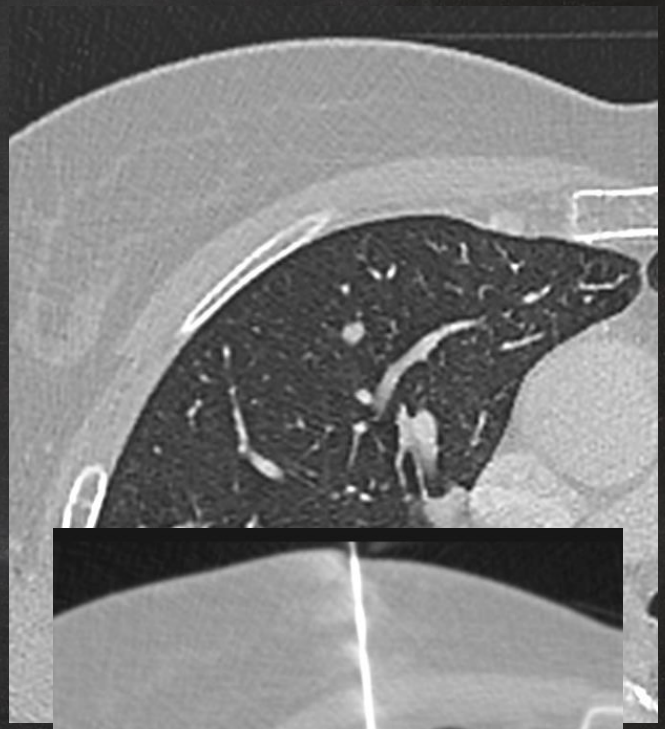
En 2014, la précision du guidage scanographique est de quelques millimètres

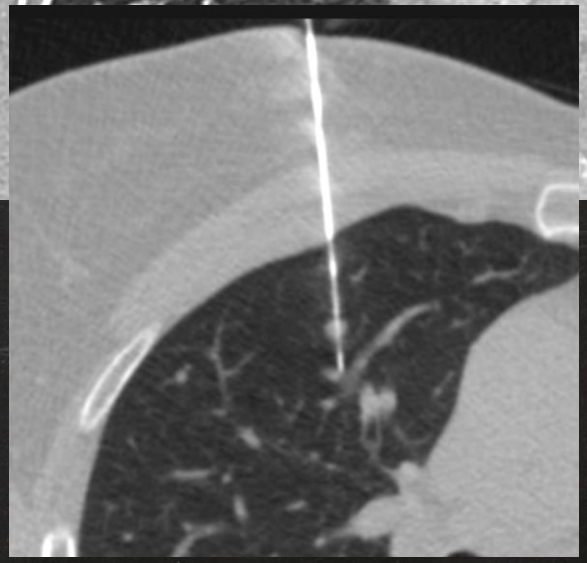


Peut-on biopsier?

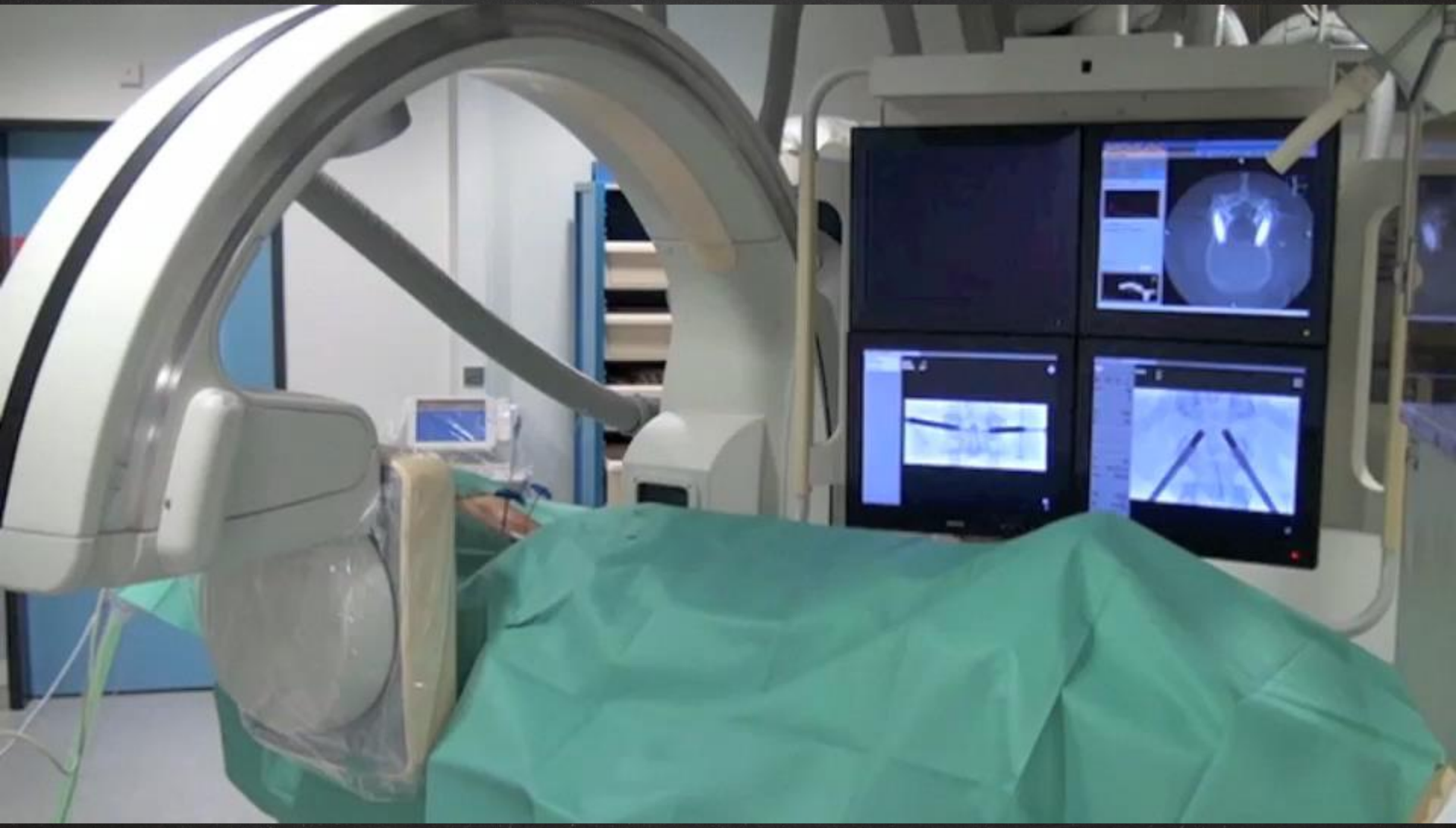






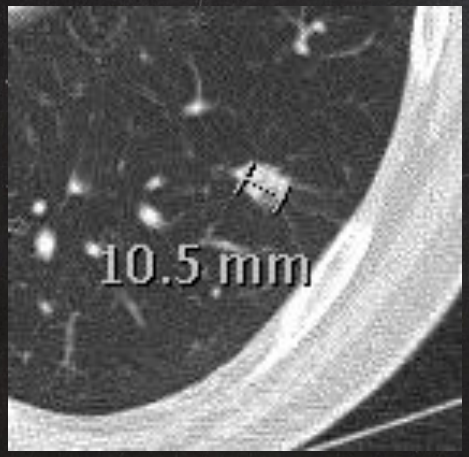


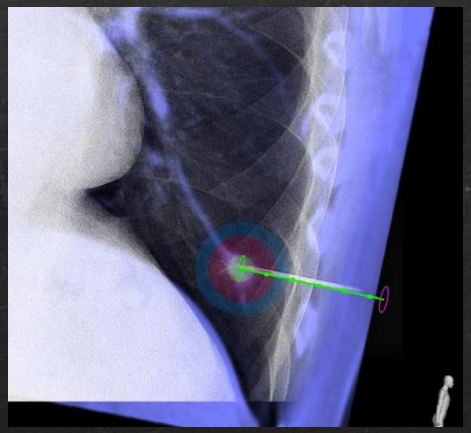
- Capteur plan 3D

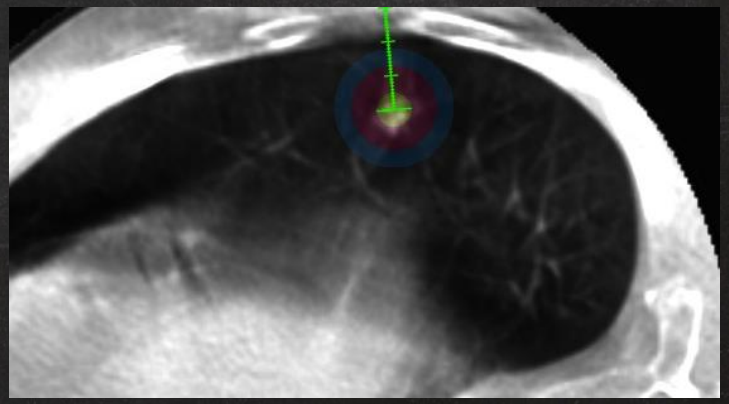


Thermo-Guidé

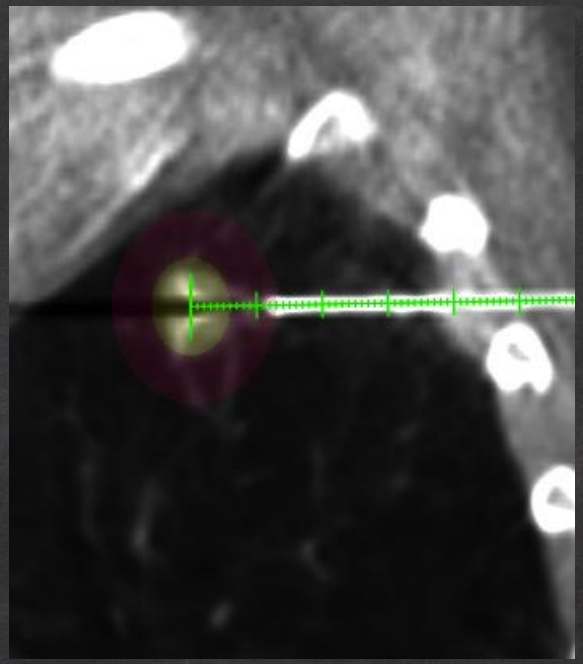
- Simulation de distribution de température
- Meilleurs estimation de la zone d’ablation
- Diffèrents modèles disponibles: RF ou Cryo
- Limitation: prend pas compte des pertes thermique (vasculaire)

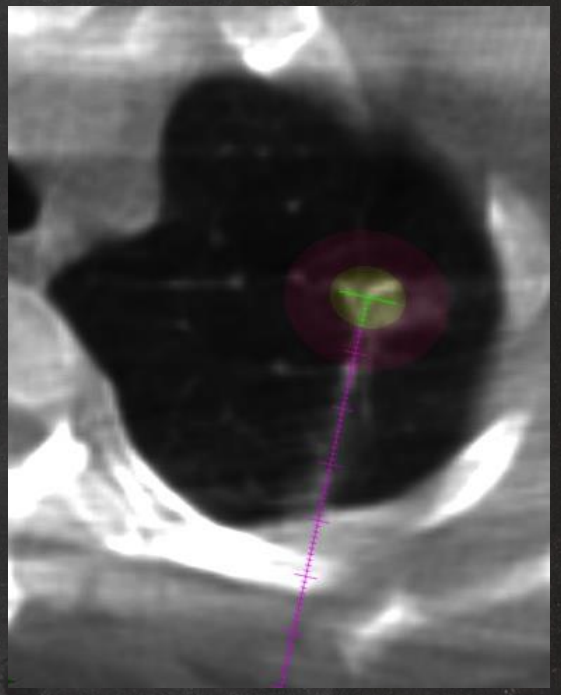


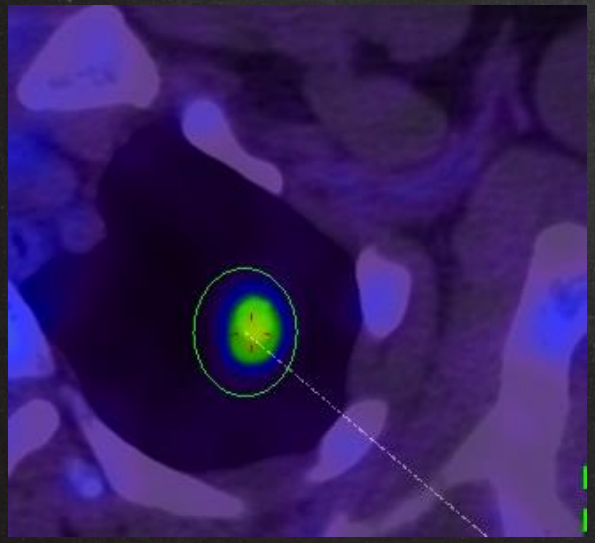


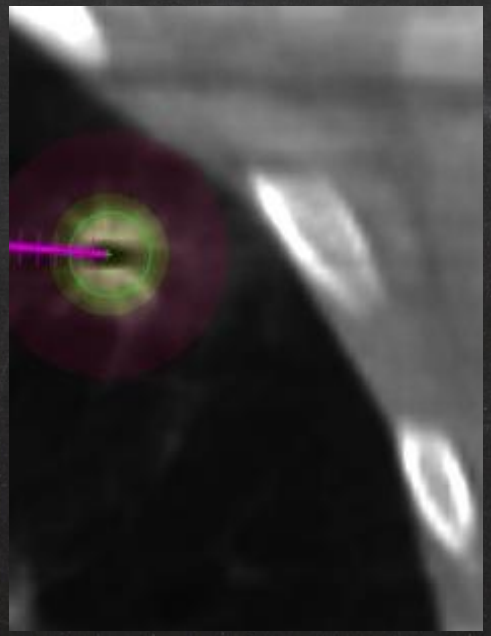


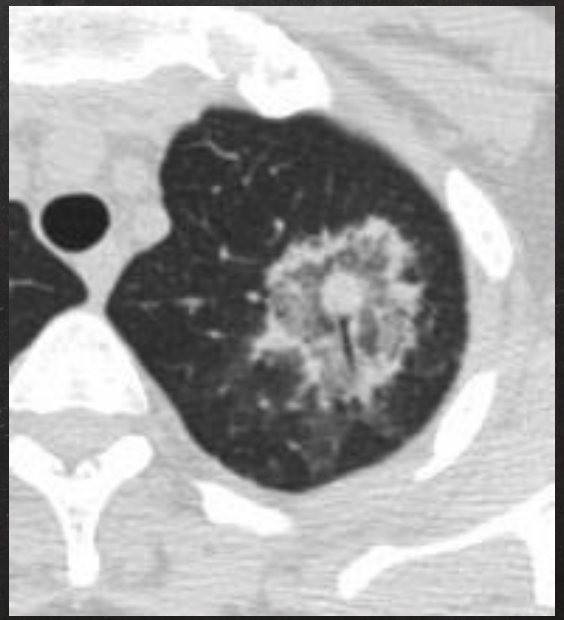

10.9 mm
BERGONIE

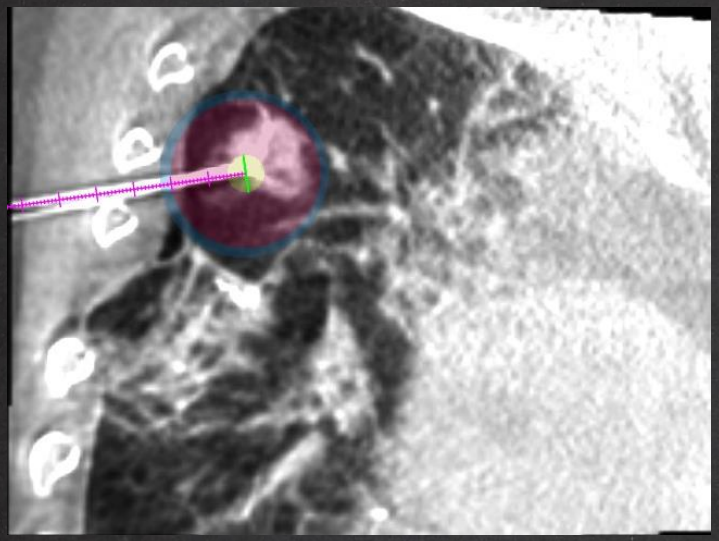


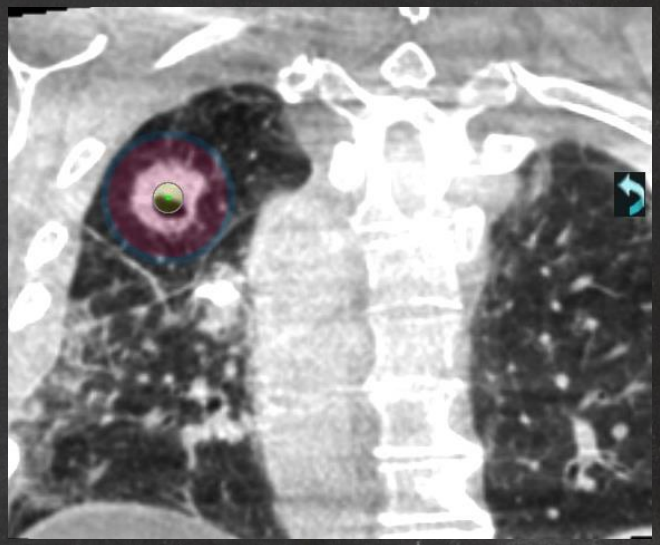


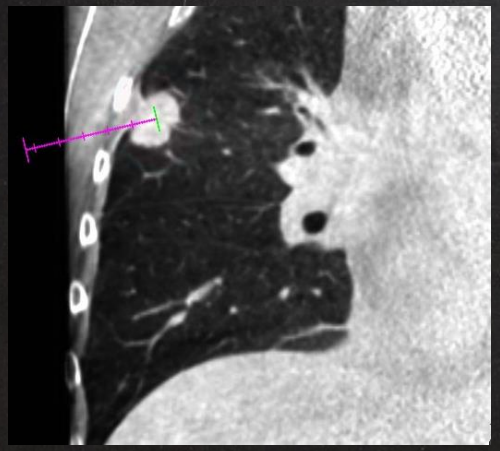




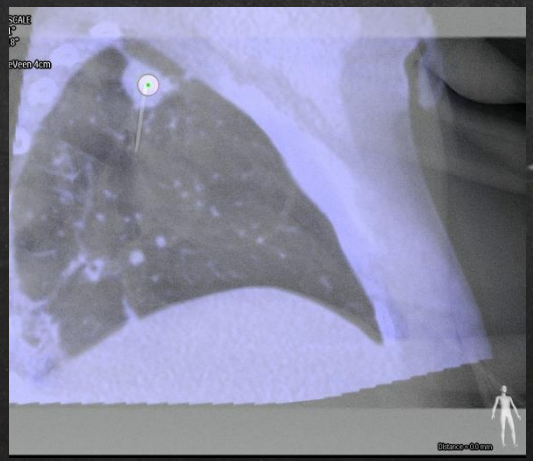


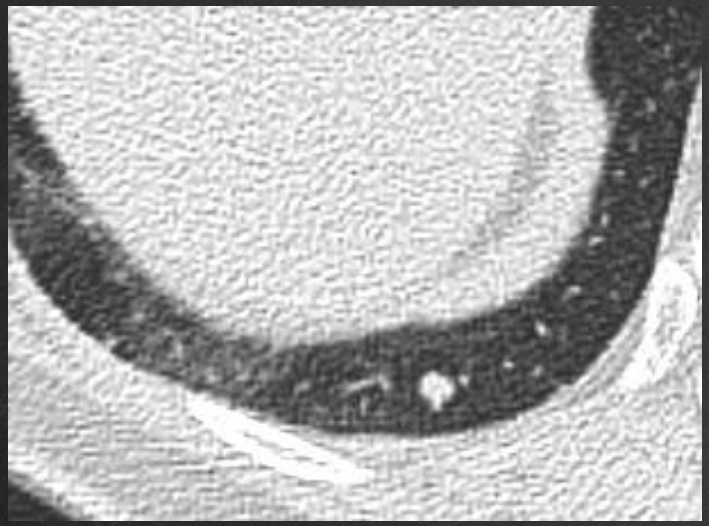


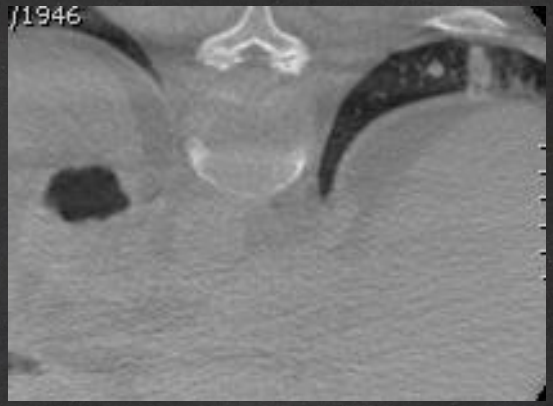





Images-clés - Pour annexion au compte



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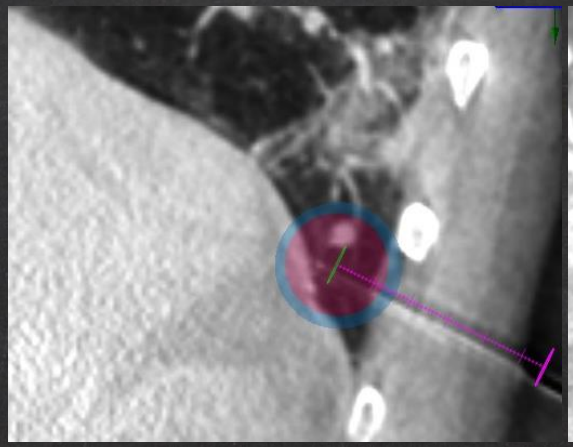
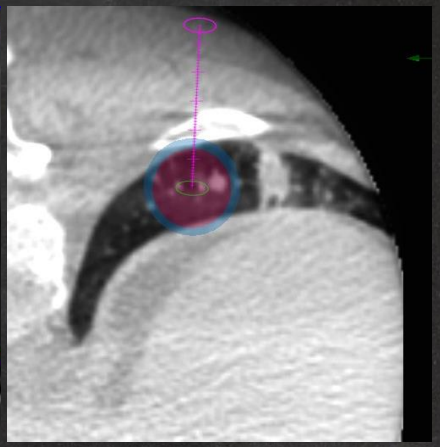
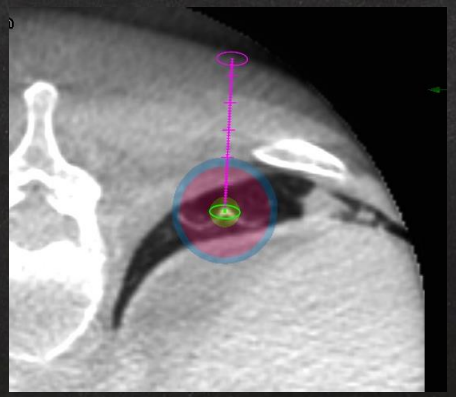
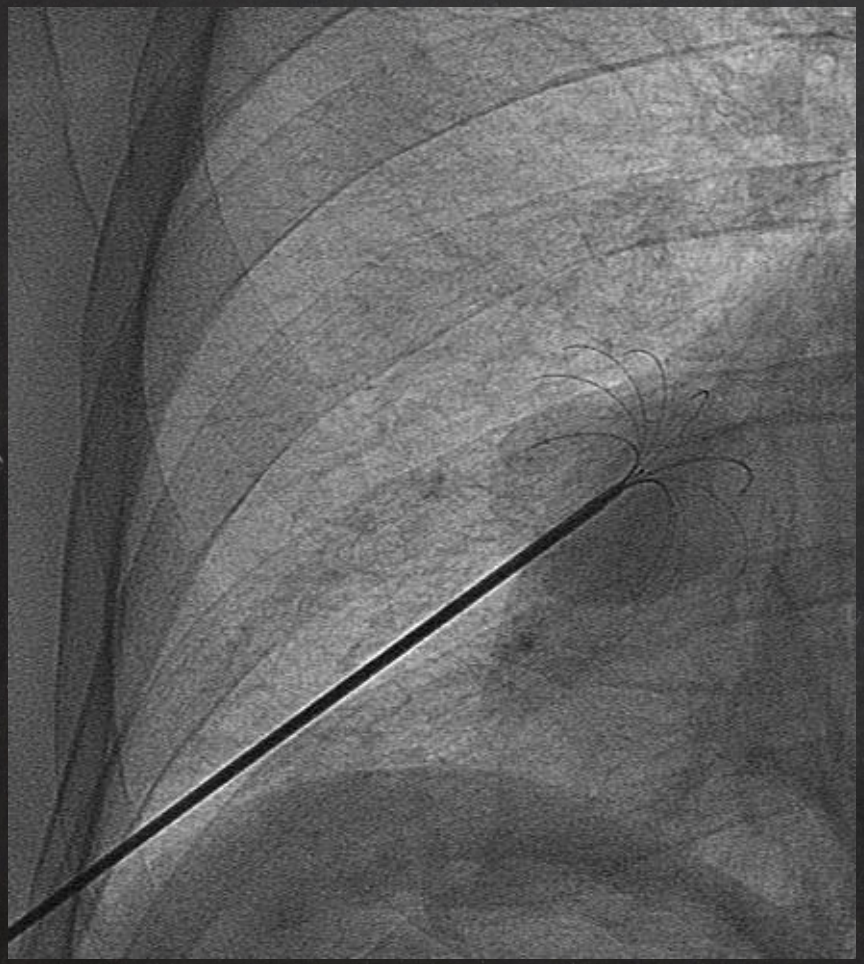
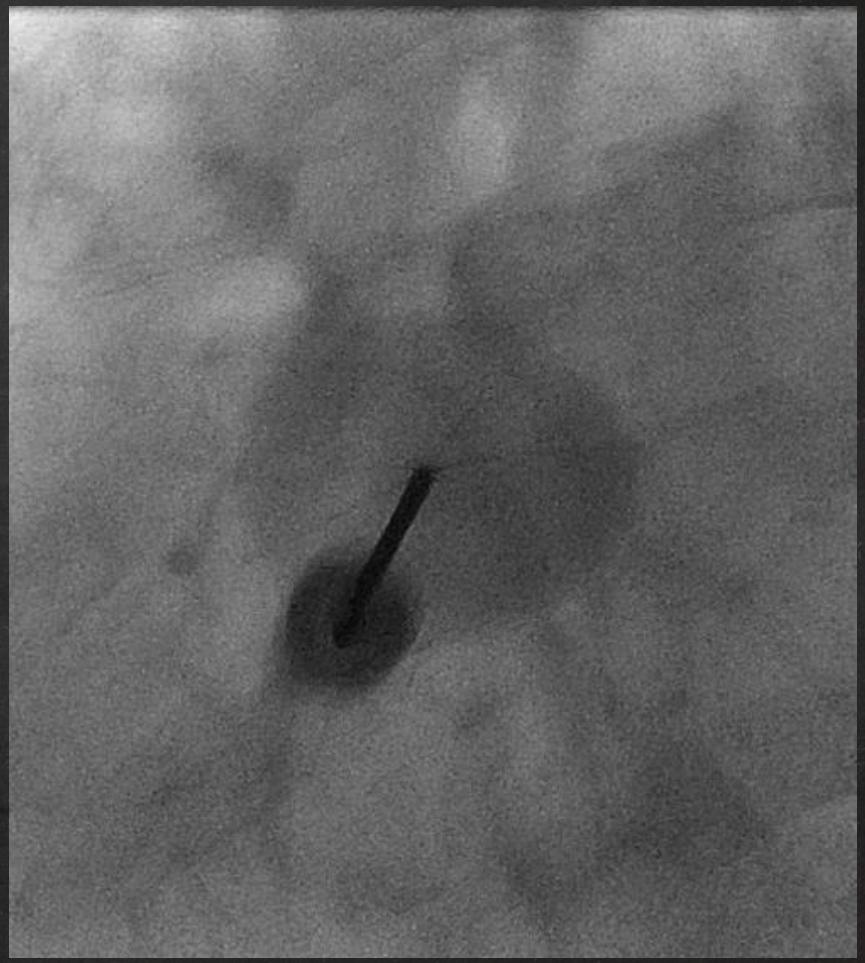
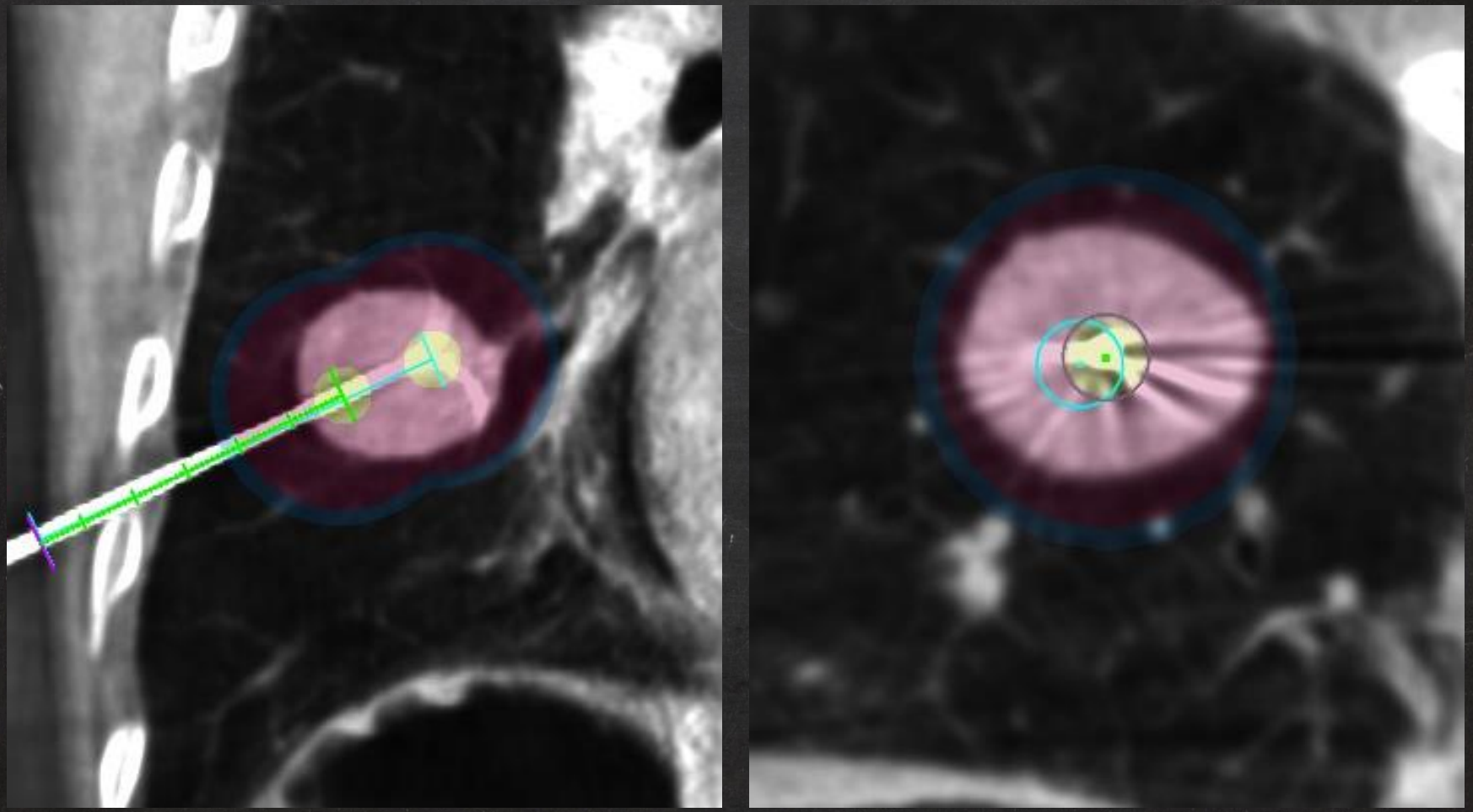


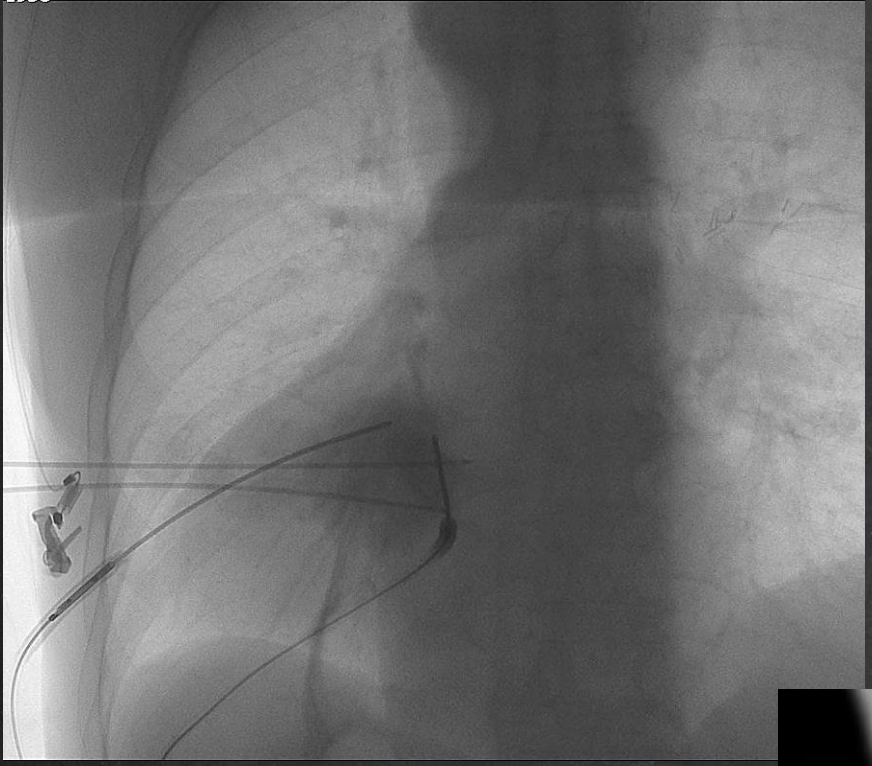


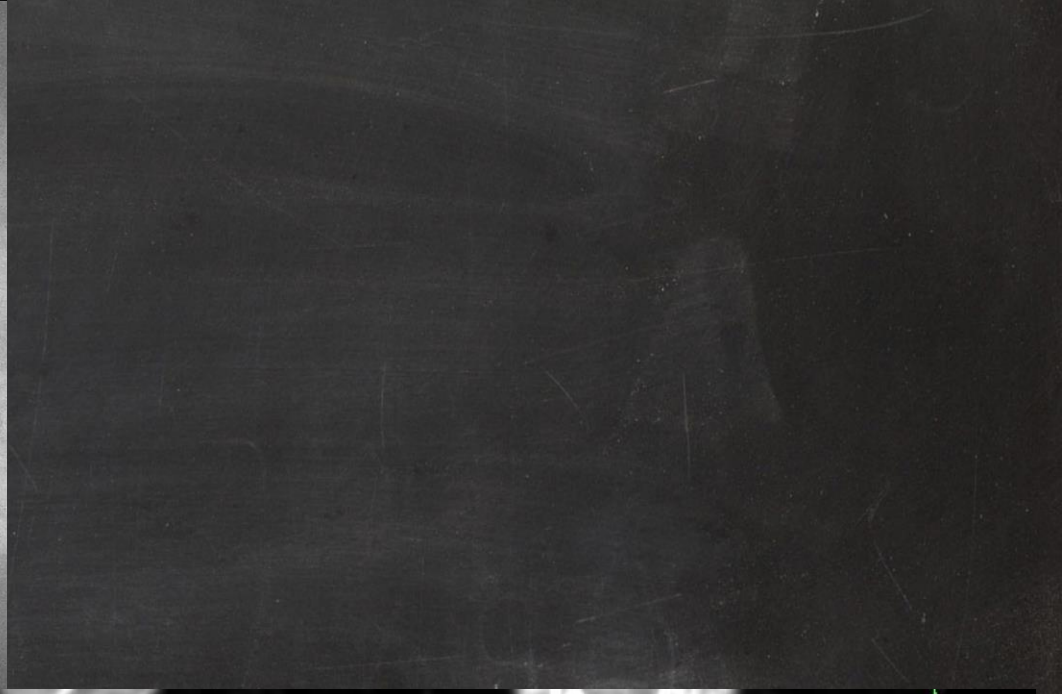


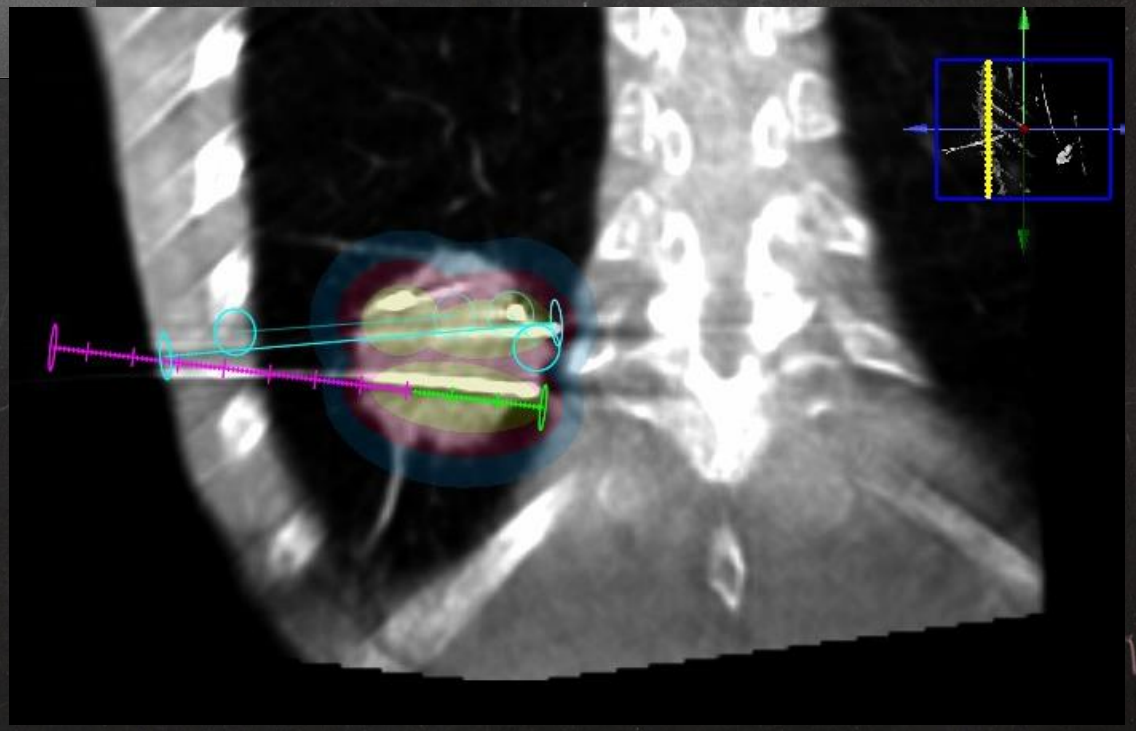




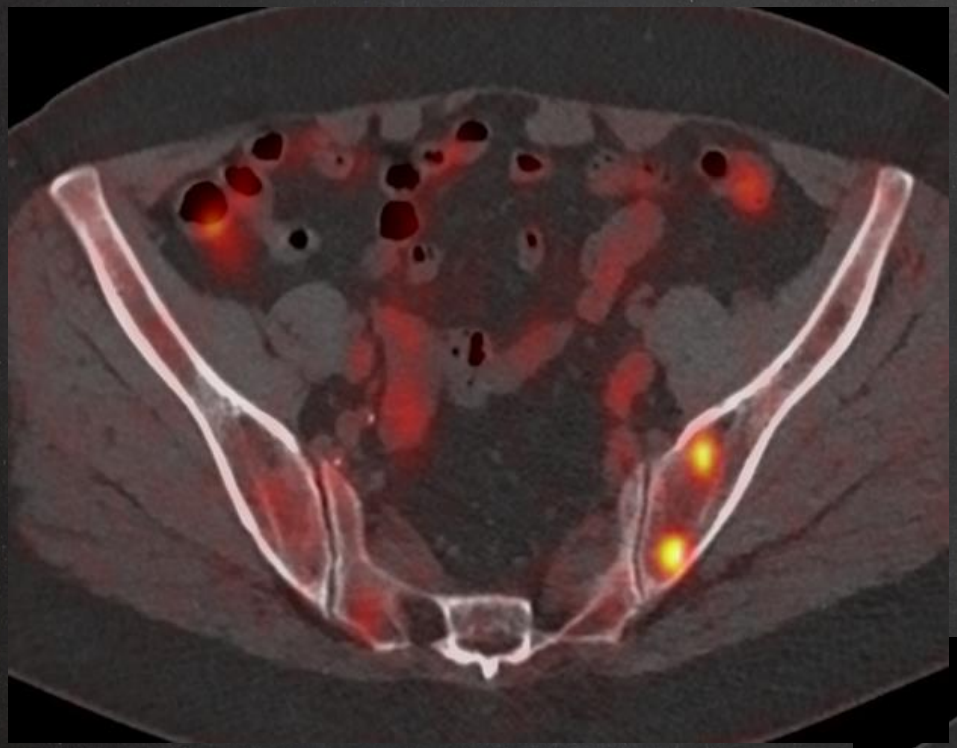


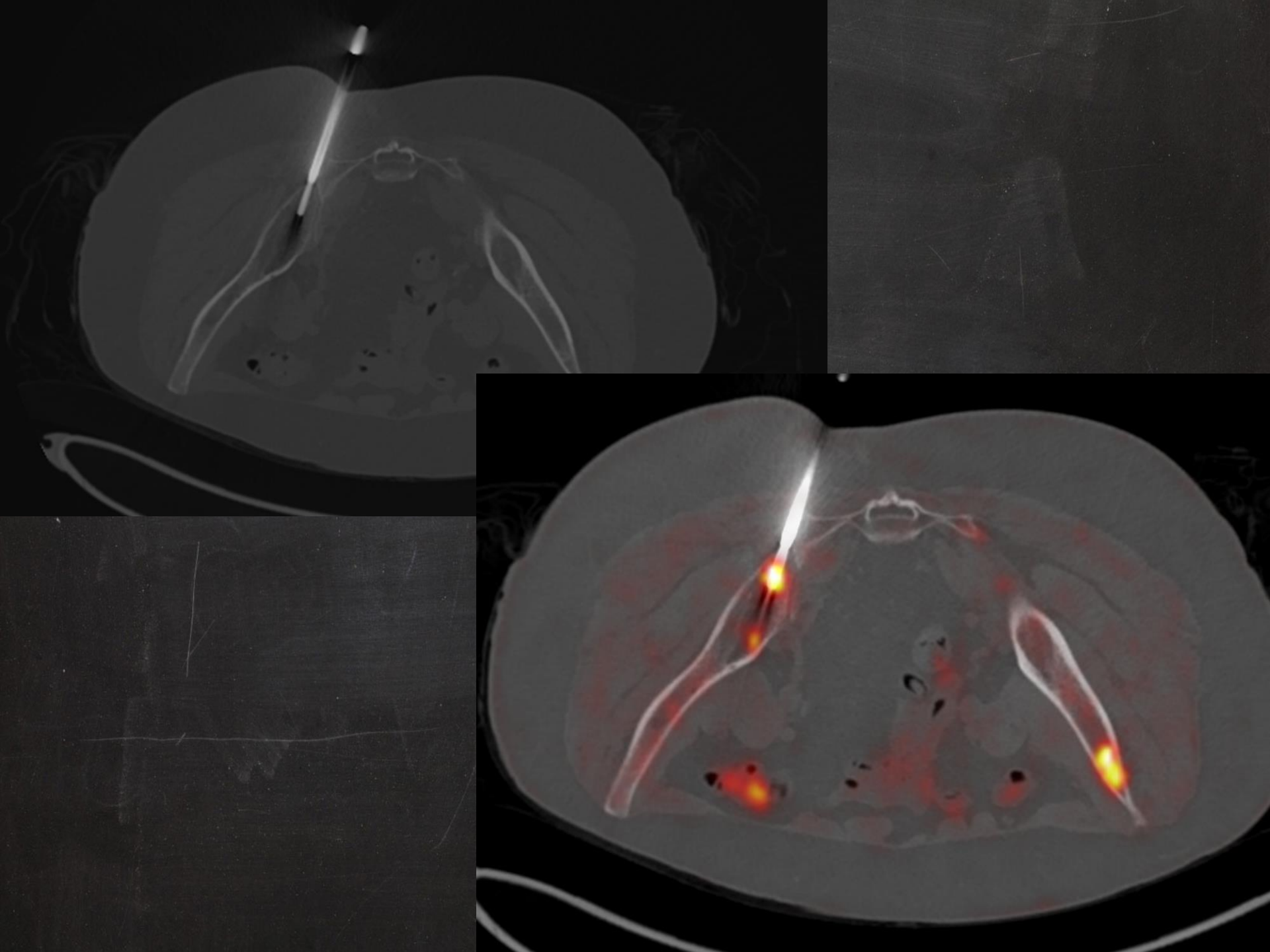


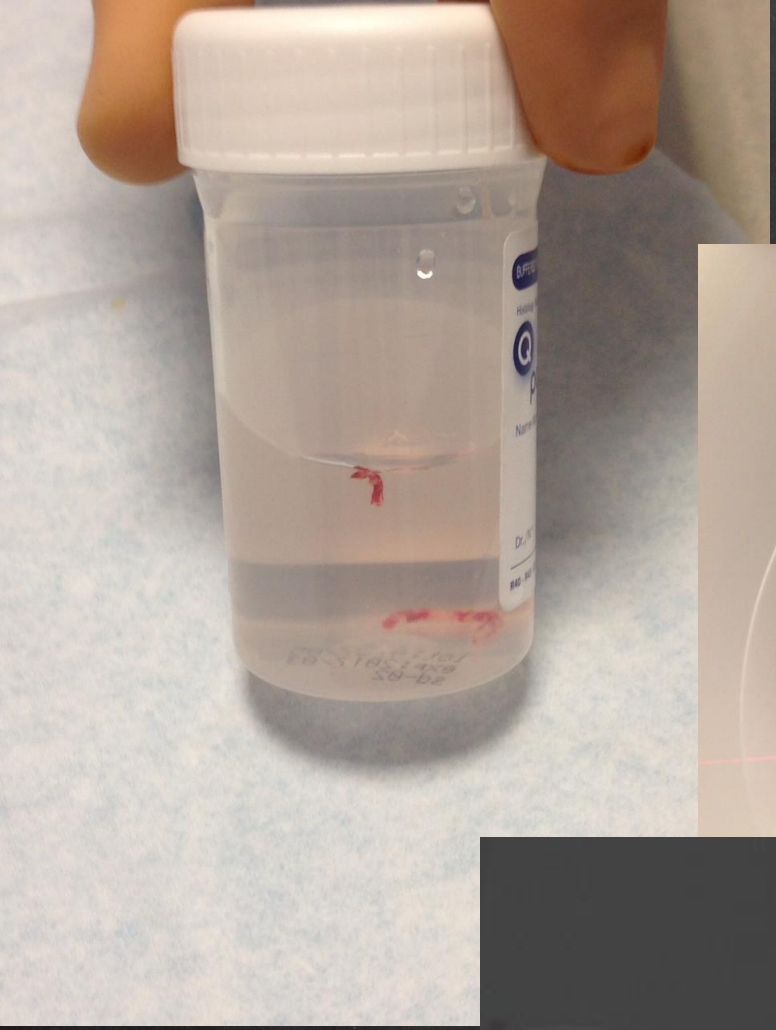


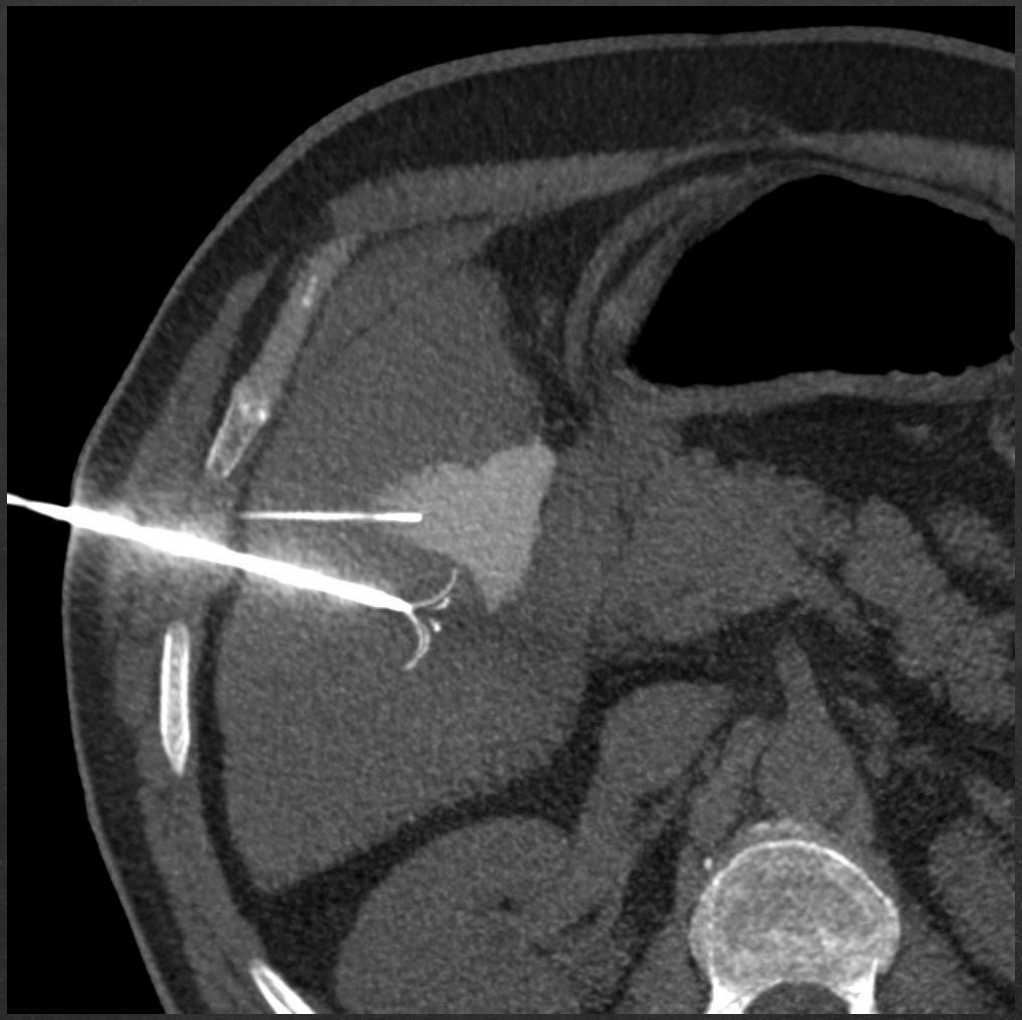


- PET-scan

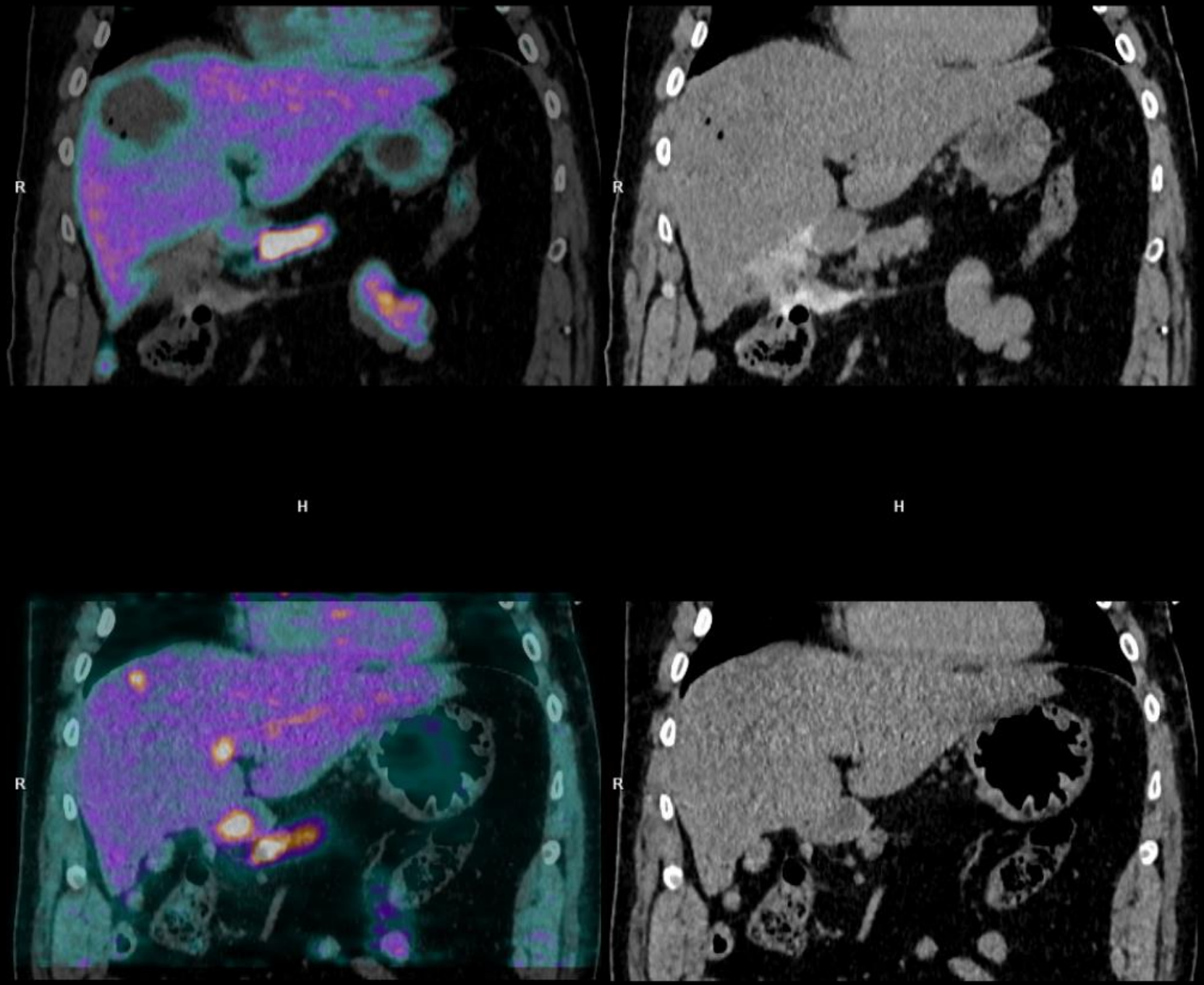








Split-dose technique for FDG PET/CT-guided percutaneous ablation: a method to facilitate lesion targeting and to provide immediate assessment of treatment effectiveness.
Ryan ER, Sofocleous CT, Schöder H, Carrasquillo JA, Nehmeh S, Larson SM, Thornton R, Siegelbaum RH, Erinjeri JP, Solomon SB.
Radiology. 2013 Jul;268(1):288-95.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Inconvénient principal: l'irradiation

Quelles techniques d’ablation pour traiter les CBP stade I?

Chaud et Froid

- Chaud:
  - Laser
  - RFA
  - MWA
  - FUS
- Froid
  - CryoA

Quelles techniques d’ablation pour traiter les CBP stade I?

- RADIOFREQUENCE

1993: 1ère RF hépatique

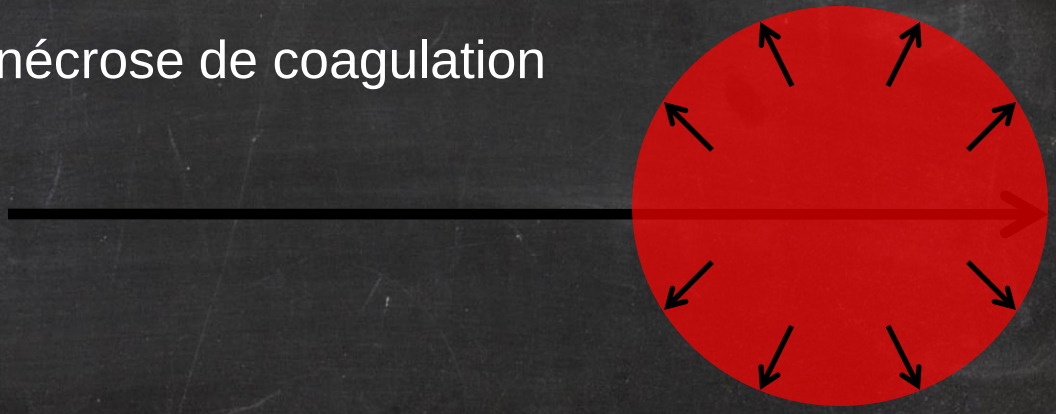
1997: 1ère RF rénale

2000: 1ère RF pulmonaire

Percutaneous radiofrequency ablation of malignancies in the lung.
Dupuy DE, Zagoria RJ, Akerley W, Mayo-Smith WW, Kavanagh PV, Safran H.
AJR Am J Roentgenol. 2000 Jan;174(1):57-9.

températures en radiofréquence:

- T° < 50°: homéostasie cellulaire
- 50° < T° < 60°: dénaturation des protéines
- 60° < T° < 100°: nécrose de coagulation



- T° > 100°: carbonisation locale

RF = « cuire longtemps à feu doux »

Blue rare (115F)- seared on the outside, completely red throughout. Meat remains gel-like in texture and difficult to chew; juices are not yet flowing freely.

Medium (134F) - seared outside, 25% pink showing inside. Much drier and tougher than *The Perfect Steak*, but still palatable.

Rare (120F)- seared and still red 75% through the centre. Once the heat transfer is completed during the resting period, this steak will achieve *The Perfect Steak* - tender & juicy.

Medium well (150F) - done throughout with a slight hint of pink. Past the point of no return.

Medium rare (126F)- seared with 50% red centre. Just passed the point of *The Perfect Steak*.

Well done (160F) - 100% brown. Waste of a good quality steak.

Indications – Cancer bronchique primitif:

- CBP non à petites cellules
- périphériques
- T1a +++
- T1b ++
- N0 et M0 (PET-scan +++)

$\Rightarrow$ Stades IA

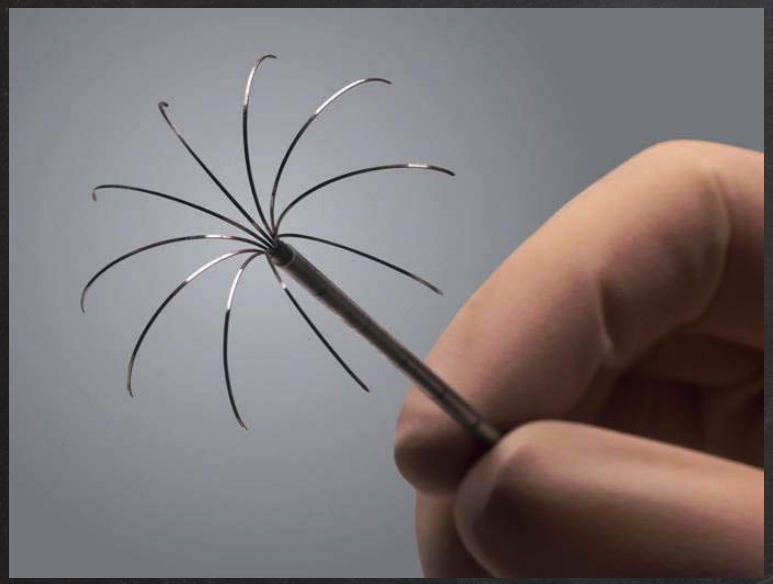
- Chez un patient avec CI chirurgicale

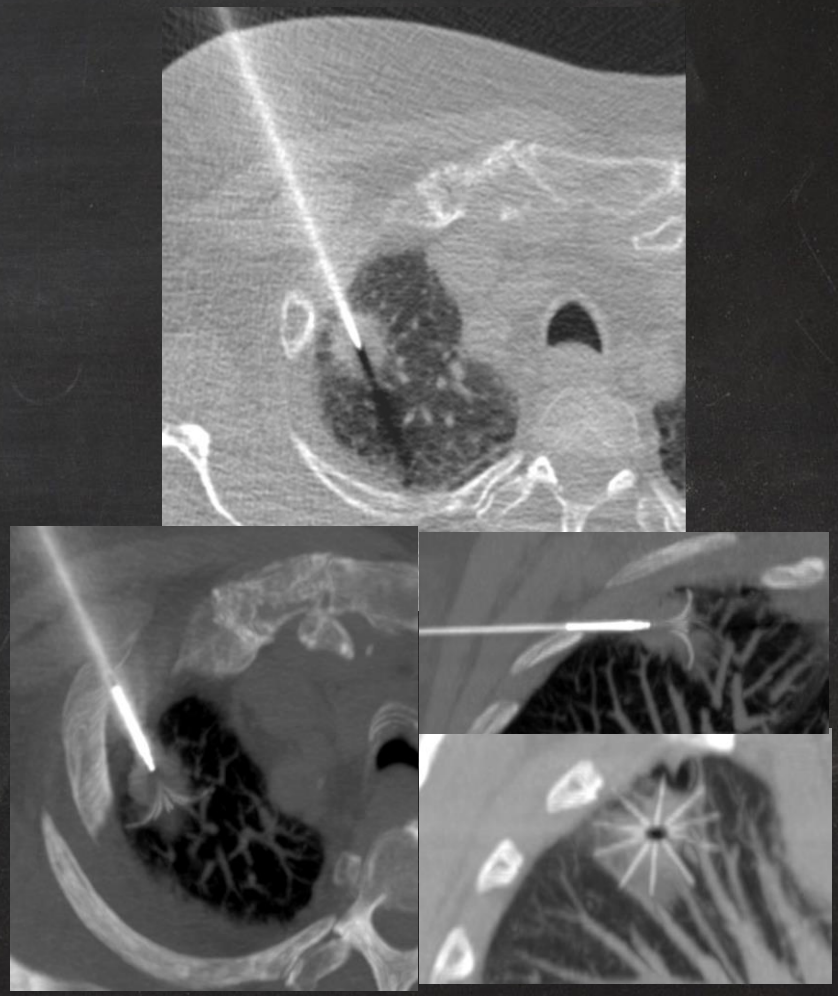
Complications RF

- Pneumothorax: immédiat ou retardé (drainage 15%)
- Douleur
- Hémoptysie
- Infection de la zone de RF
- Embolie gazeuse
- Ensemencement tumoral du trajet de ponction (0,2% des cas)

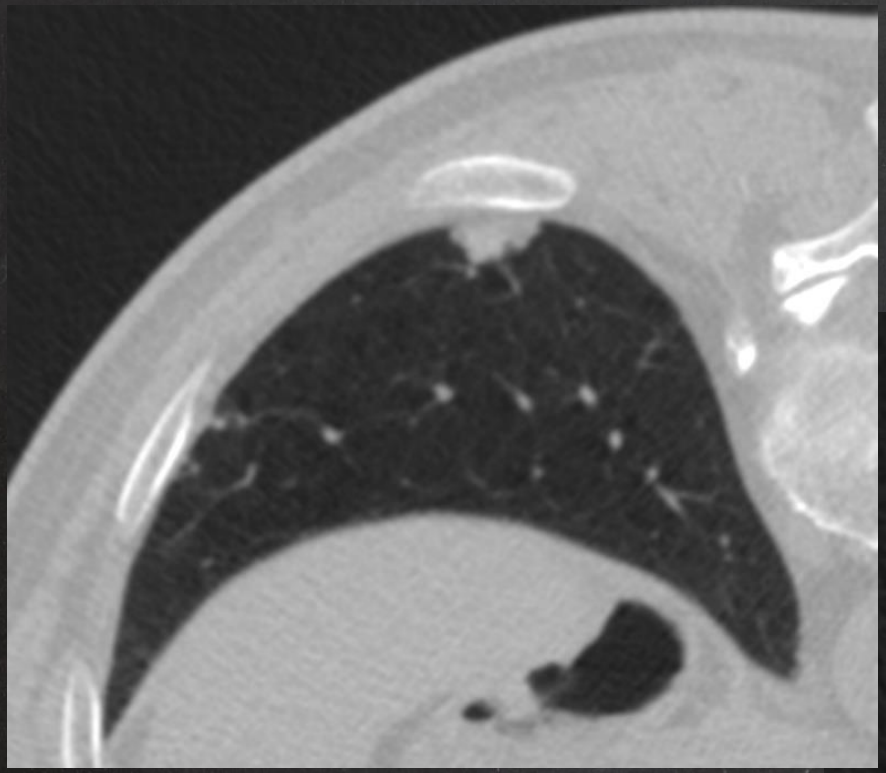
sondes de RF: 2 grands types

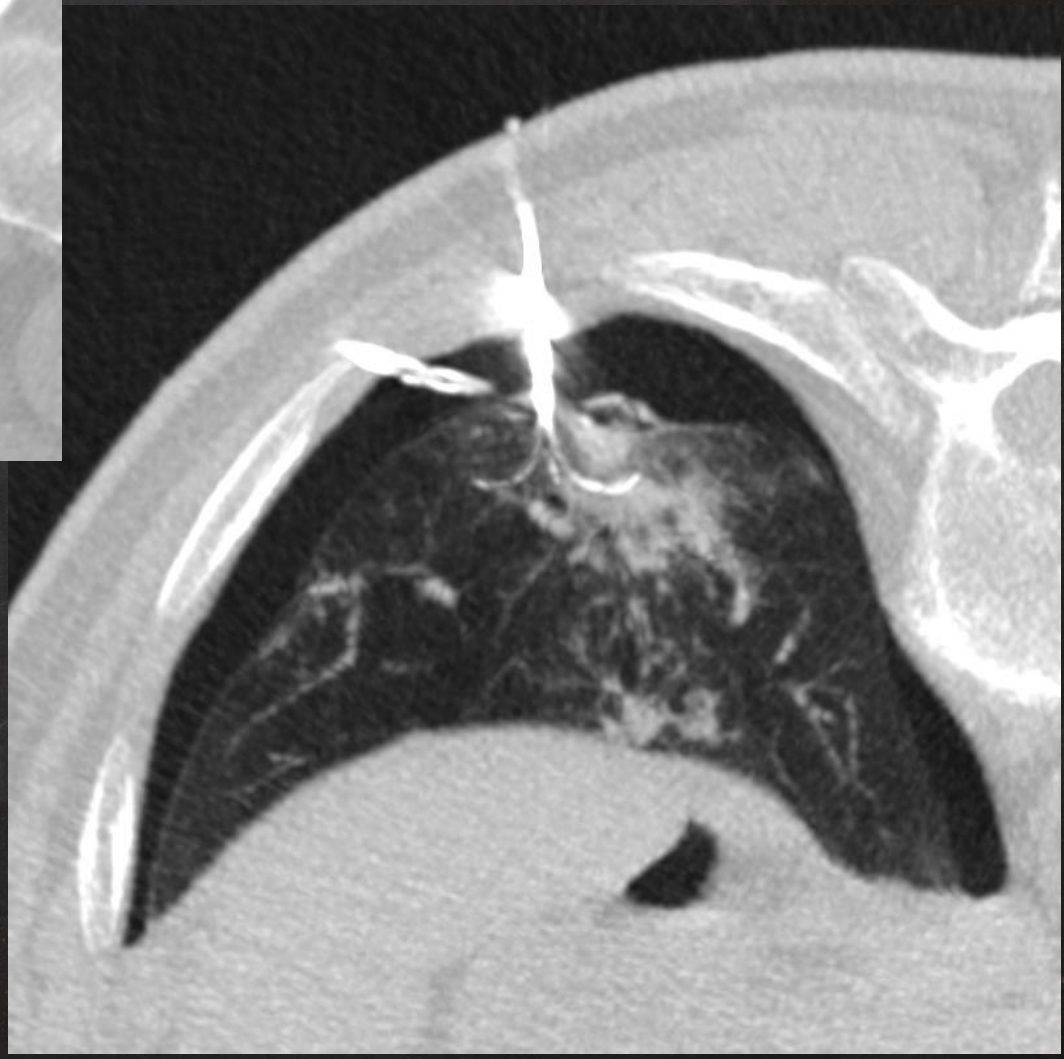
- électrodes déployables





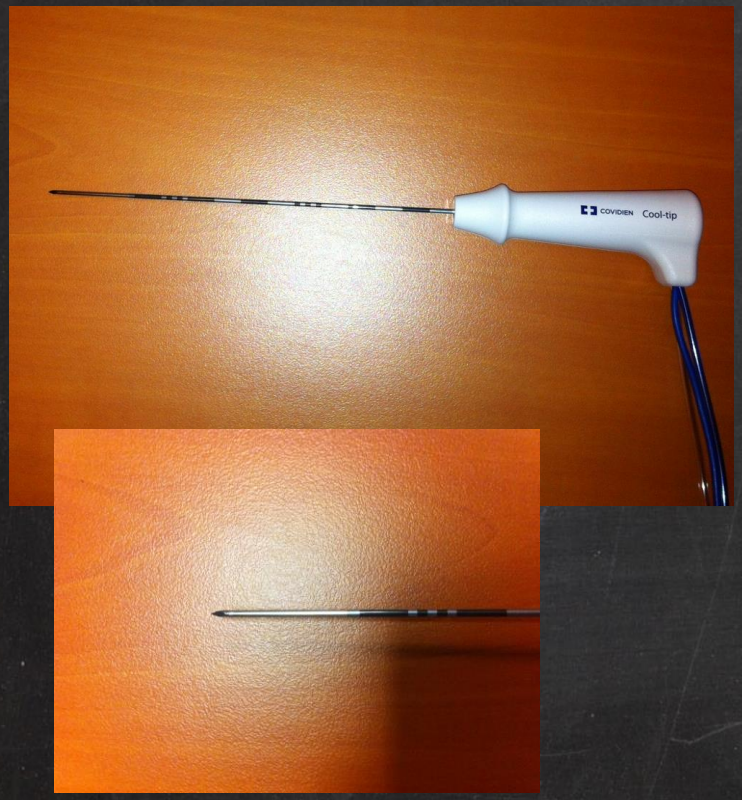
Durée: 20-30 minutes

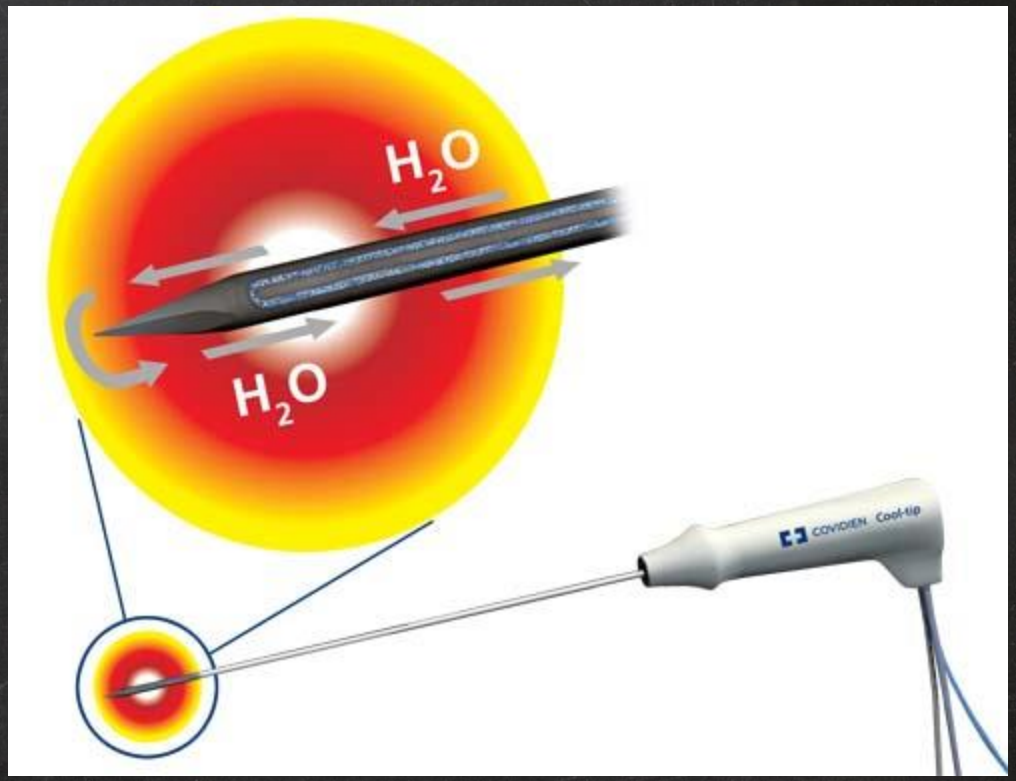




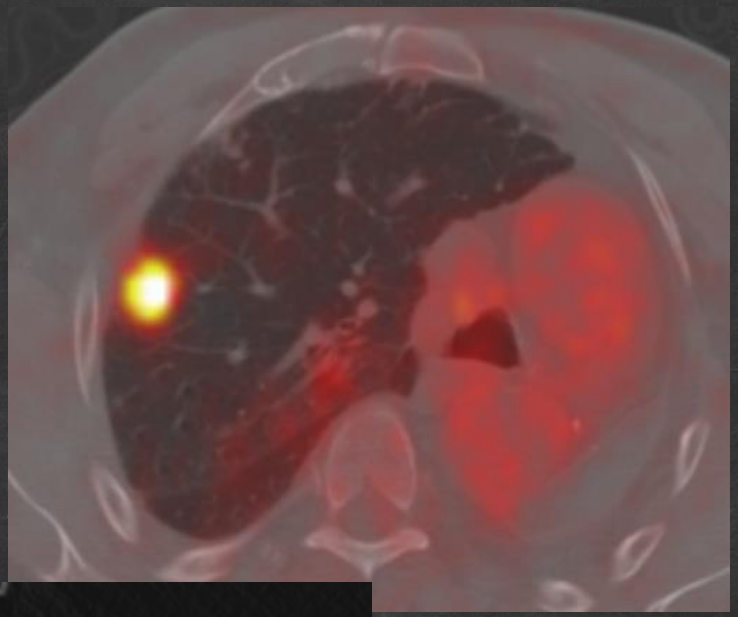
sondes de RF: 2 grands types

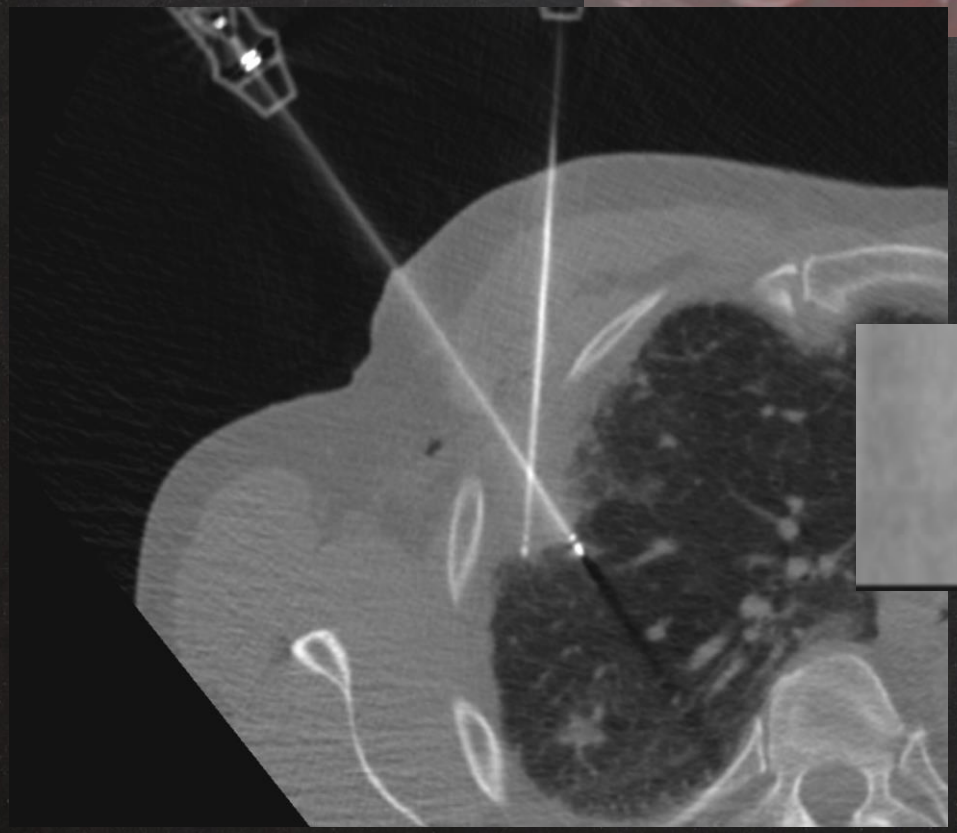
- électrodes droites perfusées

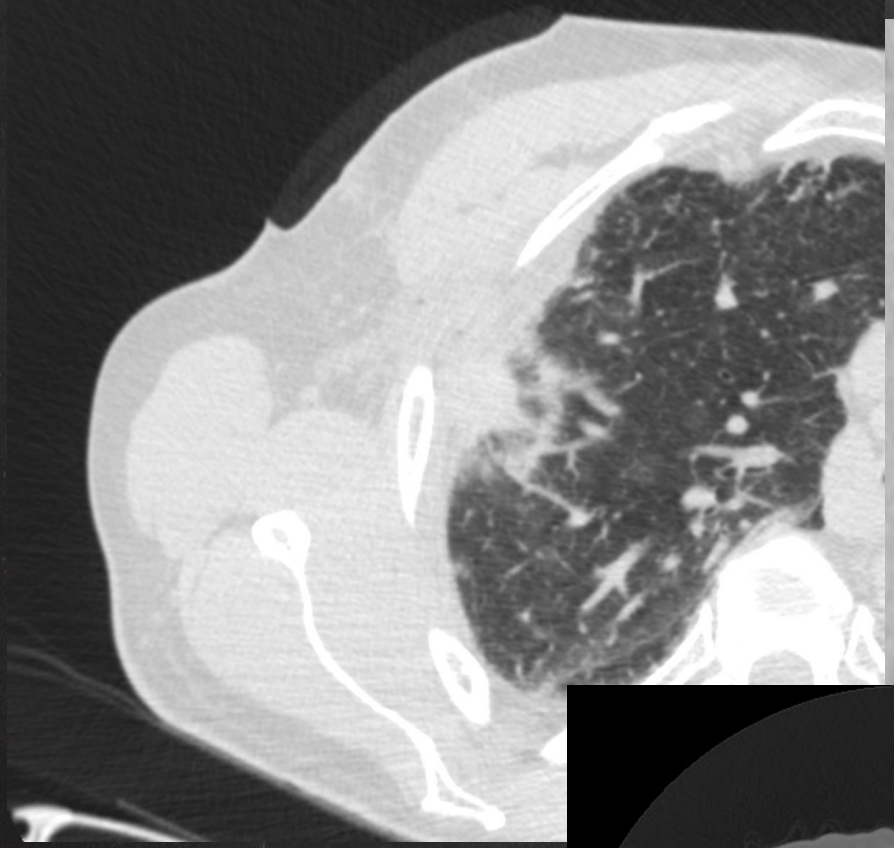


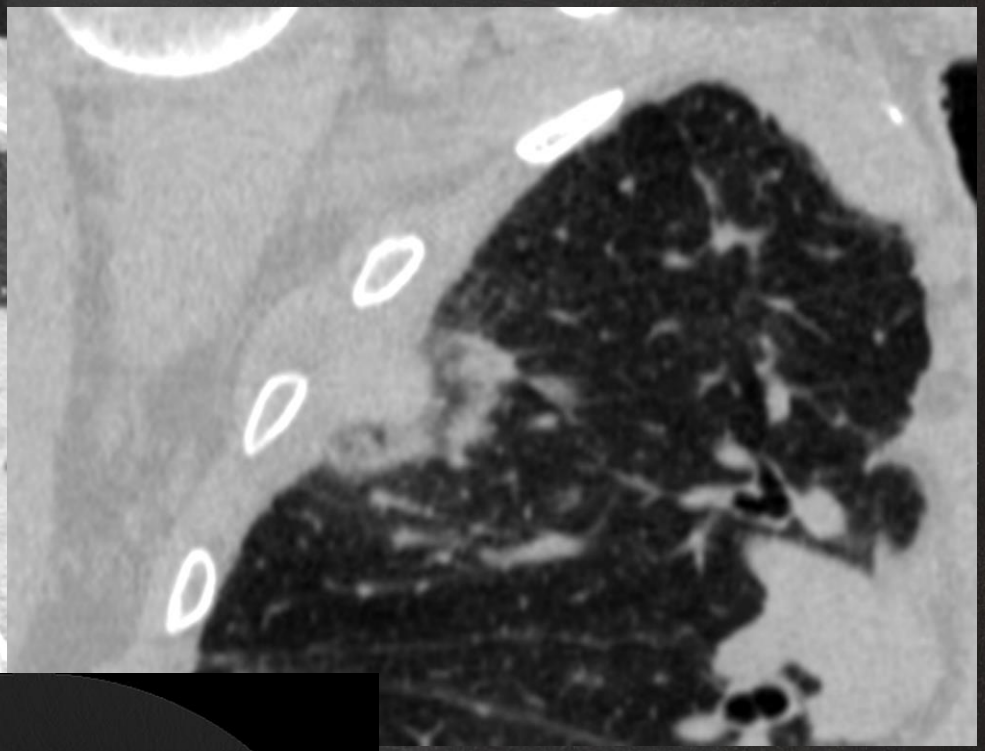


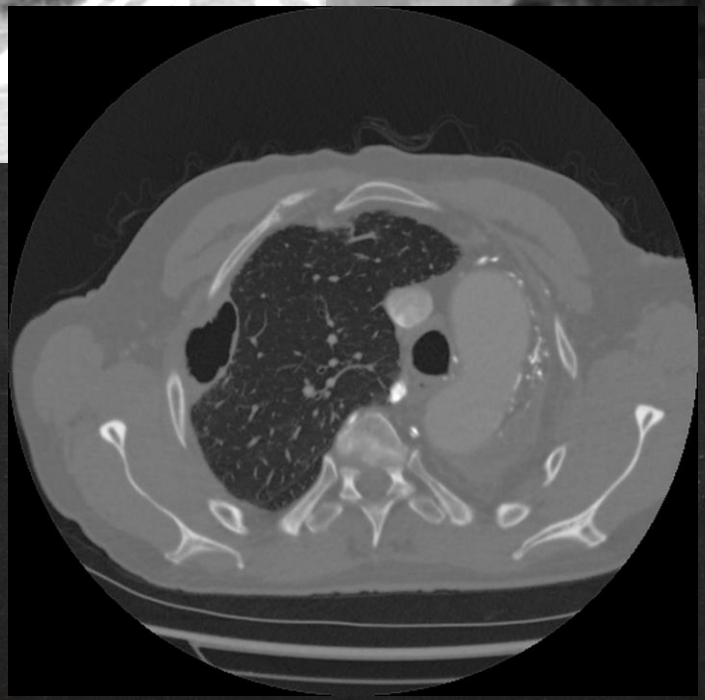
Durée: 10-15 min









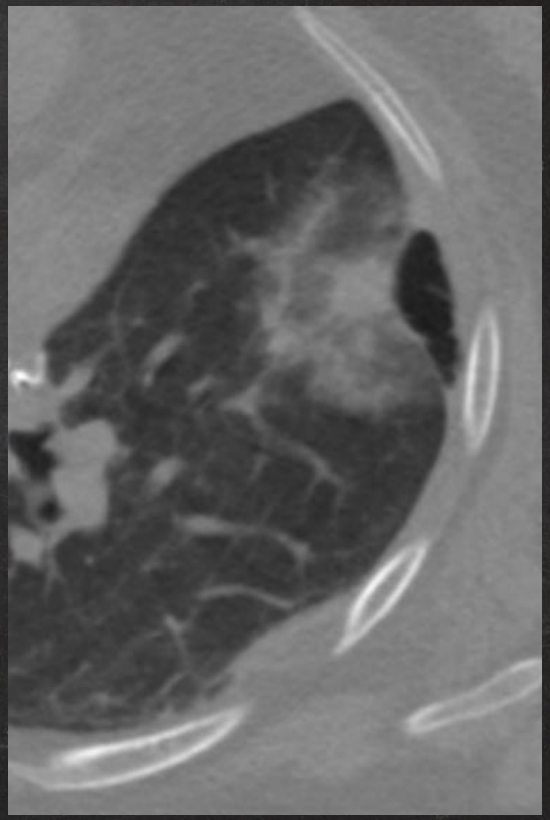


Comment sait-on que la lésion est détruite?

- Montée de l’impédance

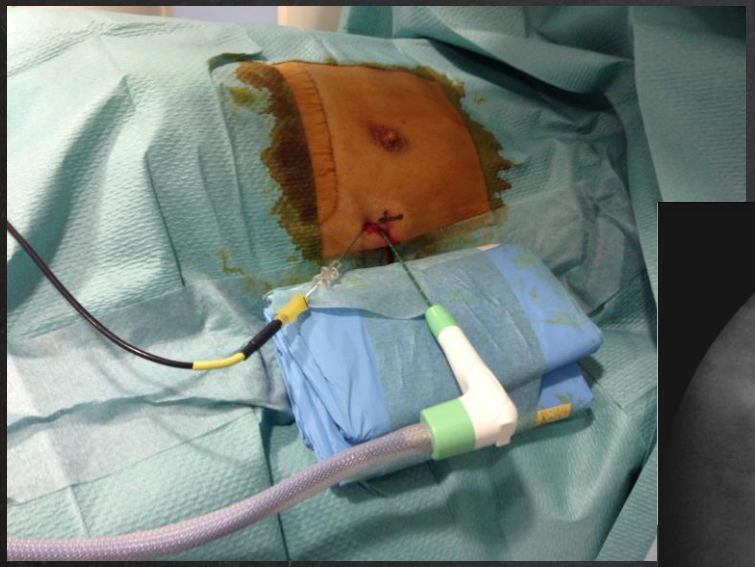
Comment sait-on que la lésion est détruite?

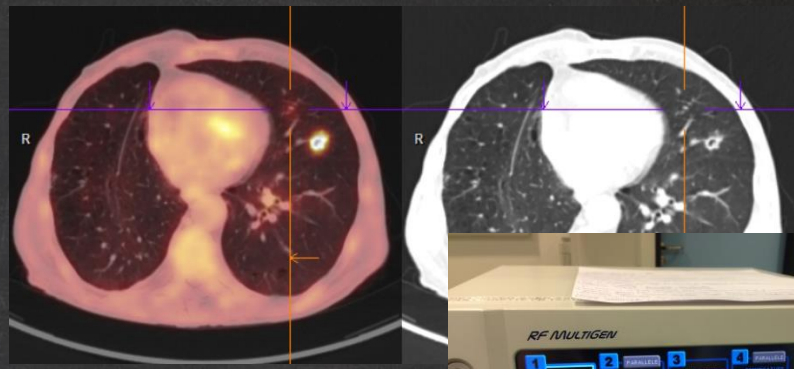
- Apparition d’un verre dépoli

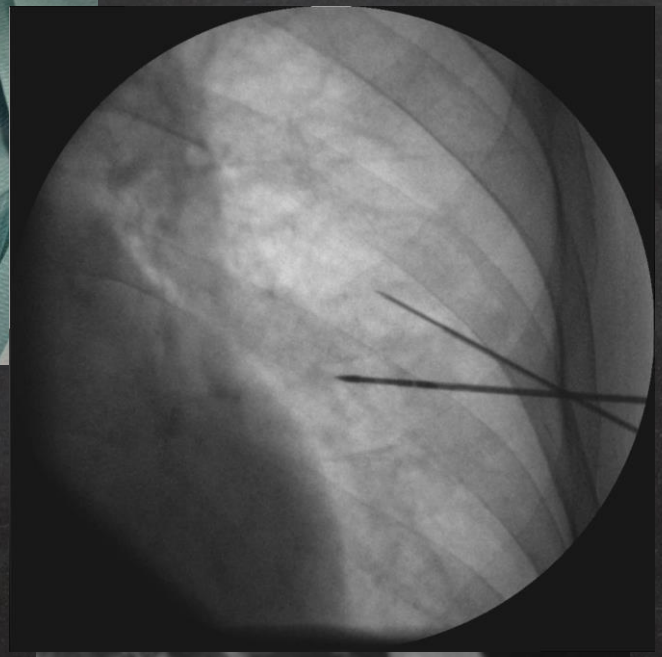


Comment sait-on que la lésion est détruite?

- Mesure de la température



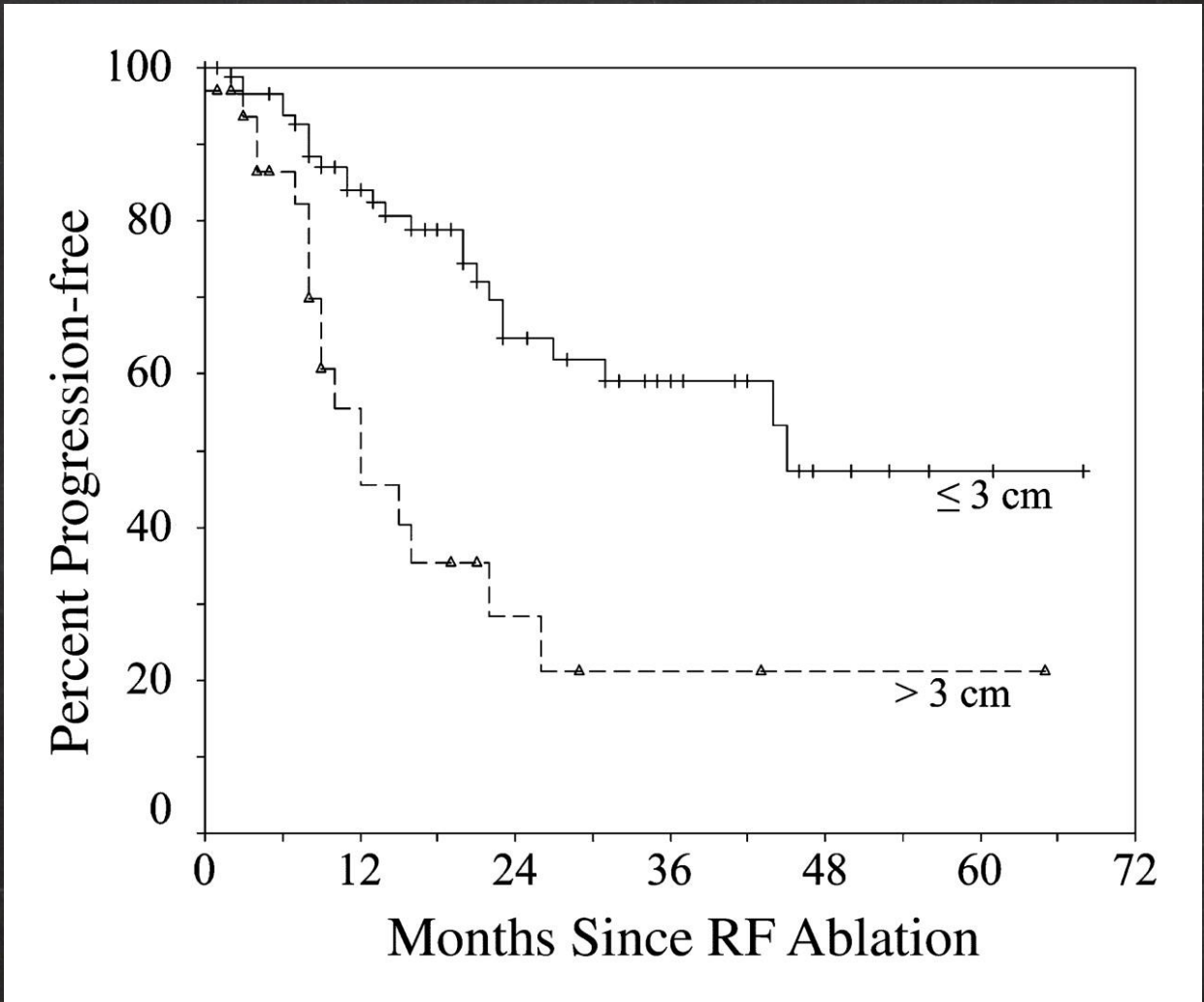




Résultats RF CBP?

étude	Nombre patients	Taille moy T	Survie moy	Survie 1 an (%)	Survie 2 ans	Survie 3 ans	Survie 4 ans	Survie 5 ans
Ambrogi et al.	57	2,6	33,4	83	62	40	-	25
Hiraki et al.	50	2,1	59	94	86	74	67	61
Lanuti et al.	31	2,0	30	85	78	47	47	-
Simon et al.	75	3,0	29	78	57	36	27	27
Hiraki et al.	20	2,4	42	90	84	74	-	-
Lencioni et al.	13	-	-	-	75	-	-	-
Simon et al.	116	-	-	78	57	36	27	27

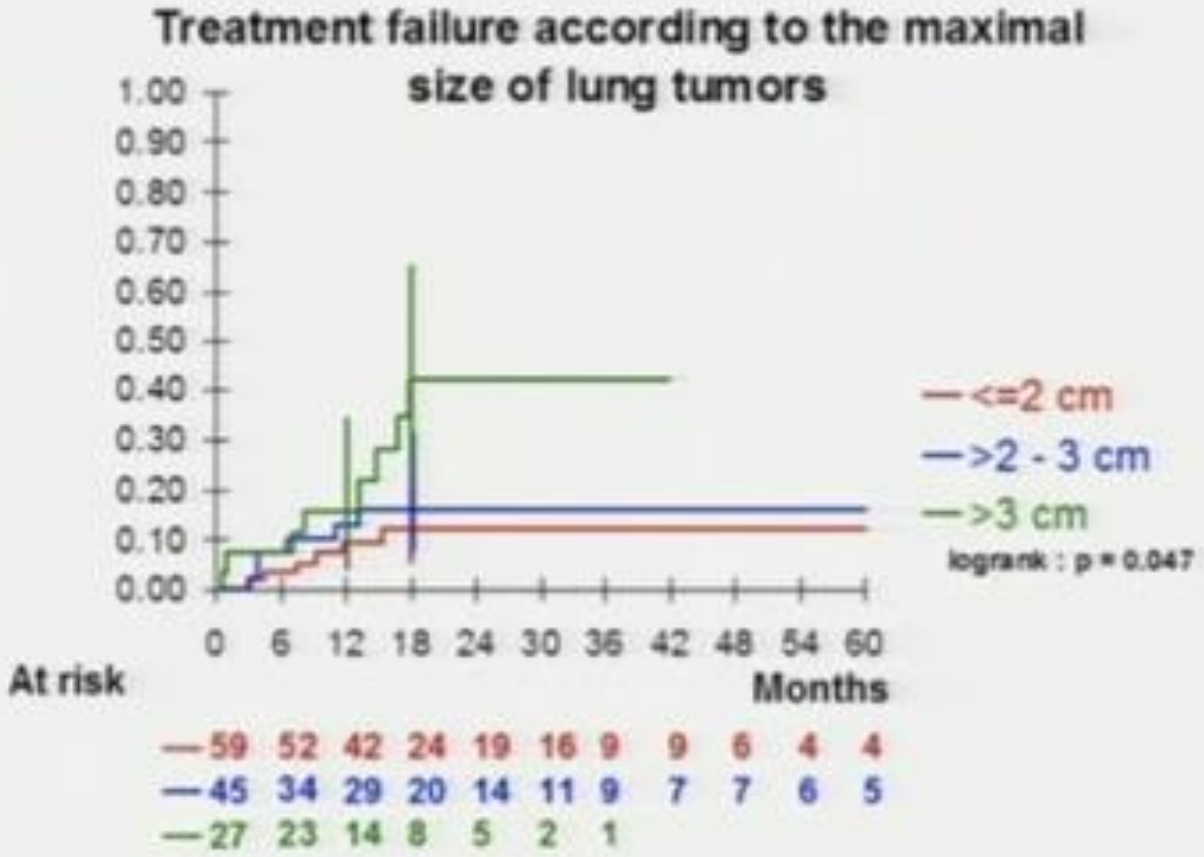
Graph shows results of Kaplan-Meier analysis of progression-free interval of all primary and metastatic lung cancers in local control group on per patient basis for tumor sizes of 3 cm or smaller and larger than 3 cm (P < .002).

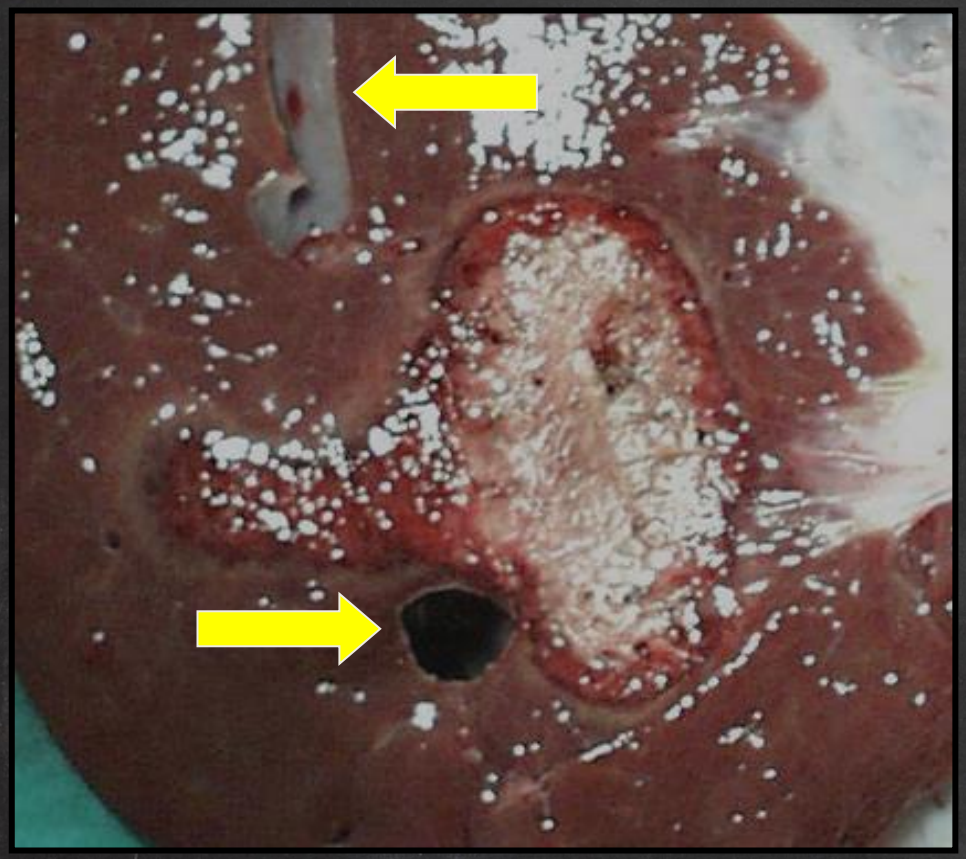


Simon C J et al. Radiology 2007;243:268-275

Radiology

135 NSCLCC in 135 non-surgical candidates (Institut Gustave Roussy / Institut Bergonié)





Heat sink effect

Effect of vessel diameter on the creation of ovine lung radiofrequency lesions in vivo: preliminary results.
Steinke K, Haghighi KS, Wulf S, Morris DL.
J Surg Res. 2005 Mar;124(1):85-91.

Risque de résidu en cas de contact avec un vaisseau > 3mm

Radiofrequency ablation of lung metastases close to large vessels during vascular occlusion: preliminary experience.

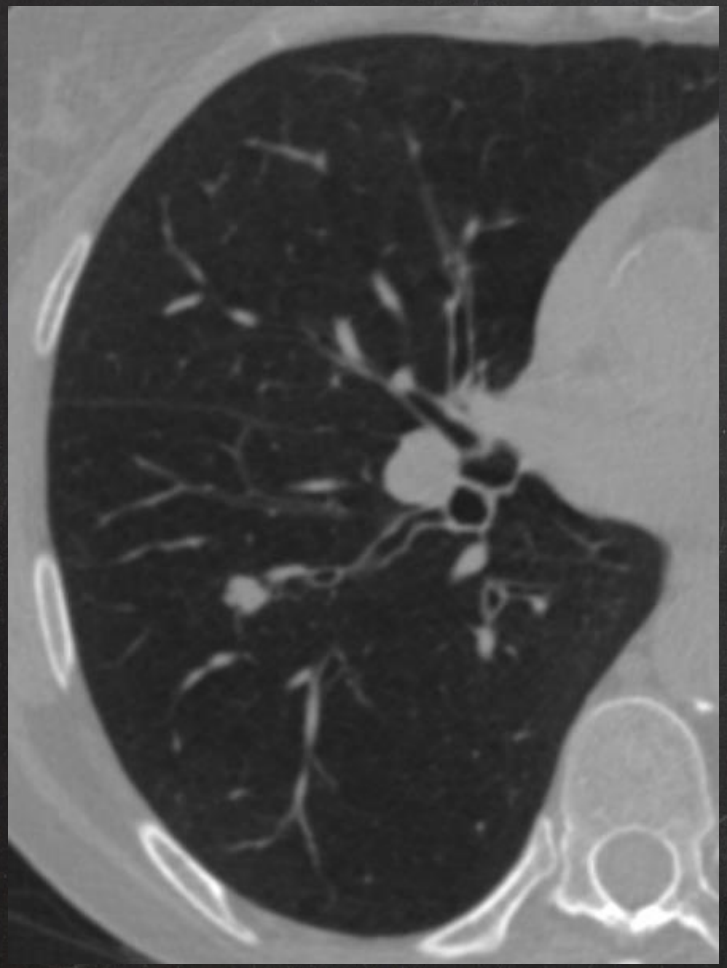
de Baere T, Robinson JM, Rao P, Teriitehau C, Deschamps F.

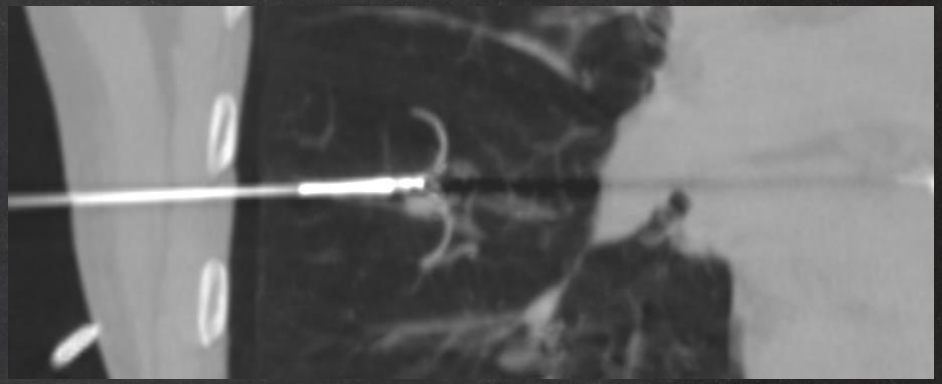
J Vasc Interv Radiol. 2011 Jun;22(6):749-54.

RESULTS: Metastases targeted measured 17-37 mm (22 ± 8) and were in contact with a pulmonary artery 3-5 mm. Temporary occlusion of the pulmonary arterial branch in contact with the tumor was technically possible in five of six patients. Postablation CT scans obtained within 2 days of the procedure showed ablation zones measuring 37-57 mm (47 ± 8) in their shortest diameter. Three patients developed lung infarction within 1 month after RF ablation, and two had to be readmitted. At 3 months after the procedure, four patients had persistent occlusion of the balloon-occluded vessel. No uptake was demonstrated 4 months after ablation; at 12 months, all tumors showed complete ablation on CT.

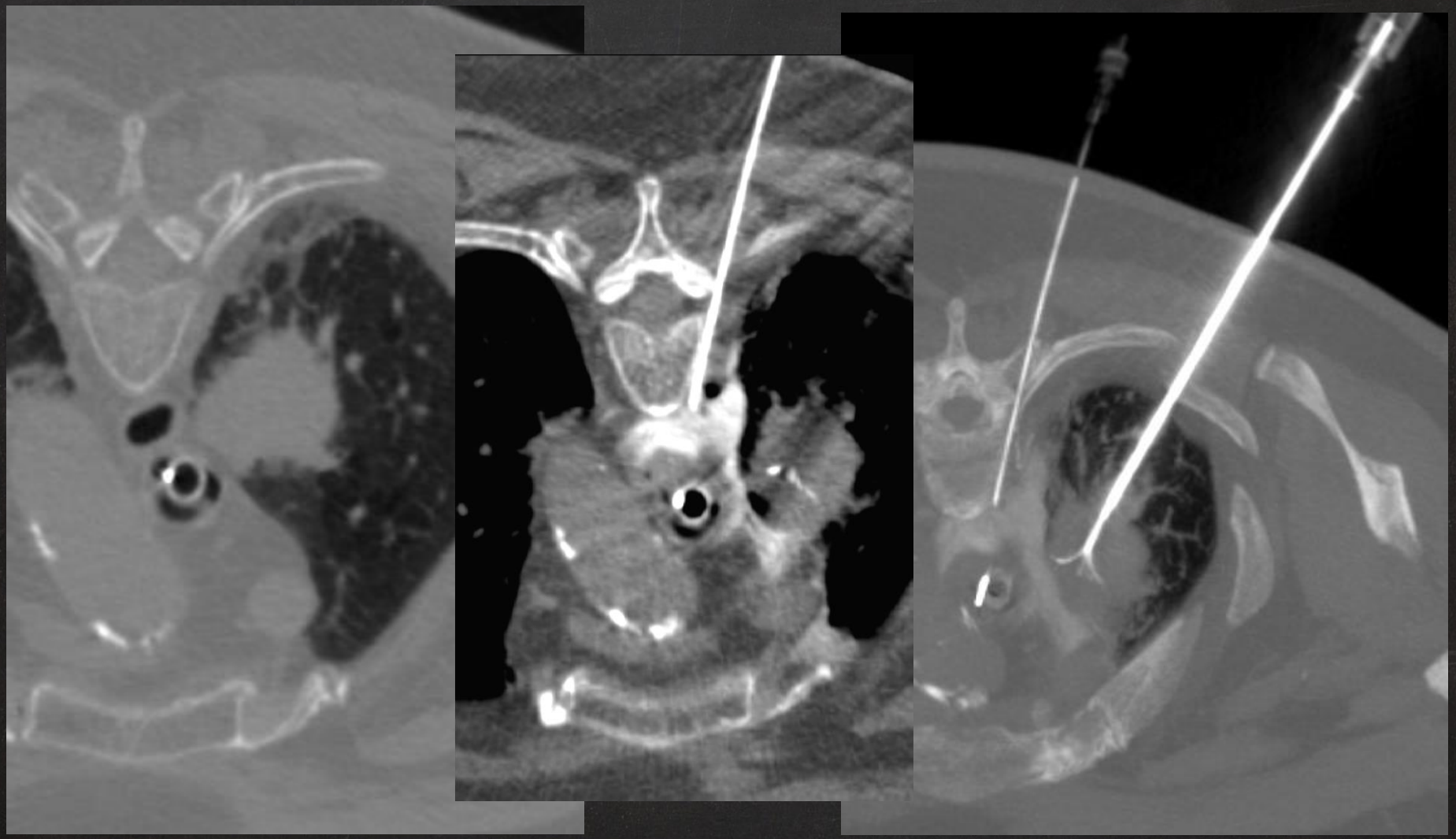
CONCLUSIONS: RF ablation of lung tumors with PBO is a feasible technique, but it induces atelectasia and long-lasting vascular occlusion responsible for a high rate of readmission. The results of this small study warrant careful further exploration of the benefits of the technique, compared with RF ablation without PBO or other methods of ablative therapy.

- Bonne indication – tumeur < 2cm en plein parenchyme



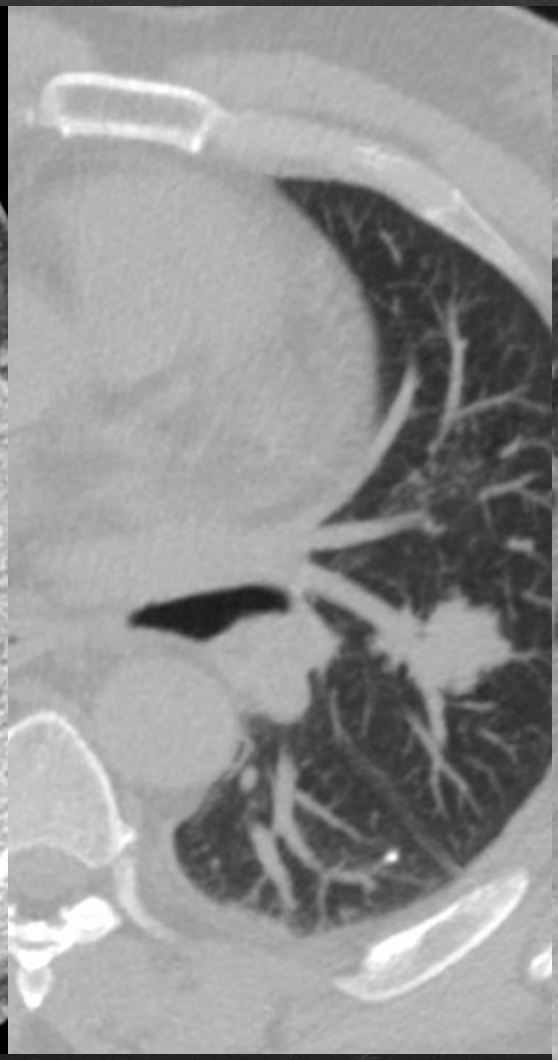


- Mauvaise indication – tumeur > 3cm



- Mauvaise indication – tumeur avec contact vasculaire (vx > 3mm)

  => tumeurs centrales



Expérience de l’opérateur + sélection optimale des patients:

- Simon et al. (2007)

75 CBP

Survie 1, 2, 3 ans: 78%, 57%, 36%

- Simons et al. (2012)

82 CBP

Survie 1, 2, 3 ans: 77%, 62%, 50%

- Kodama et al. (2012)

51CBP

Survie 1, 2, 3 ans: 97%, 72%, 55%

Pas d'altération de la fonction respiratoire après RF:

No change in respiratory function after RFA

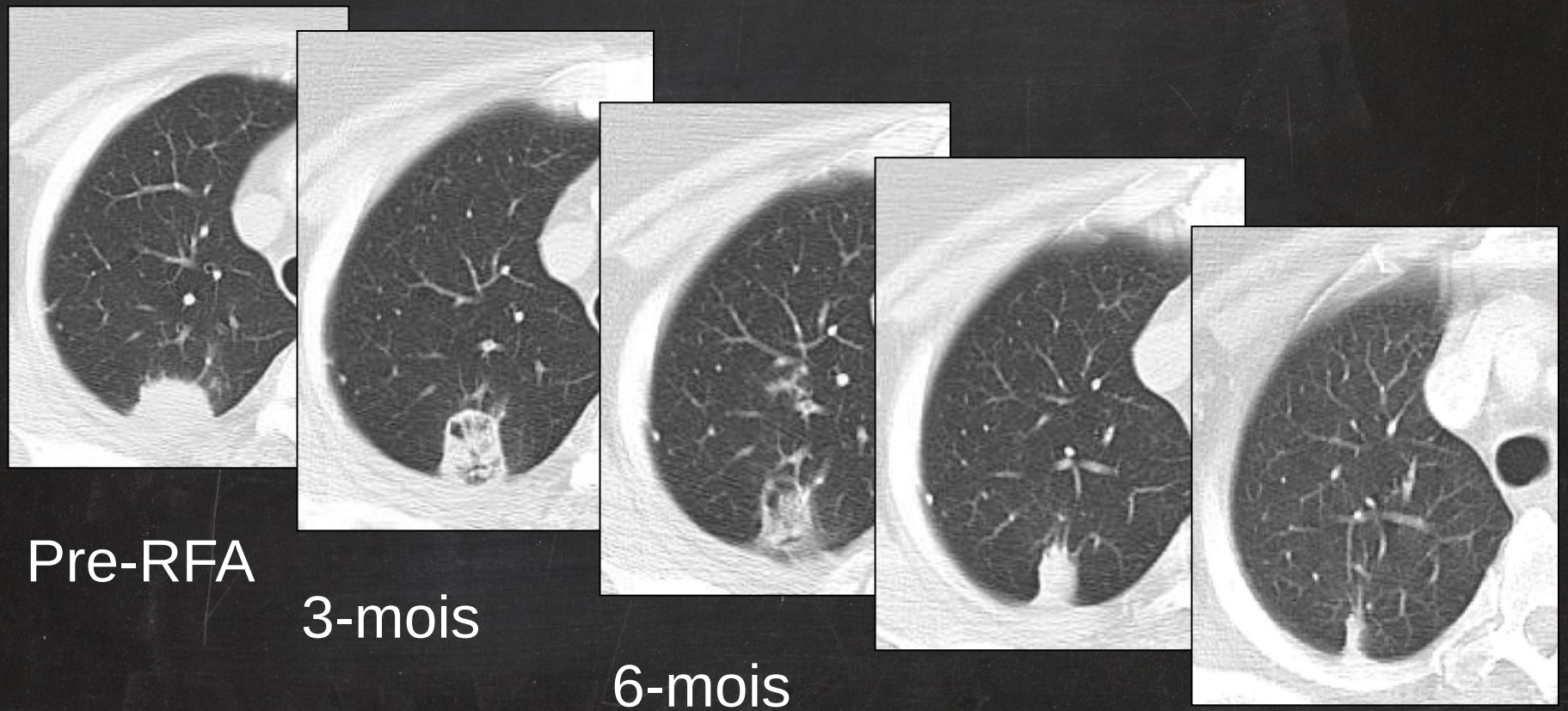
	Before RF	1 month after RF
FEV1	2.2 (0.62-3.75)	2.1 (0.72-3.61)
VC	2.77 (0.8-7.9)	2.6 (0.83-5.43)

(de Baere T, Radiology 2006)

No significant changes in FEV or FVC at baseline, 1, 3, 6 ans 12 months

(Lencionni R, Lancet Onco; 2008)

Suivi post RF



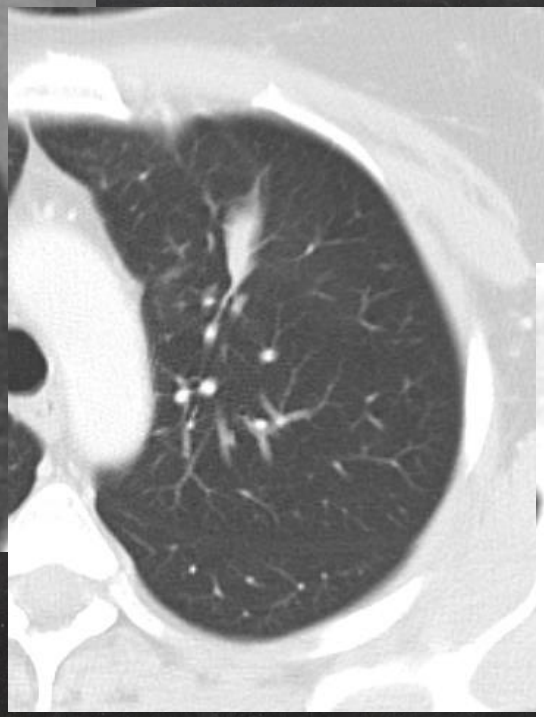
Pre-RFA

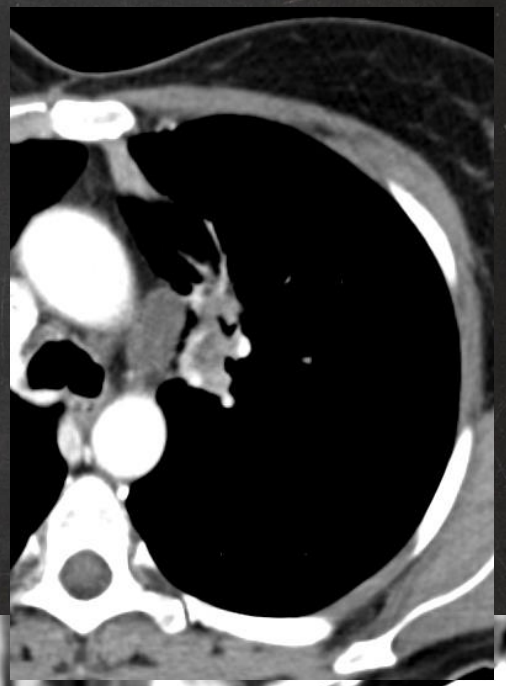
3-mois

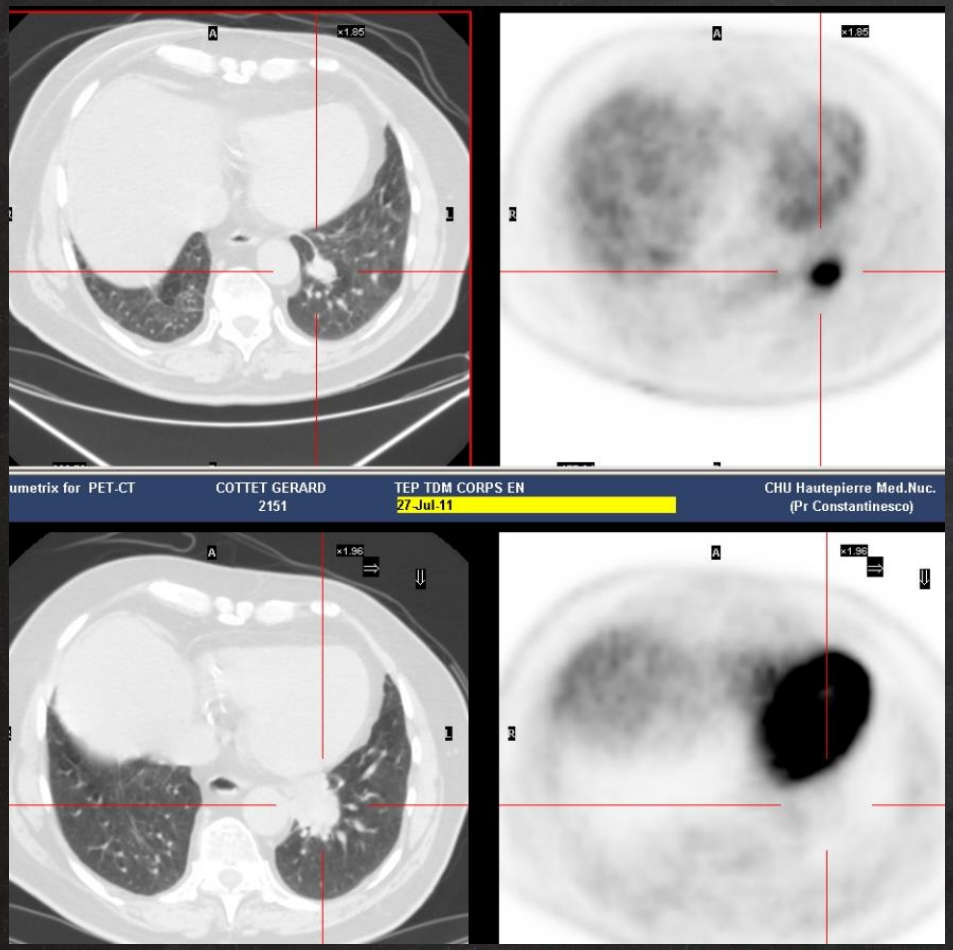
6-mois

1-an

2-ans






umetrix for PET-CT
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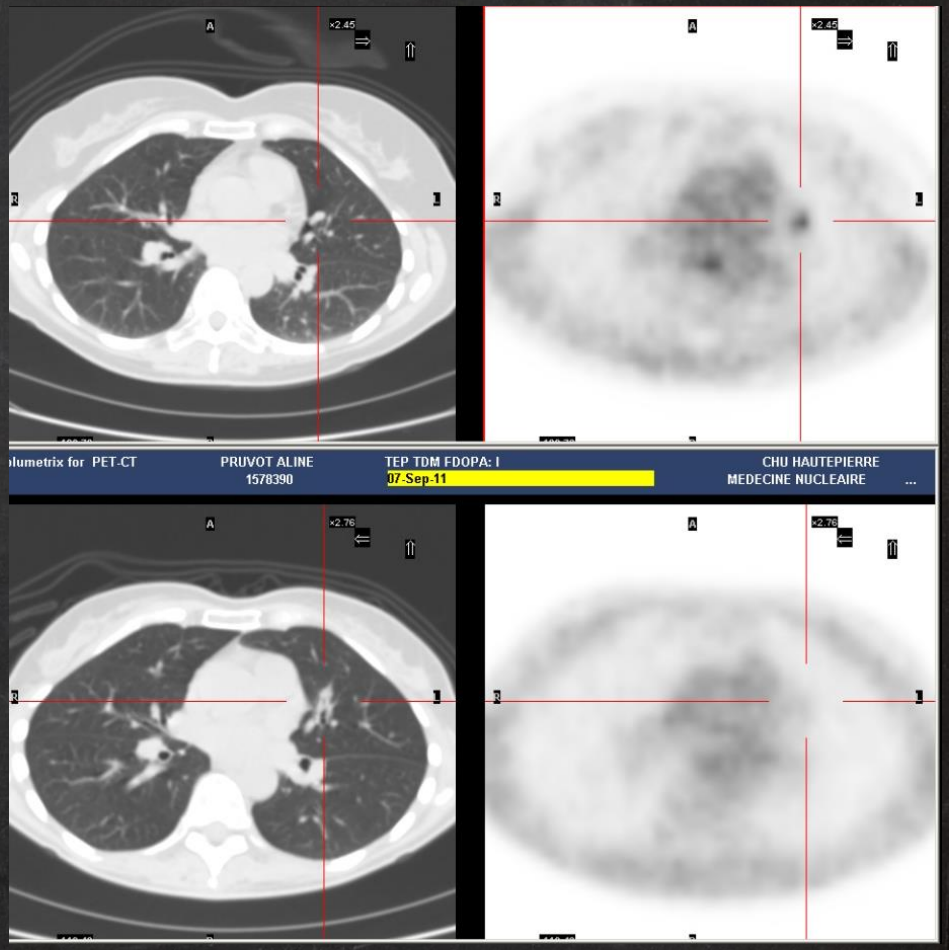
CHU Hautepierre Med.Nuc.
(Pr Constantinesco)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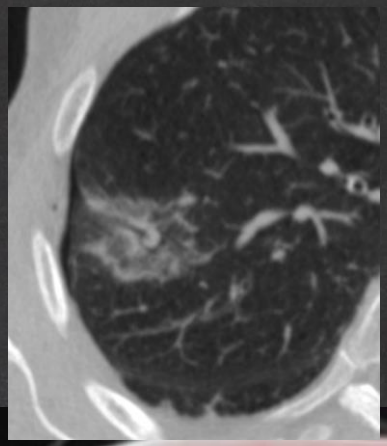
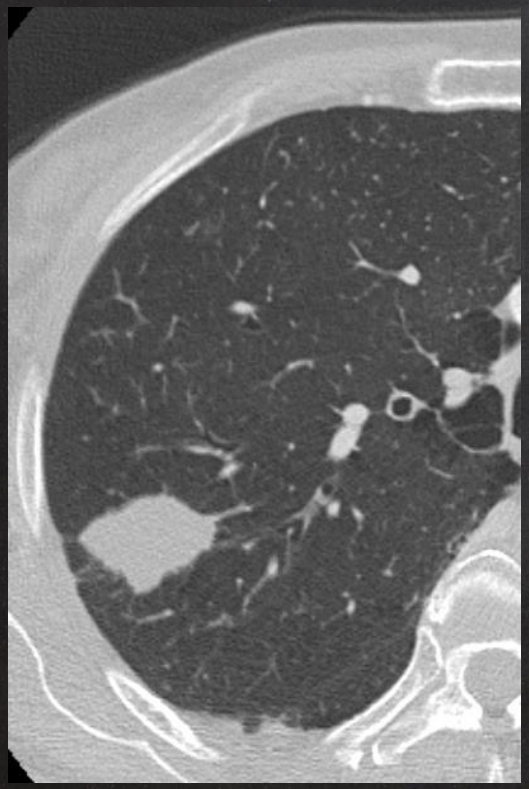
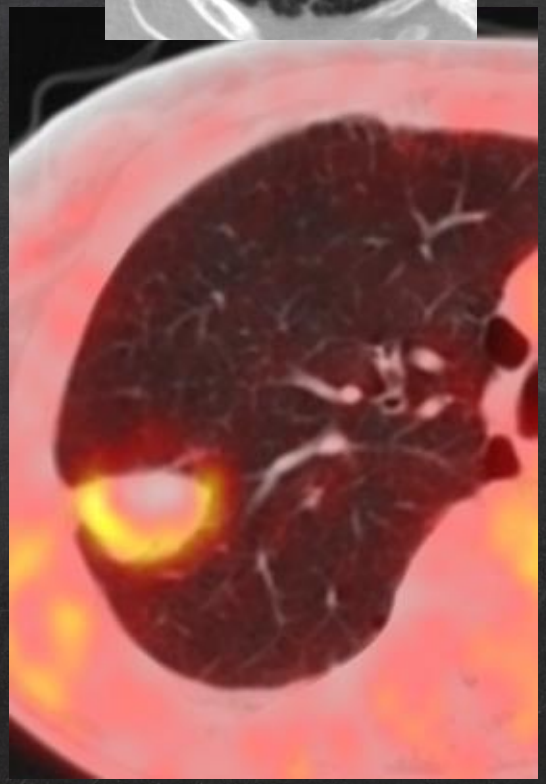
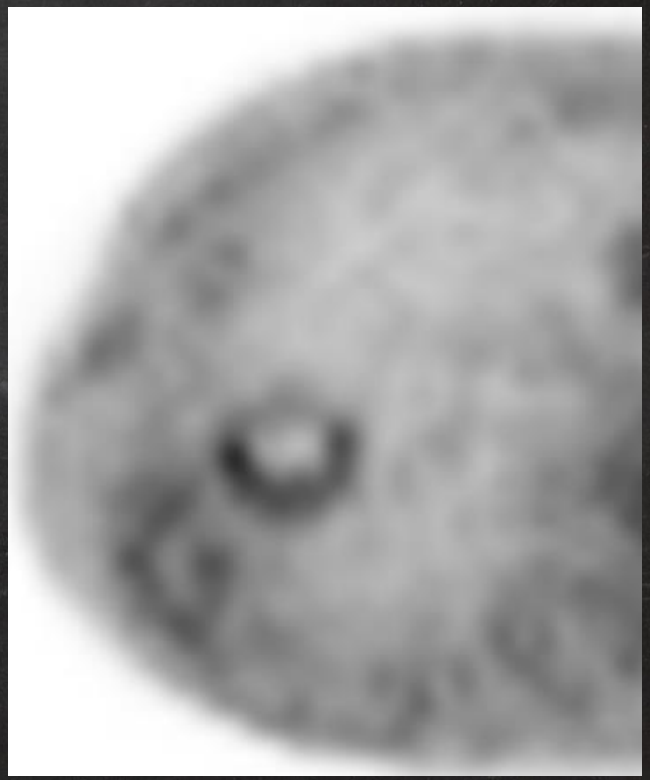








- MICRO-ONDES

Principe: émission locale de micro-ondes

=> rotation des molécules d'eau

=> augmentation locale de la température

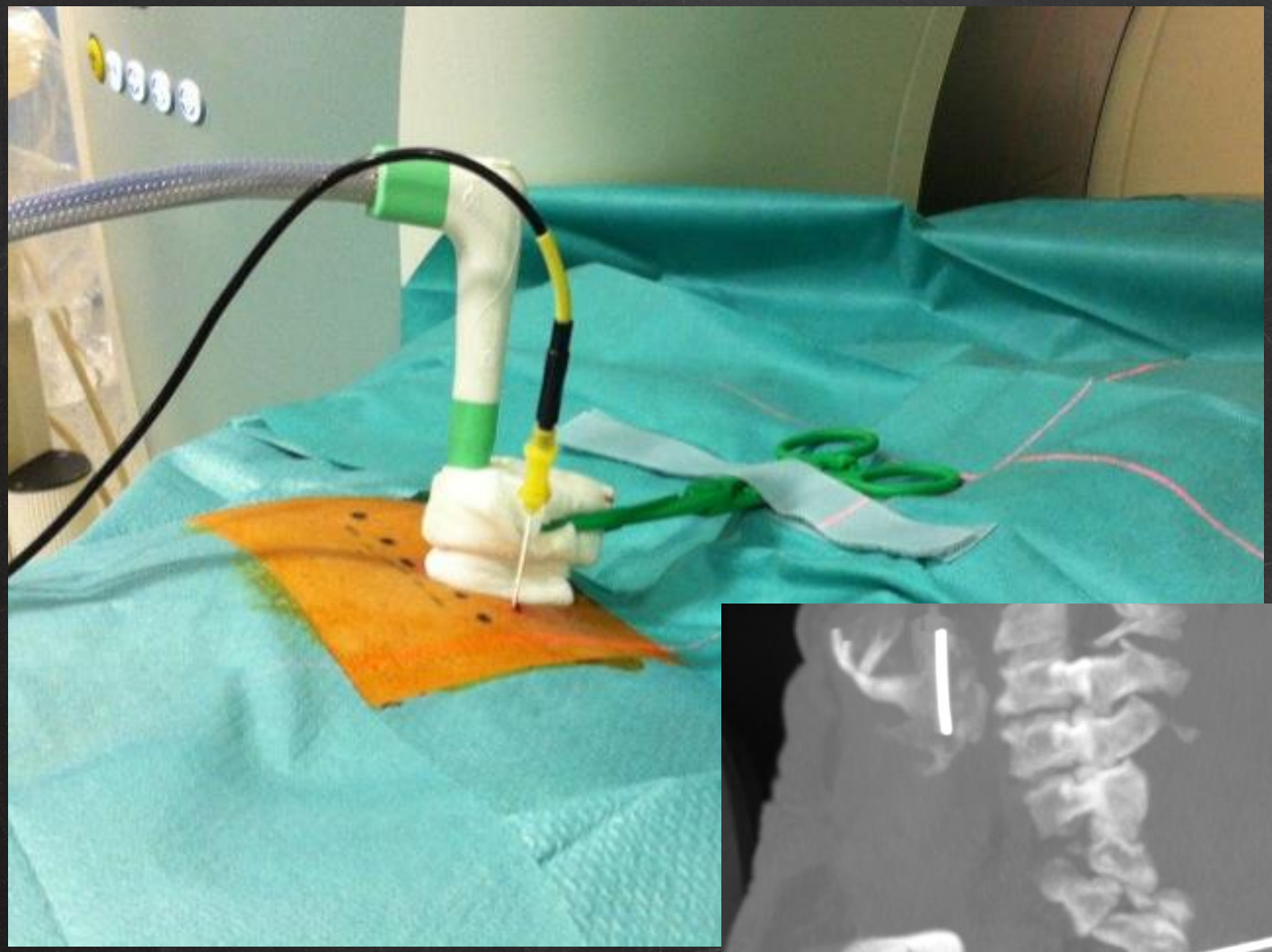
Fréquence = 900 Mhz - 2,5 Ghz (RF: 400 – 500 kHz)

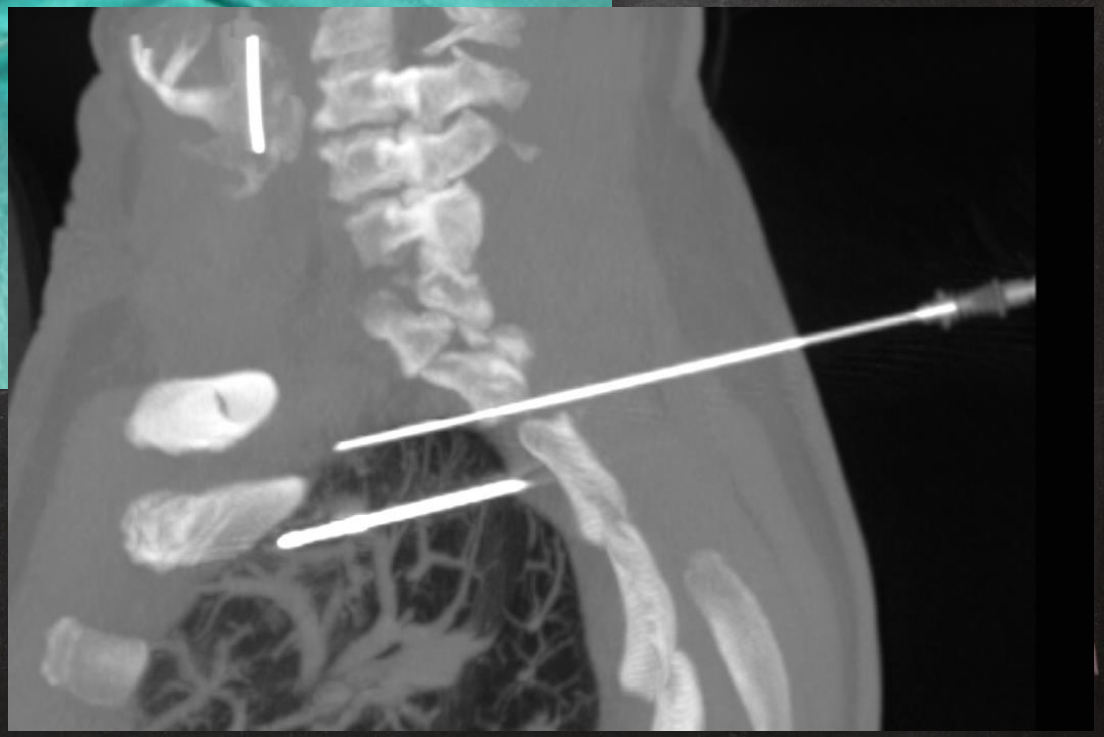
⇒ Température plus élevée (180°)

⇒ Pas de limitation de la coagulation par la résistance de l'air

⇒ Ablation plus rapide

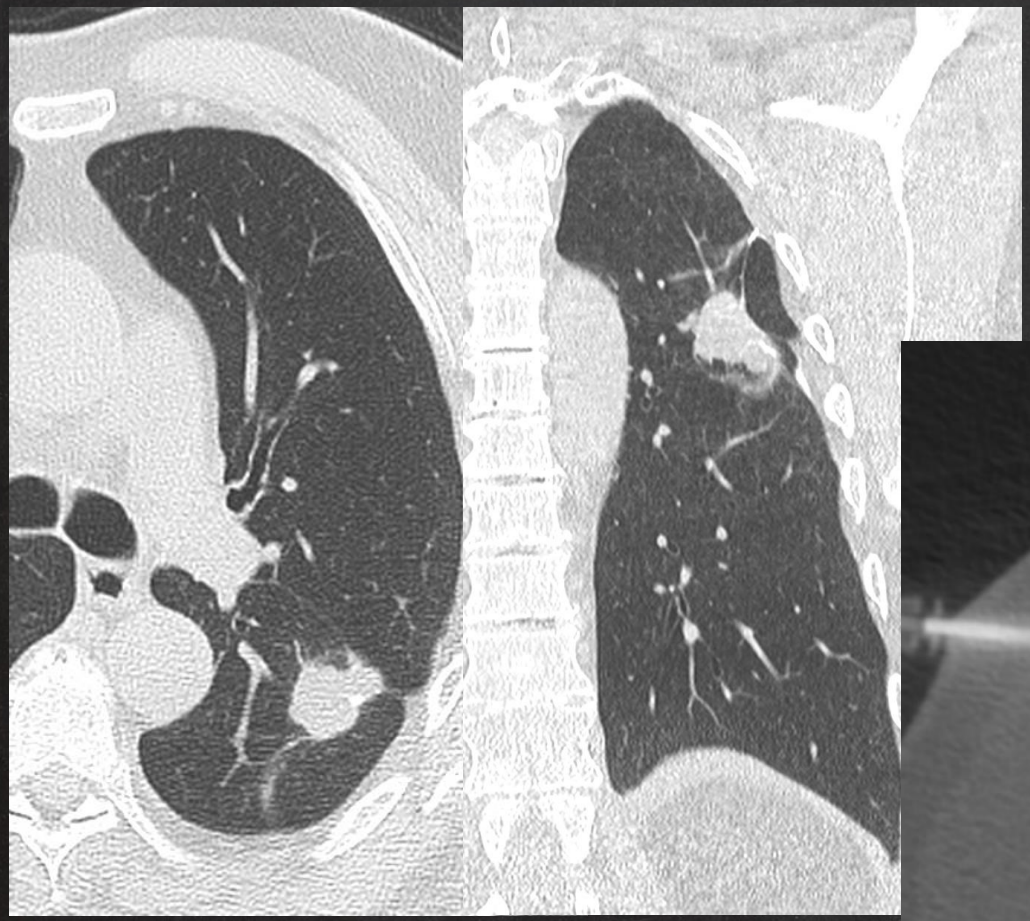
⇒ Zone d'ablation plus grande

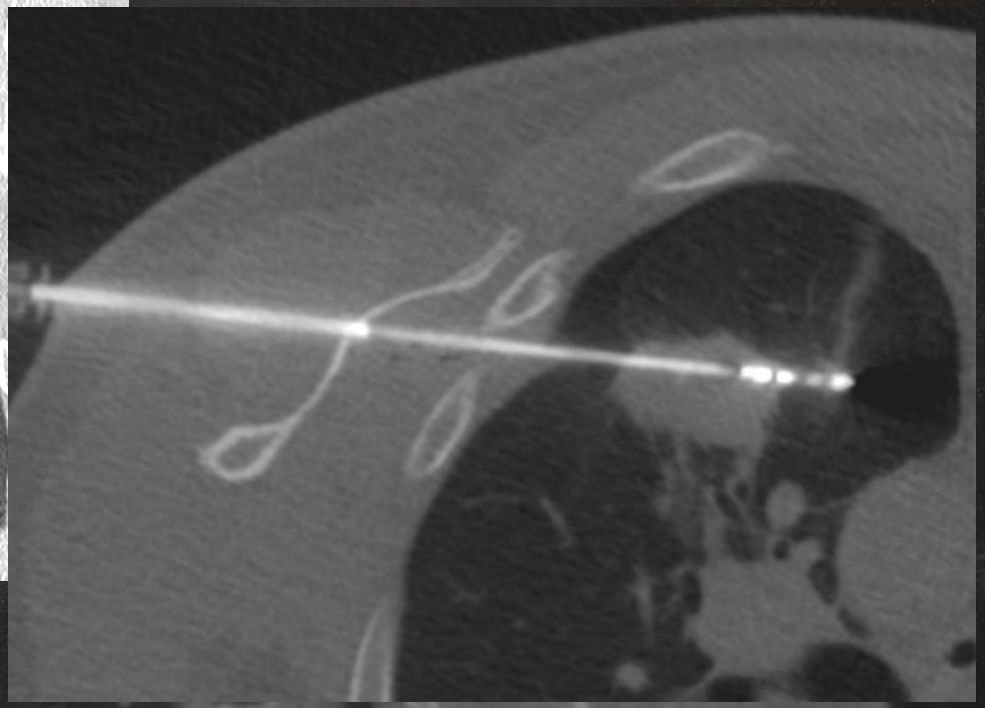


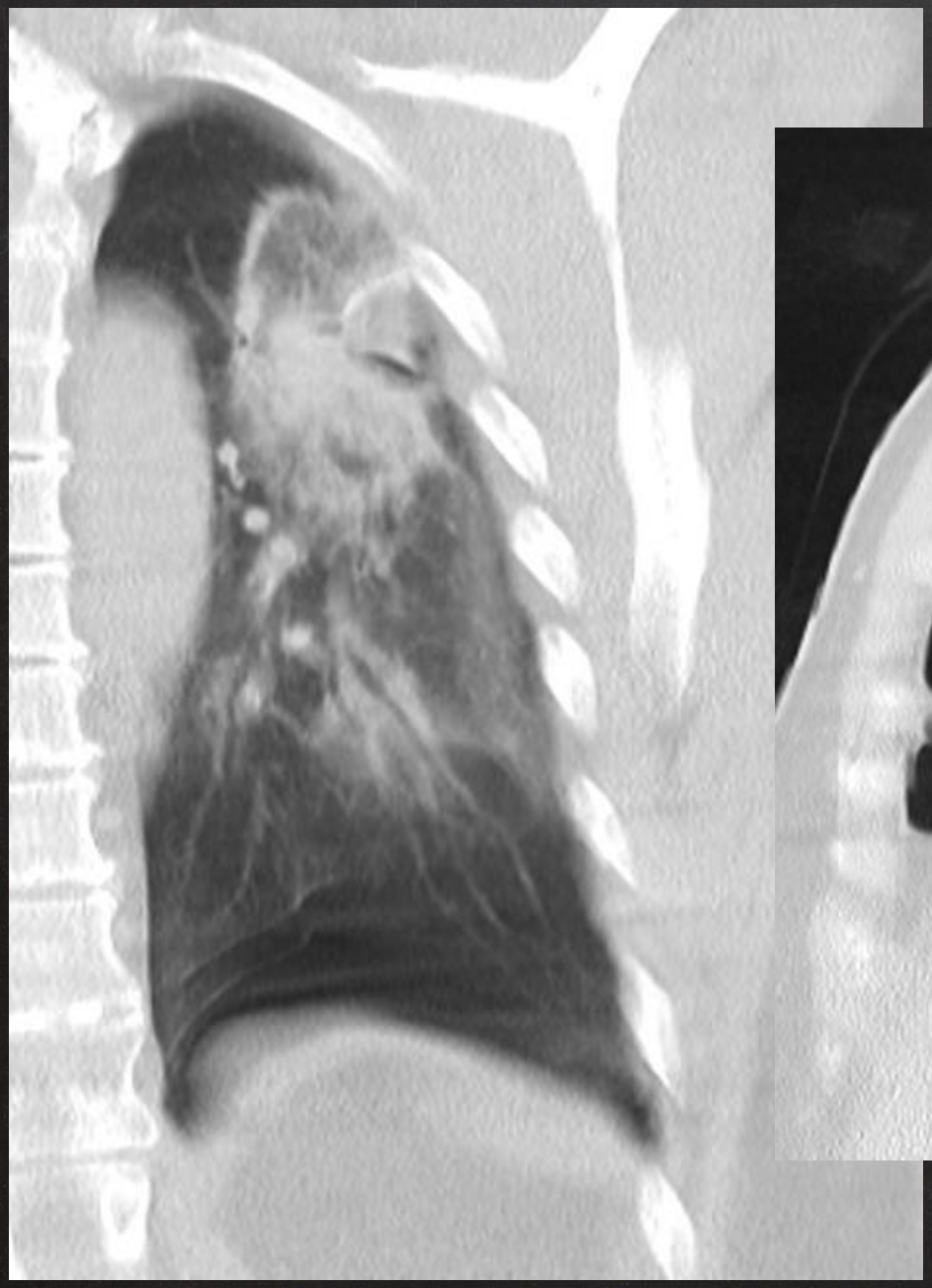



RF MULTIGEN
48,2
HAUTE
HAUTE
HAUTE
HAUTE
SORTIE RF
SENSORIEL
MOTEUR

- Ablation de grande taille





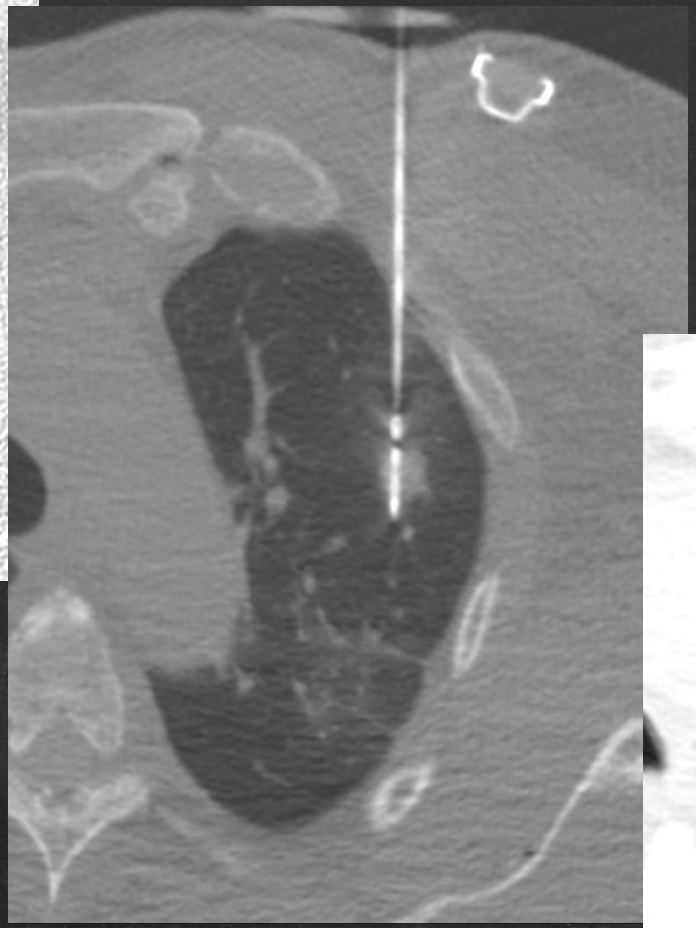
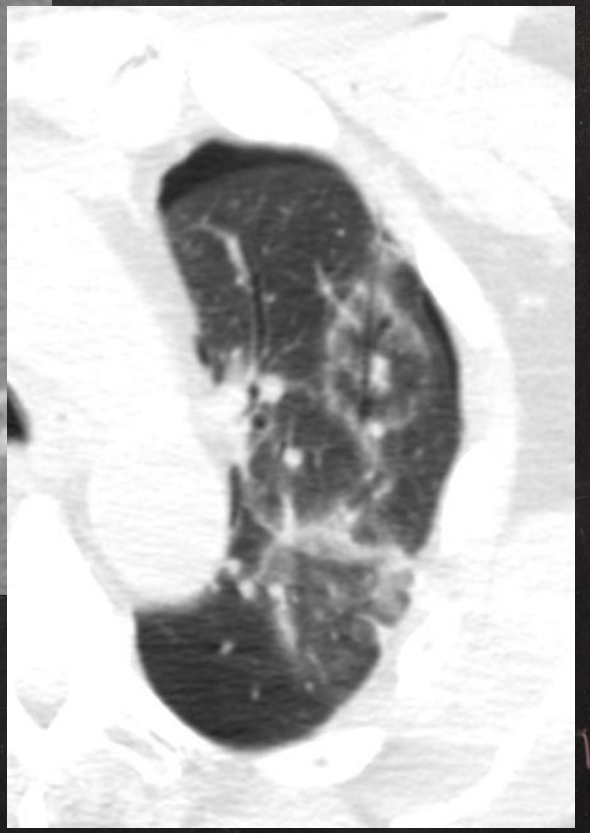


Microwave Ablation Therapy: Clinical Utility in Treatment of Pulmonary Metastases[1]

Thomas J. Vogl, MD
Nagy N. N. Naguib, MSc
Tatjana Gruber-Rouh, MD
Karen Koitka, MBBCh
Thomas Lehnert, MD
Nour-Eldin A. Nour-Eldin, MD, MSc

RESULTS: Complete, successful ablation was achieved in 95 (73.1%) of 130 lesions. Successful tumor ablation was significantly more frequent for lesions with a maximal axial diameter of 3 cm or smaller (90 of 110) than for lesions greater than 3 cm in maximal axial diameter (five of 20) ($P < .0001$) and for peripheral lesions (80 [80%] of 100) than for centrally located lesions (15 [50%] of 30) ($P = .002$). The histopathologic type of the metastasis did not significantly correlate with the ablation result ($P > .3$). The 12- and 24-month survival rates were 91.3% and 75%, respectively. There was no intraprocedural death, and the overall 60-day mortality rate after ablation was 0%. Higher survival rates were observed in patients with tumor-free states after successful ablation than in patients with failed ablation ($P = .001$). The incidence of pneumothorax was 8.5% (11 of 130). An intercostal chest tube was applied in one (0.8%) of the 11 sessions. Pulmonary hemorrhage developed in eight (6.2%) of 130 sessions.

CONCLUSION: Microwave ablation therapy may be safely and effectively used as a therapeutic tool for treatment of pulmonary metastases. The efficacy of the treatment is primarily determined by preablation tumor size and location in relation to the hilum.

Résultats Micro-ondes

CT-guided percutaneous microwave ablation of pulmonary malignancies: Results in 69 cases

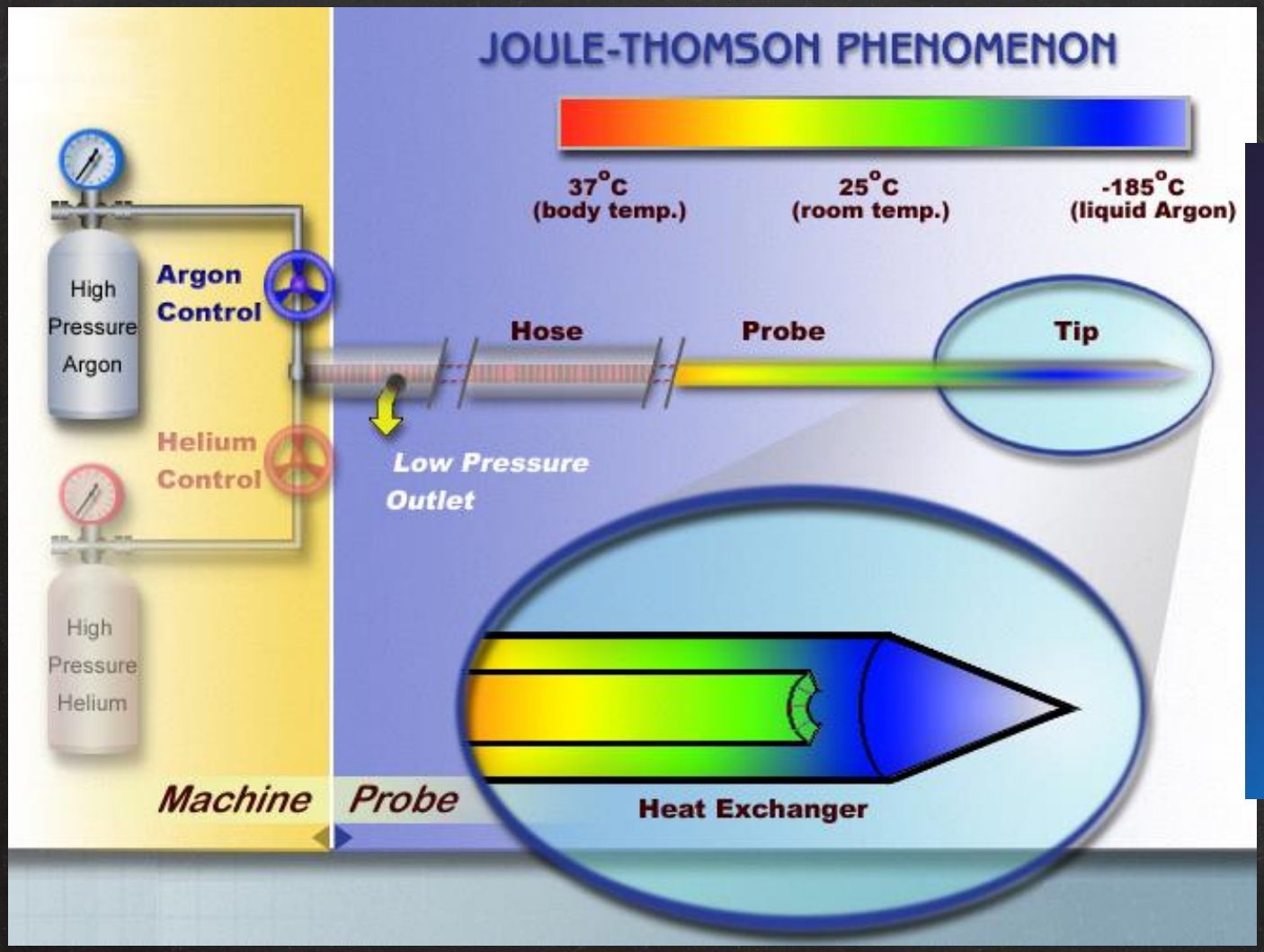
Qiang Lu[1†], Wei Cao[2†], Lijun Huang[1†], Yi Wan[3†], Tonggang Liu[4], Qingshu Cheng[1], Yong Han[1*] and Xiaofei Li[1*]

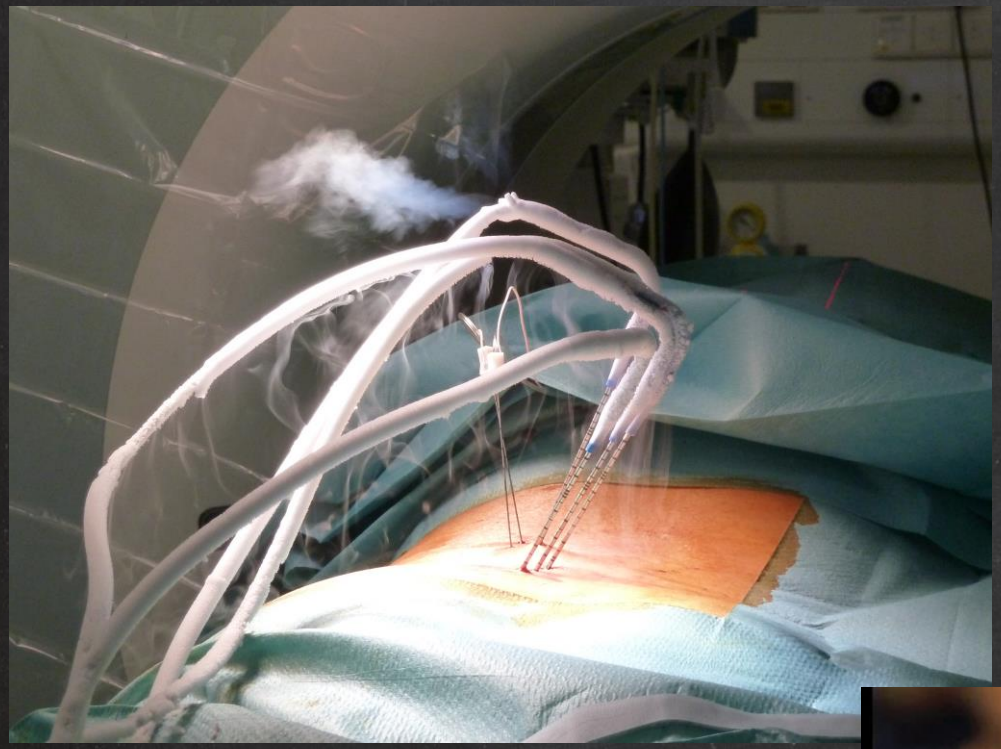
The overall survival rates for NSCLC patients:
1 year – 75%
2 years – 54,2%
3 years – 29,2%

The overall survival rates for pulmonary metastatic tumor patients:
1 year – 47,6%
2 years – 23,8%
3 years – 14,3%

Différence significative de contrôle local entre T<4 et T>4cm

- CRYOTHERAPIE



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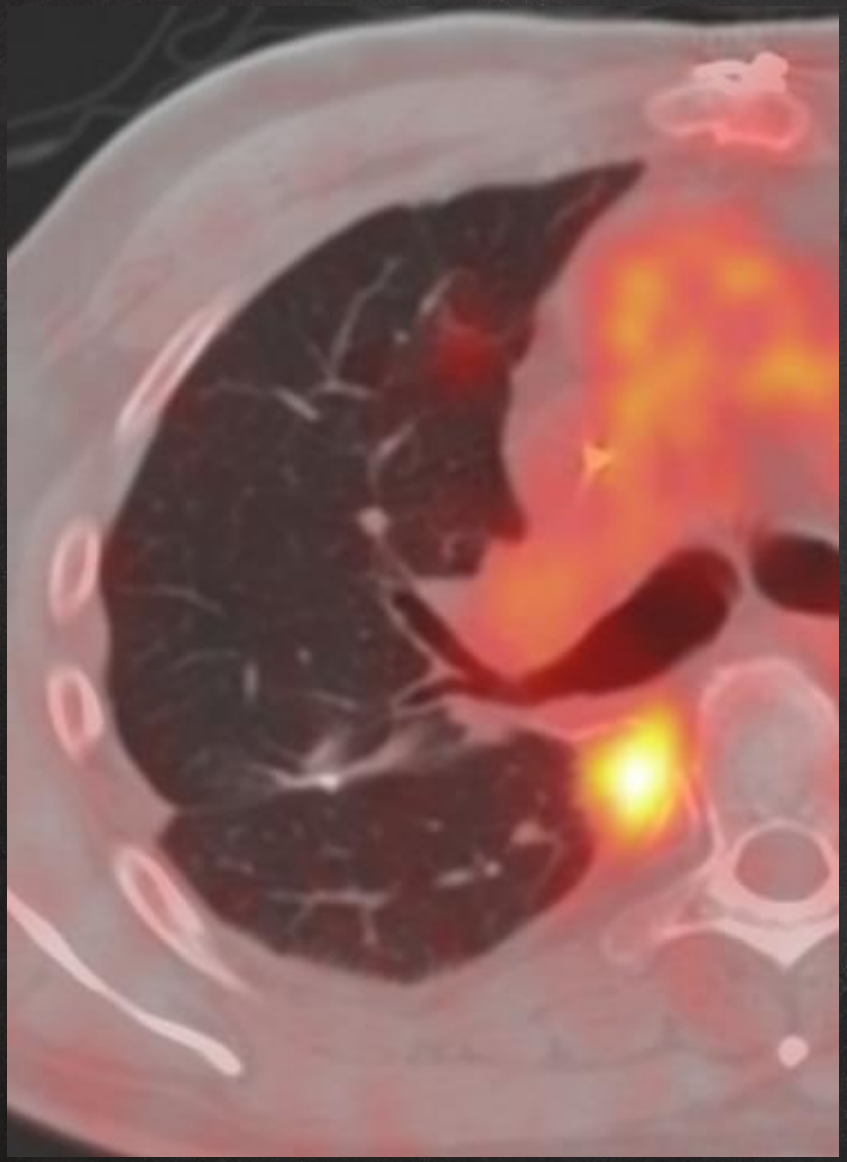

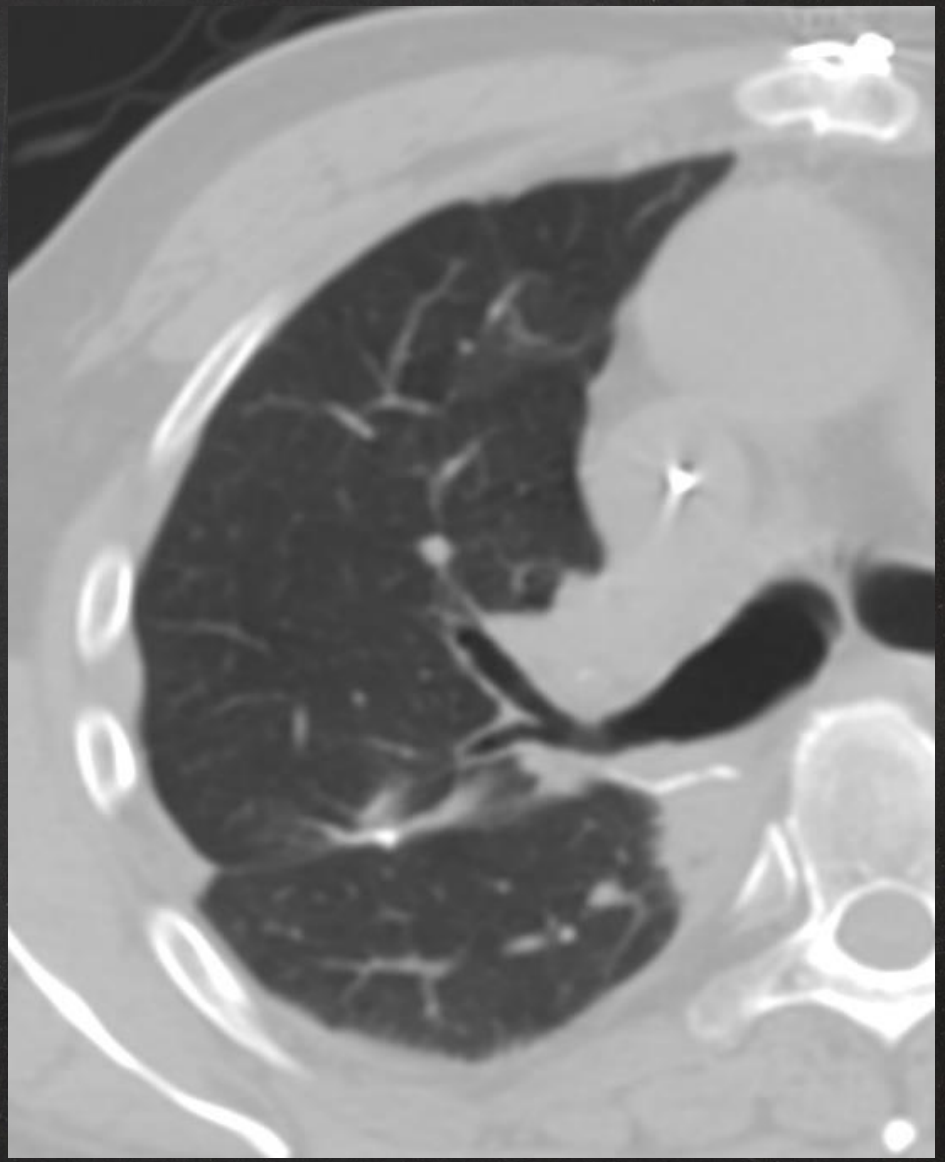

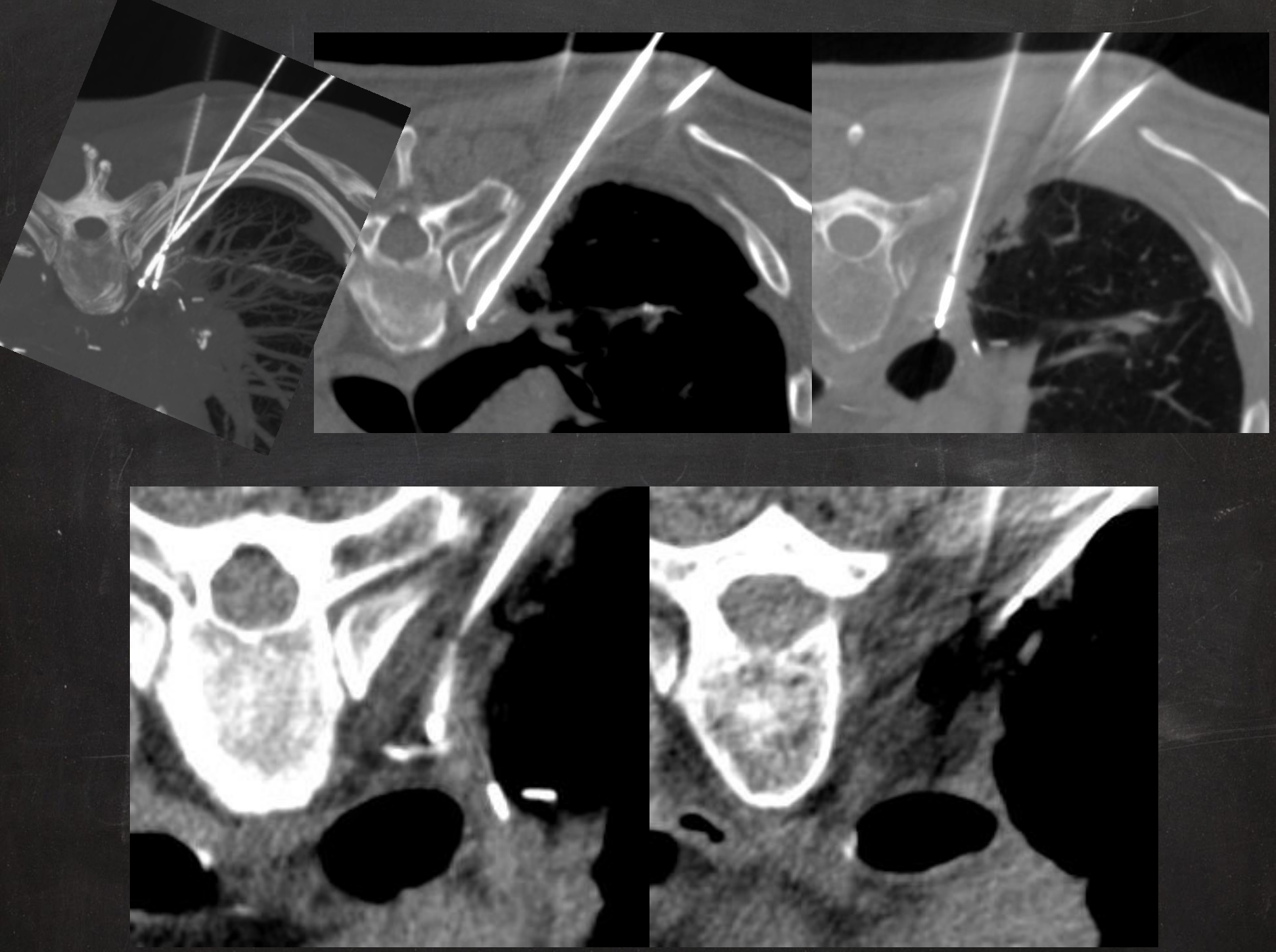

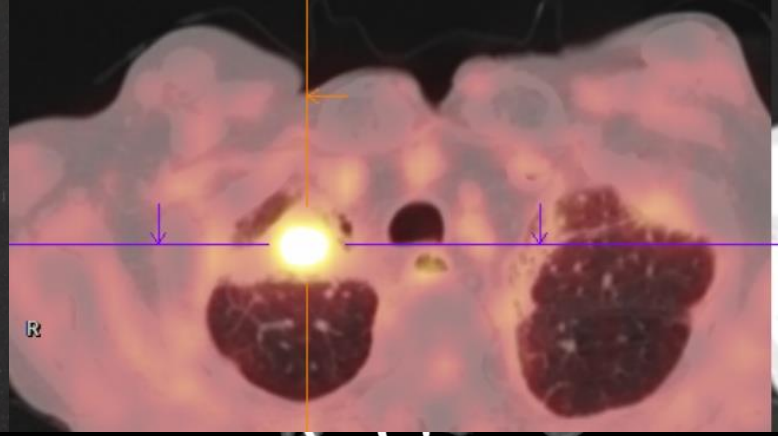
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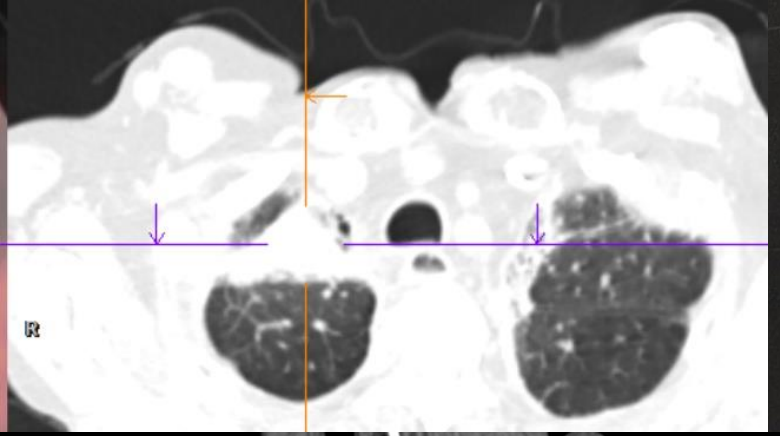
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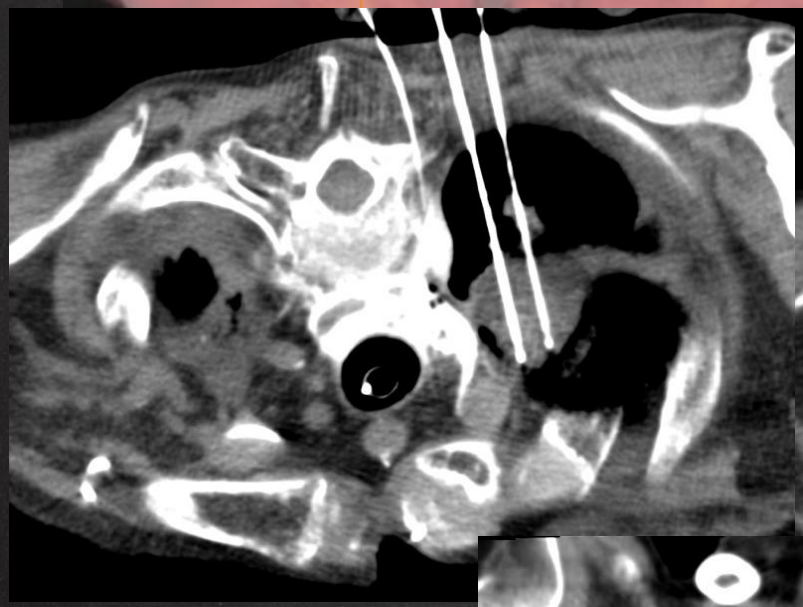
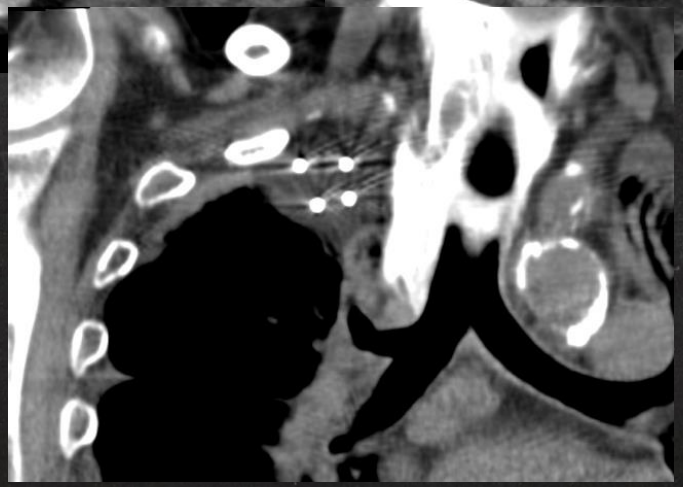




Résultats cryo

Percutaneous Cryoablation for the Treatment of Medically Inoperable Stage I Non-Small Cell Lung Cancer

Yoshikane Yamauchi[1], Yotaro Izumi[1]*, Kohei Hashimoto[1], Hideki Yashiro[2], Masanori Inoue[2], Seishi Nakatsuka[2], Taichiro Goto[1], Masaki Anraku[1], Takashi Ohtsuka[1], Mitsutomo Kohno[1], Masafumi Kawamura[3], Hiroaki Nomori[1]

1 Department of Surgery, School of Medicine, Keio University, Tokyo, Japan, **2** Department of Diagnostic Radiology, School of Medicine, Keio University, Tokyo, Japan, **3** Department of Surgery, Teikyo University School of Medicine, Tokyo, Japan

160 patients

Local tumor progression was observed in one tumor (3%).

The overall 2- and 3-year survivals were 88% and 88%, respectively. Median overall survival was 68 months.

The disease-free 2- and 3-year survivals were 78% and 67%, respectively.

Pulmonary function tests were done in 16 patients (18 treatments) before and after cryoablation. Percentage of predicted vital capacity, and percentage of predicted forced expiratory volume in 1 second, did not differ significantly before and after cryoablation.

Radiologie interventionnelle

vs.

Radiothérapie

Avantages de la Rx interventionnelle vs SBRT:

- 1 session de traitement
- Biopsie faisable dans le même temps opératoire
- Plusieurs lésions traitables dans le même temps
- Possibilité de retraiter autant de fois qu’on veut en théorie
- Accessibilité

Inconvénients de la Rx interventionnelle vs SBRT:

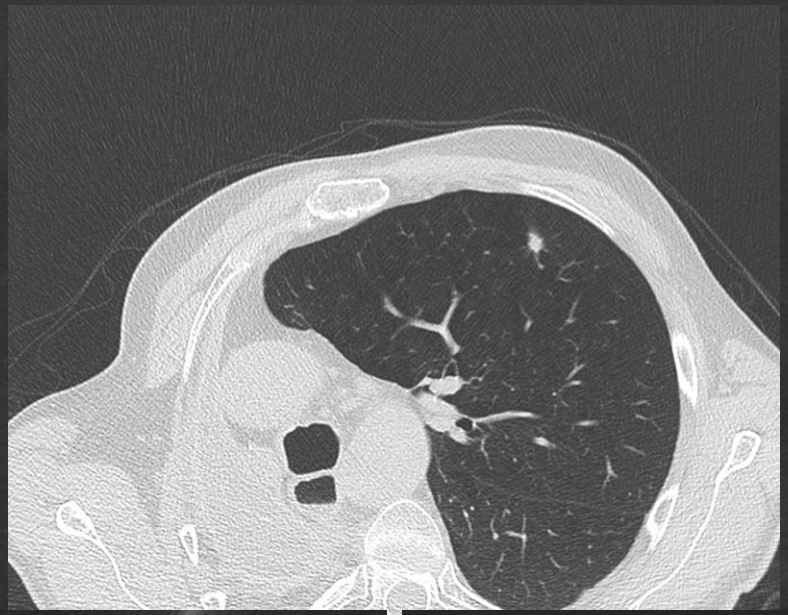
- Plus invasif (anesthésie, ponction pulmonaire)
- Plus douloureux
- Mauvais efficacité en cas de T > 3cm et/ou proche de vx > 3mm

Pas de réponse claire dans la littérature:

- Aucune étude prospective randomisée
- Guidelines des sociétés savantes:

SBRT > RFA > radiothérapie « classique »

- Quid des résultats avec micro-ondes ou cryo?



Et si la réponse était:

RX interventionnelle +

Radiothérapie?

Clare Horkan, MB, BCh
Kshitij Dalal, MD
Jeffrey A. Coderre, PhD
Jingli Liu Kiger, MS
Damian E. Dupuy, MD
Sabina Signoretti, MD
Elkan F. Halpern, MD
S. Nahum Goldberg, MD

Published online before print
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Reduced Tumor Growth with Combined Radiofrequency Ablation and Radiation Therapy in a Rat Breast Tumor Model[1]

CHEST

Original Research

LUNG CANCER

Radiofrequency Ablation Followed by Conventional Radiotherapy for Medically Inoperable Stage I Non-small Cell Lung Cancer*

Damian E. Dupuy, MD; Thomas DiPetrillo, MD; Sachin Gandhi, MD; Neal Ready, MD; Thomas Ng, MD; Walter Donat, MD; and William W. Mayo-Smith, MD

chirurgien

chirurgien

pneumologue


chirurgien
pneumologue
radiothérapeute


chirurgien
radiologue interventionnel
pneumologue
radiothérapeute

CONCLUSION