DES de Radiodiagnostic – 10/01/2020

# Techniques modernes de guidage en RI

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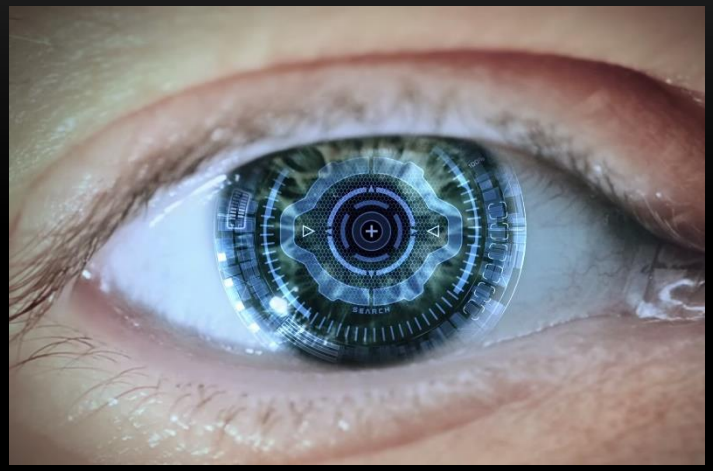
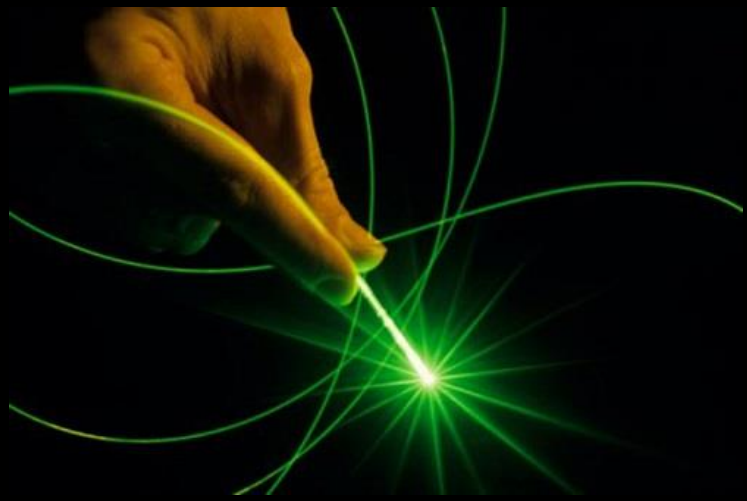
# Techniques modernes de guidage en RI ?

- RX
- CT +/- robot ?
- **US +/- contraste, +/- fusion**
- **C-arm Cone Beam CT (CBCT)**
- IRM





# GUIDAGE: RX

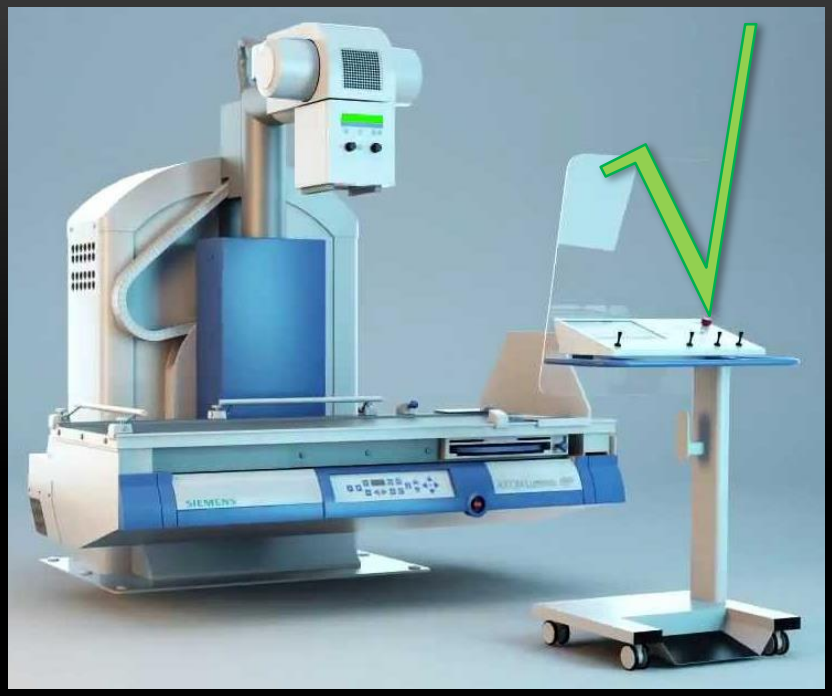
- Avantages
  - Accès facile
  - Large champs de vision
  - Temps réel
  - **Opacification**

- Inconvénients
  - Pas (peu) de visibilité des organes pleins et des tissus mous !
  - 2D
  - Irradiation +

- Indications

  Ostéo-articulaire *--> Cf. Cours dédiés*

??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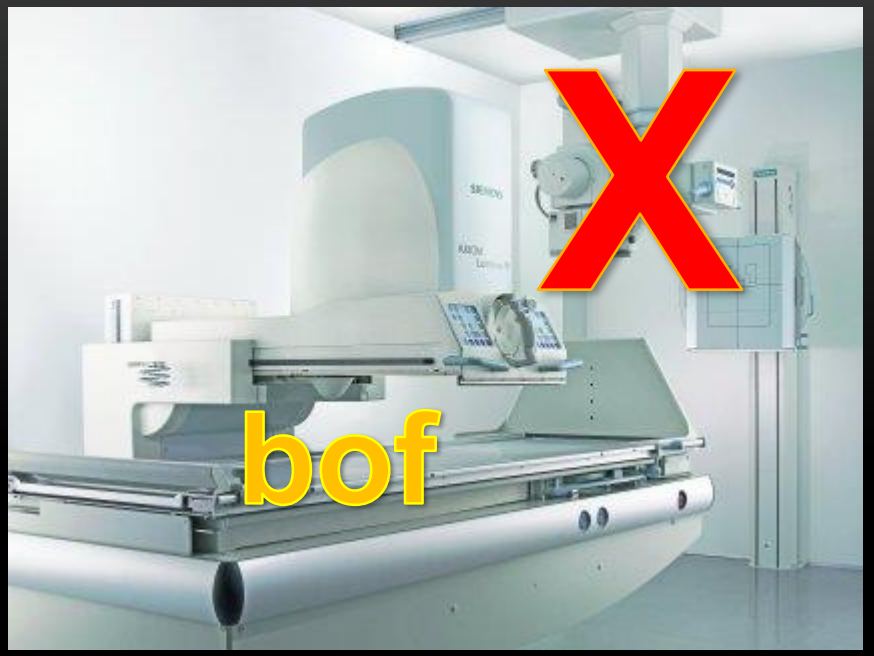
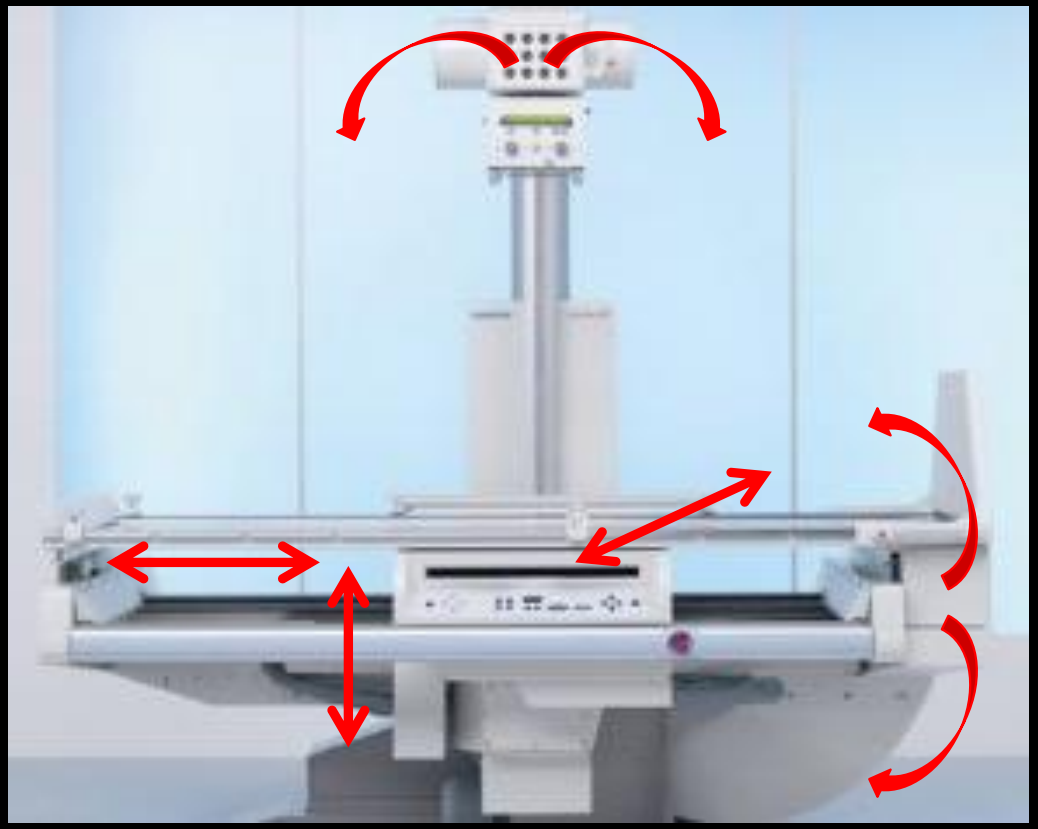

X
bof


X


√

- Avantages
  - Combinaison table + tube/capteur
  - Scopie +/- Graphie (capteur plan)
  - Table et tube mobile

- Inconvénients
  - Radioprotection sub-optimale
  - Mobilité << C-arm



(*Siemens* Axiom Luminos)

# Exemple: Arthrographie

# GUIDAGE: CT

- Avantages
  - 2D/3D, **contrôle topographique très précis**
  - Résolution en contraste satisfaisante (tissus mous) +/- contraste IV

- Inconvénients
  - Limites du plan de coupe axial + diamètre gantry
  - « Coup par coup » ... *sauf Fluoro-CT*
  - Irradiation +++ ... *surtout Fluoro-CT !*
  - ... résolution en contraste pas toujours suffisante (biopsie, tumorectomie) ... améliorée par PdC IV
  - Disponibilité ?

- Indications: très larges → **Thorax**, Ostéo-articulaire, Abdomen

# GUIDAGE: CT

- Mode de visualisation en « coups par coups », selon largeur totale des rangées de détecteurs:
  - 1 coupe
  - 3 coupes « pieds » / centre / « tête » — le + fréquent
  - Volume (séquentiel)

Exemple : 64 barrettes, 4cm de couverture en 1 spire (séquentiel)

- 1 coupe: en général visibilité limitée à 10mm (sinon volume partiel ++)
- 3 coupes: min 3 x 1mm – max 3 x 13,3mm (le plus souvent: 3x3mm ou 3x8mm)
- Volume: 40 coupes de 1mm, 13 coupes de 3mm…

- Pédale d'acquisition et moniteur de visualisation en salle
- Equipement de monitoring patient (TA, FC, saturation $O_2$) + $O_2$
- Gestion des complications à anticiper !!

Moniteurs en salle

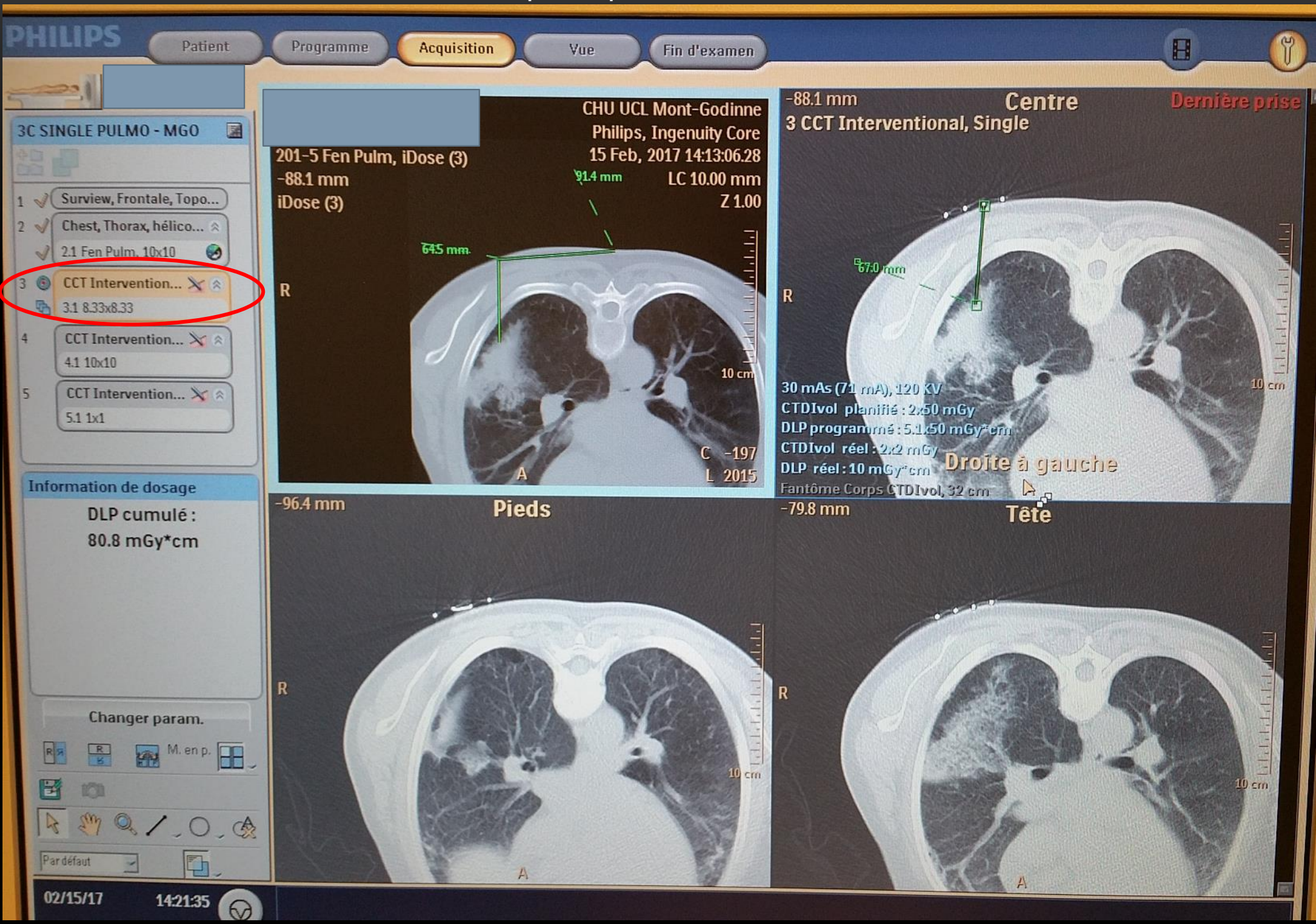

Laser à angles

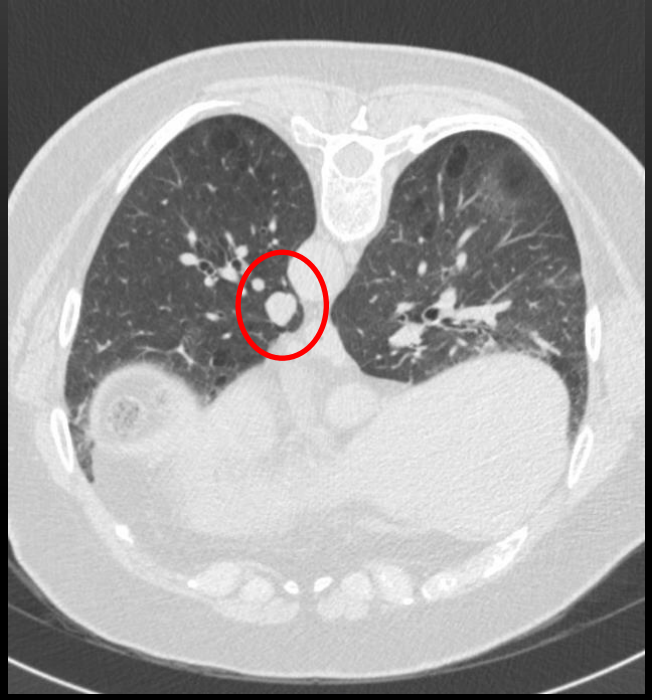
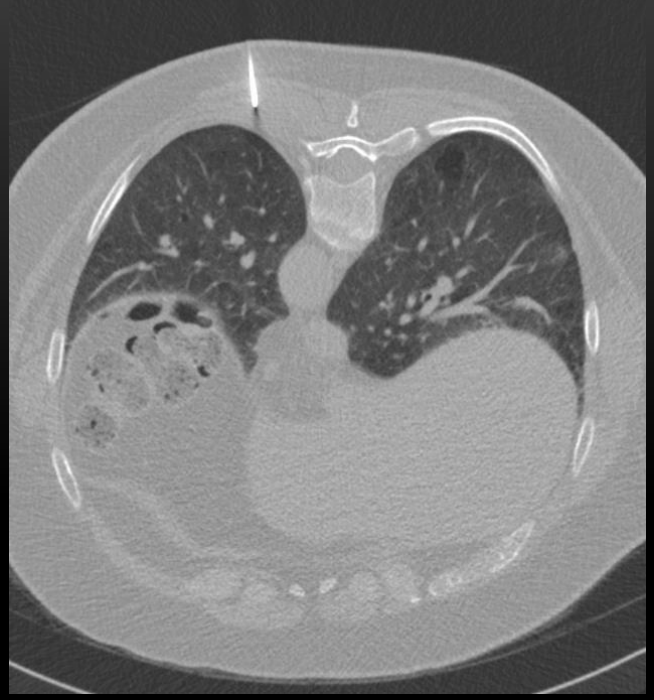
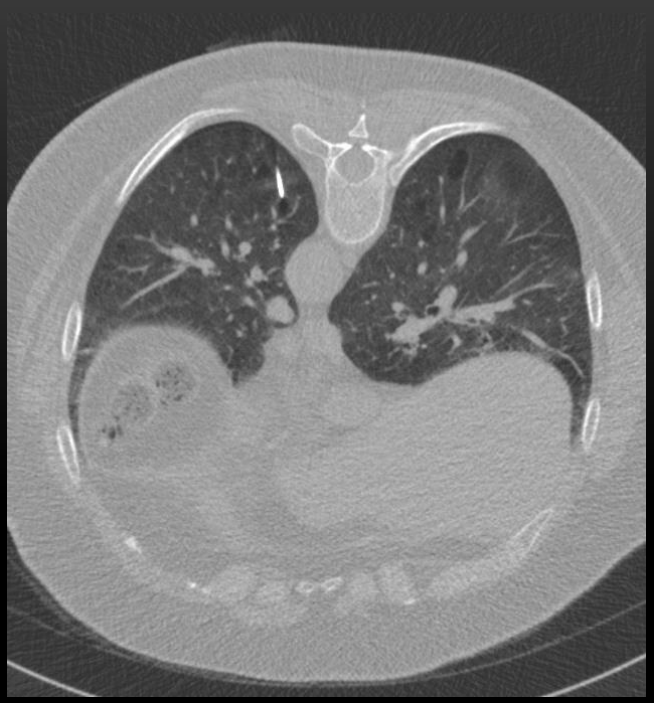
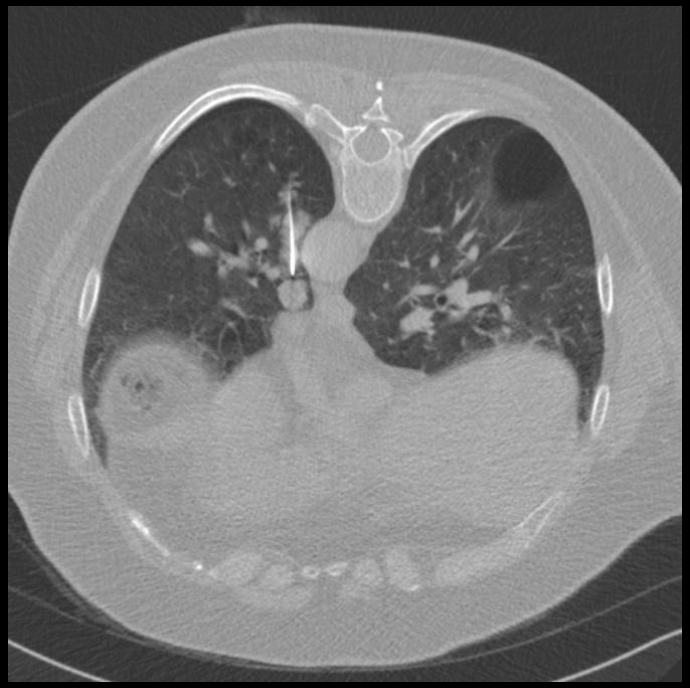
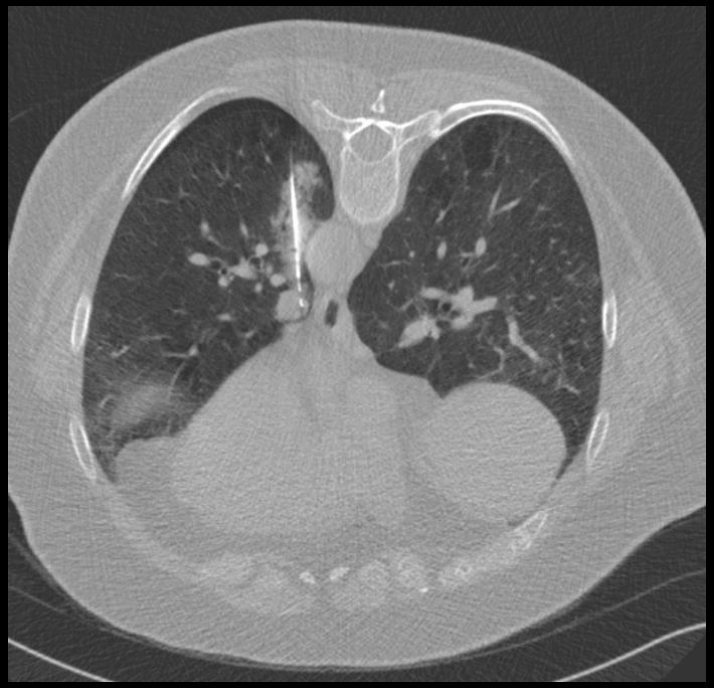
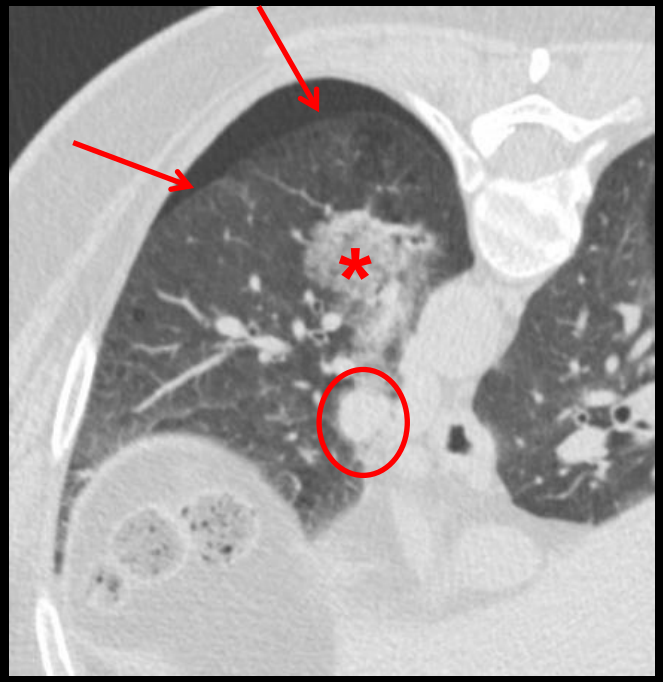
Monitoring patient
(côté tête patient) →

Pédale

+/- commandes de table

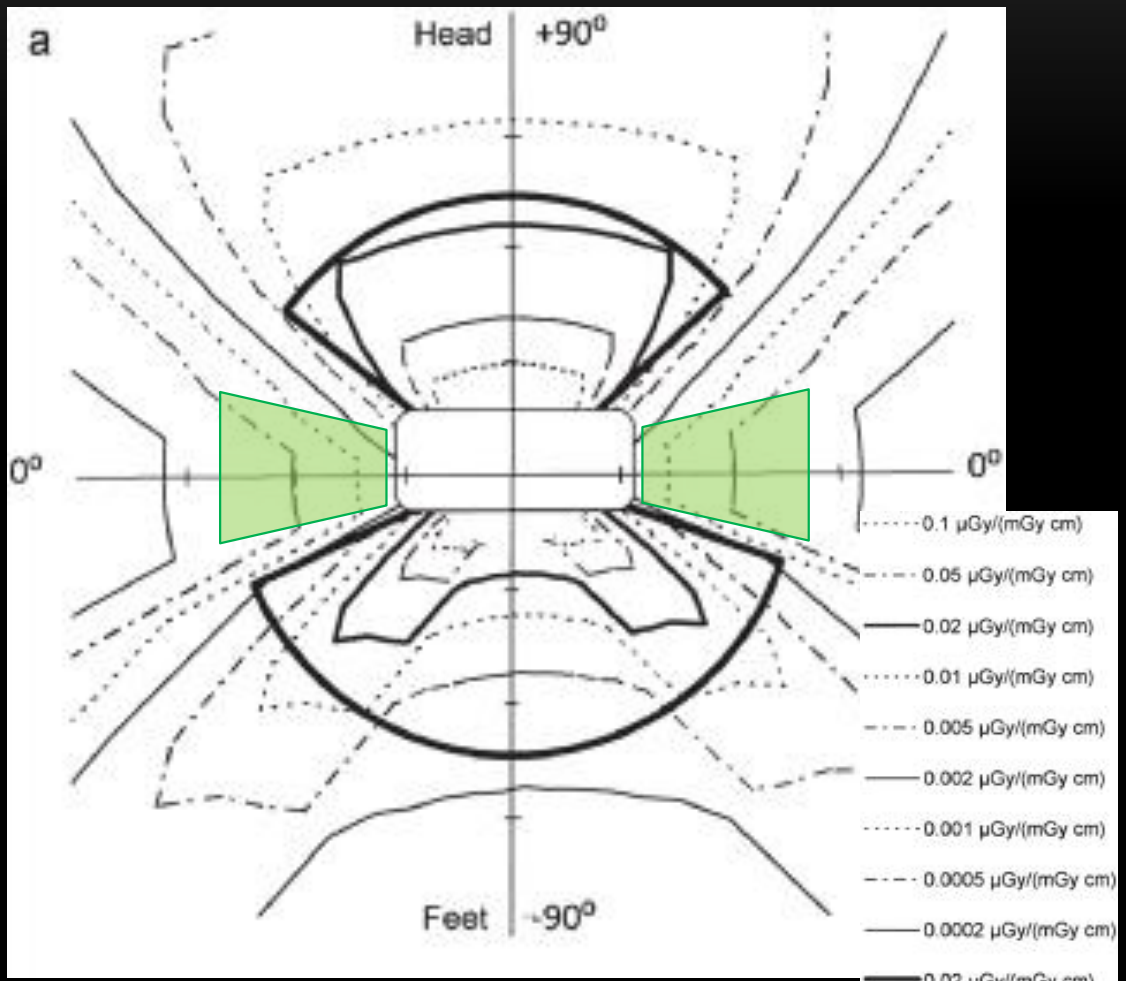
# 3 coupes « pieds » / centre / « tête »



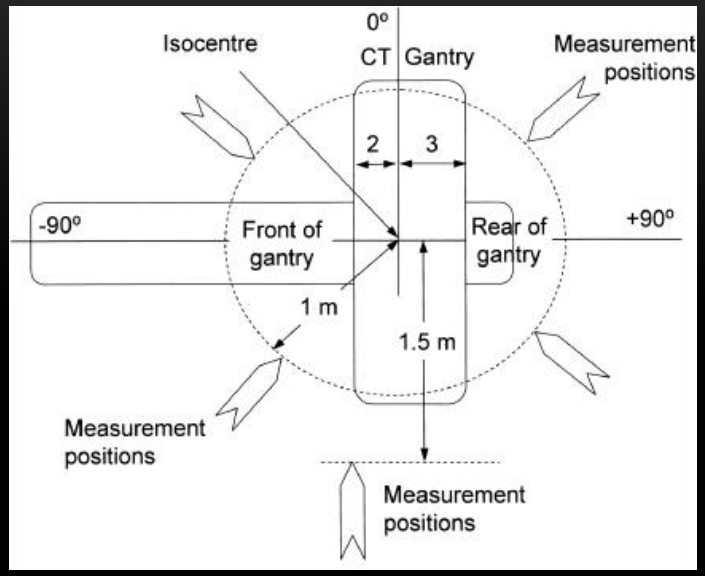
**Fluro-CT** *! Irradiation +++*

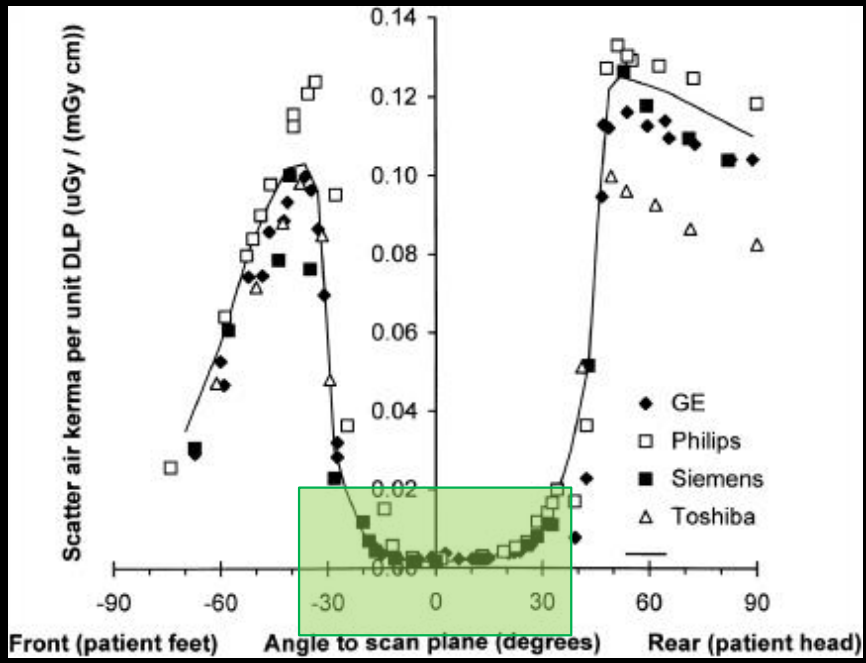
# GUIDAGE: CT - RADIOPROTECTION









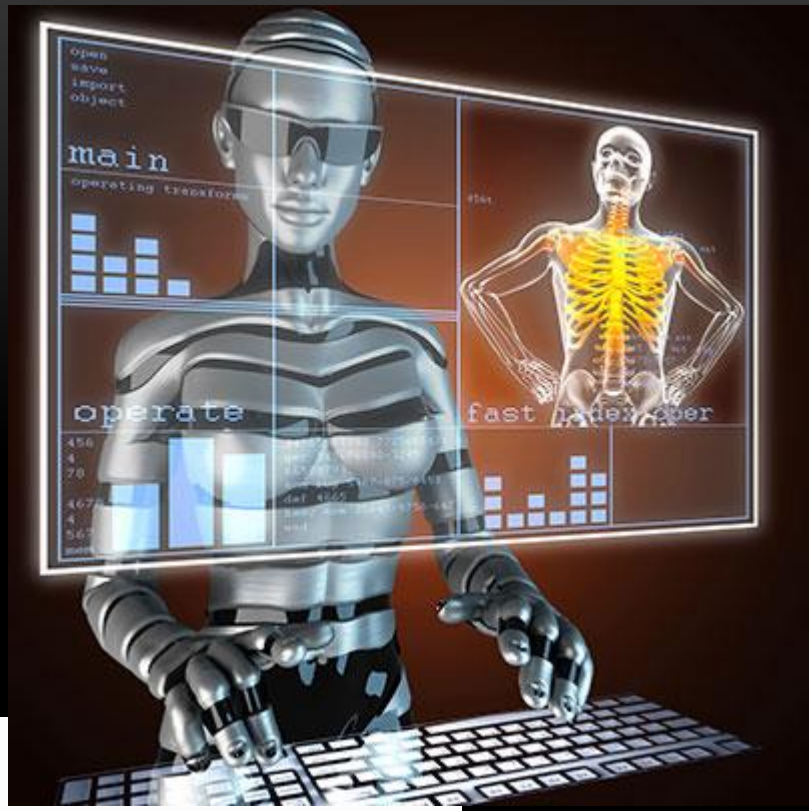




**Establishment of scatter factors for use in shielding calculations and risk assessment for computed tomography facilities**

H Wallace[1], C J Martin[1], D G Sutton[2], D Peet[3] and J R Williams[4]

Published 10 February 2012 • IOP Publishing Ltd
Journal of Radiological Protection, Volume 32, Number 1

# GUIDAGE: CT + ROBOT ?




RSNA 2014 Daily Bulletin
Wednesday, December 03, 2014

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Question of the Day
Why can't I use my other workstations to review mammograms?

## Robotic System for CT-guided Biopsies of Lung Lesions Shows Promise

*By Mike Bassett*

Robot-assisted CT-guided biopsy of lung lesions can be used safely and accurately, particularly compared to conventional CT-guided biopsy techniques, according to a study presented Tuesday.

While CT-guided lung biopsy has become the standard procedure for obtaining a diagnosis of pulmonary lesions that are suspicious for malignancy, the two ways in which this procedure is usually performed—the


Andrea Porfiri, M.D.

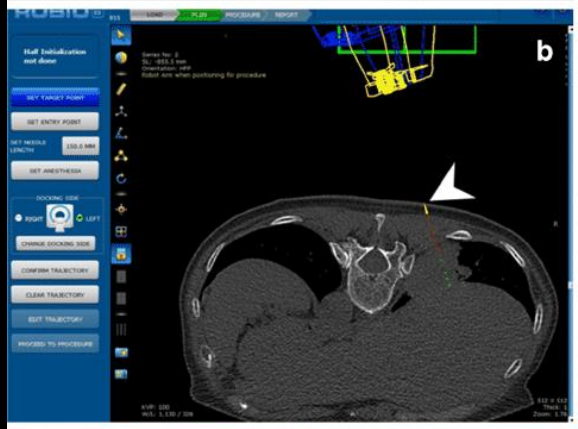


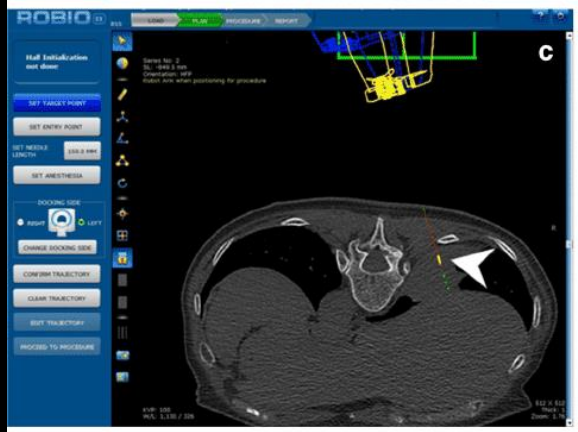
European Radiology
May 2015, Volume 25, Issue 5, pp 1310–1316

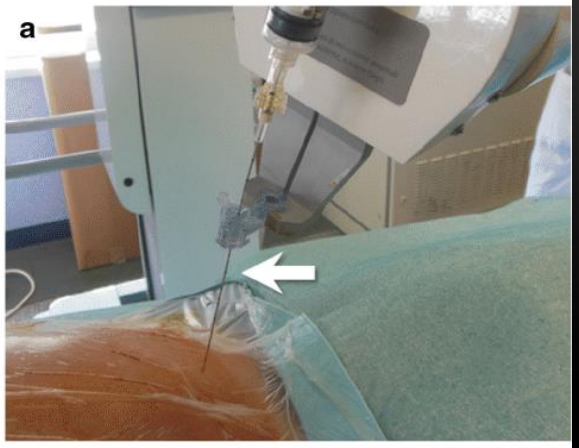
# Preliminary clinical experience with a dedicated interventional robotic system for CT-guided biopsies of lung lesions: a comparison with the conventional manual technique

Authors | Authors and affiliations

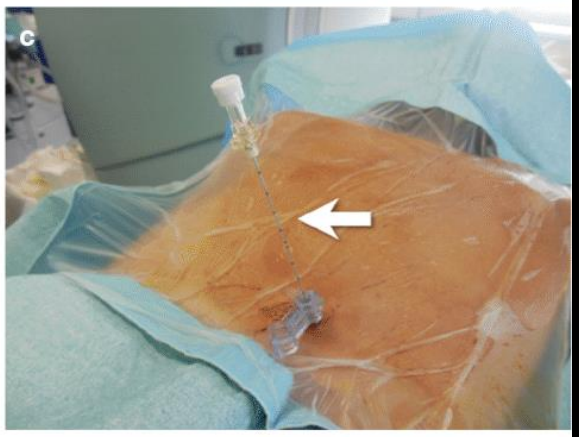
Michele Anzidei, Renato Argirò, Andrea Porfiri, Fabrizio Boni, Marco Anile, Fulvio Zaccagna, Domenico Vitolo, Luca Saba, Alessandro Napoli, Andrea Leonardi, Flavia Longo, Federico Venuta, Mario Bezzi, Carlo Catalano

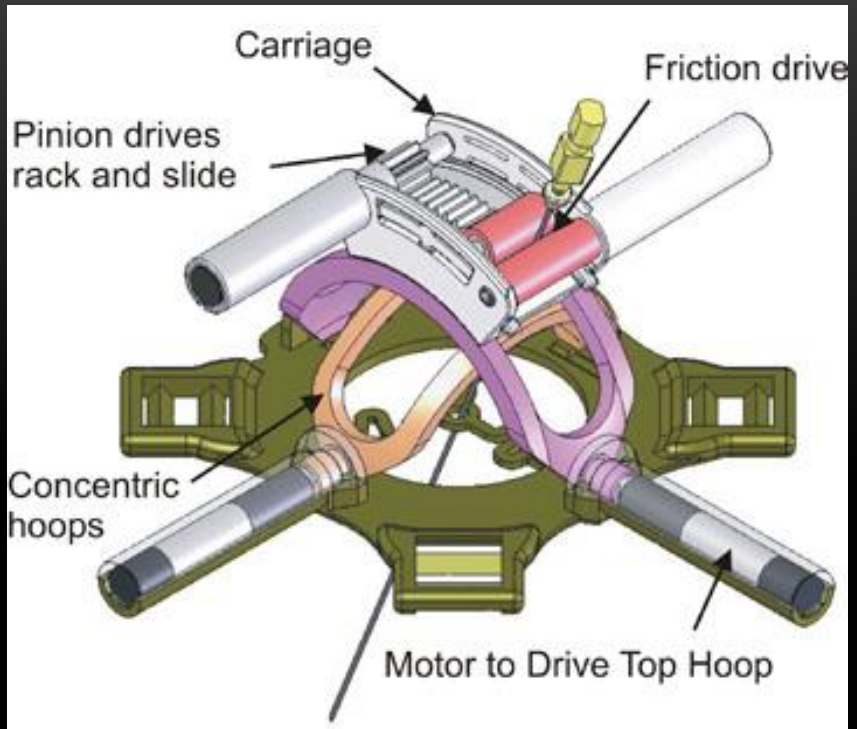



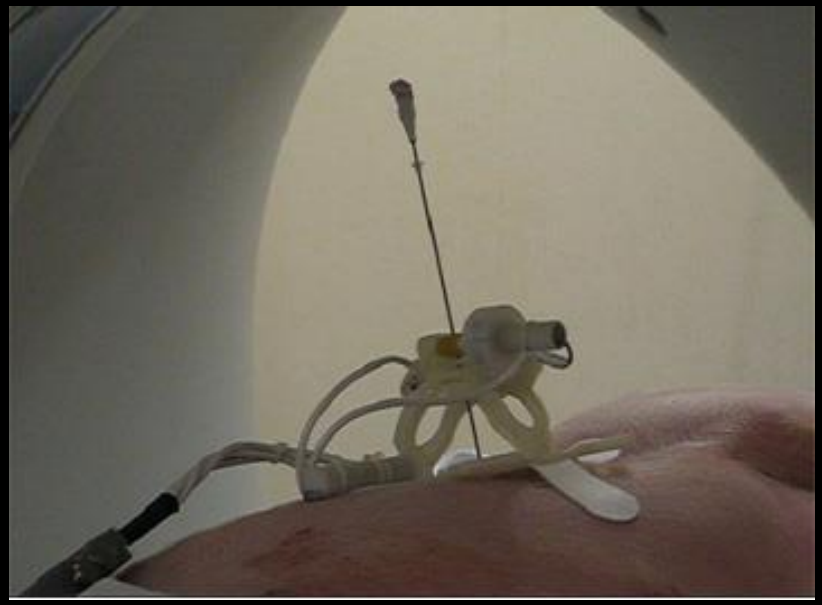








Robopsy robotic biopsy system consists of two hoops (tan and purple) set orthogonal to one another and revolving about their long axes. A carriage that rides atop the hoops encloses the needle (top). A pinion-driven roller (red, left) drives the needle against a passive roller (red, right), which rotates to drive the needle into the lesion.



# GUIDAGE: C-ARM +/- CONE-BEAM CT

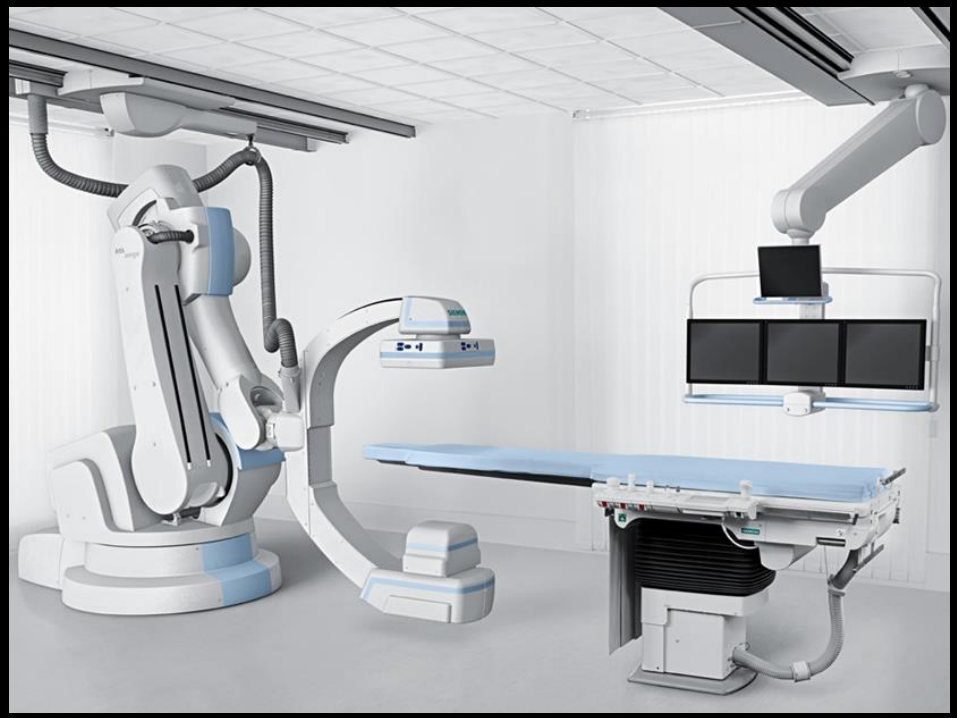
- Avantages
  - **Vasculaire: angio/phlébo avec soustraction !**
  - Large champ, mobilité/multi-plans, scopie temps réel, 3D
  - **CBCT: +/- idem CT** (plus faible résolution en contraste):
    - Analyse **MPR**, **Mesures** calibrées, **Fusion images** CT injecté, IRM, PetCT...
    - **Guidage abords percutanés**
    - **3D RoadMap, Analyse et Détection automatique des vaisseaux**

- Inconvénients
  - Irradiation ++
  - Disponibilité ?

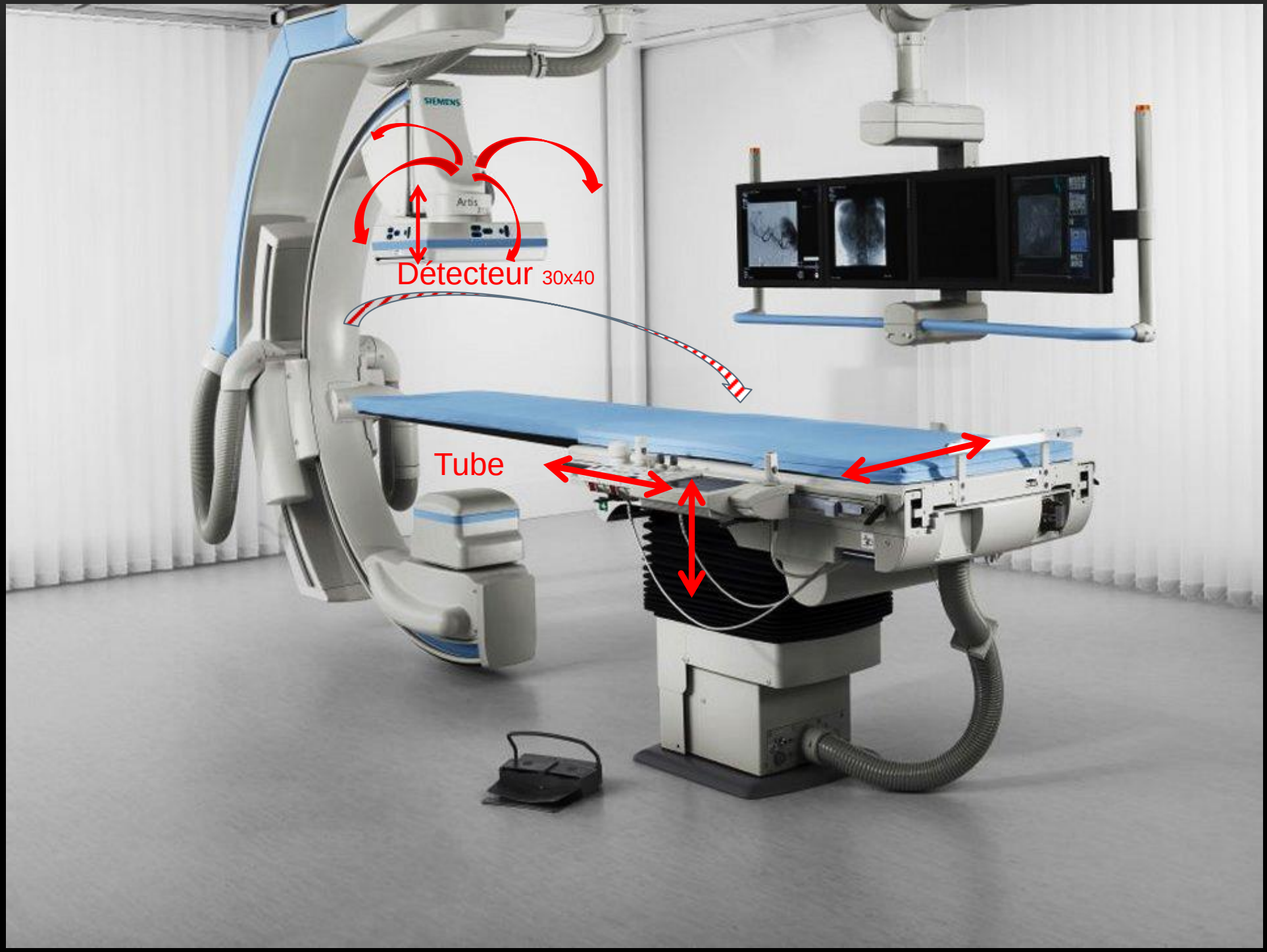
- Indications: ***larges***

  **VASCULAIRE**, Neuro, Ostéo-articulaire, Thorax, Abdomen

# C-arm – Radiologie interventionnelle



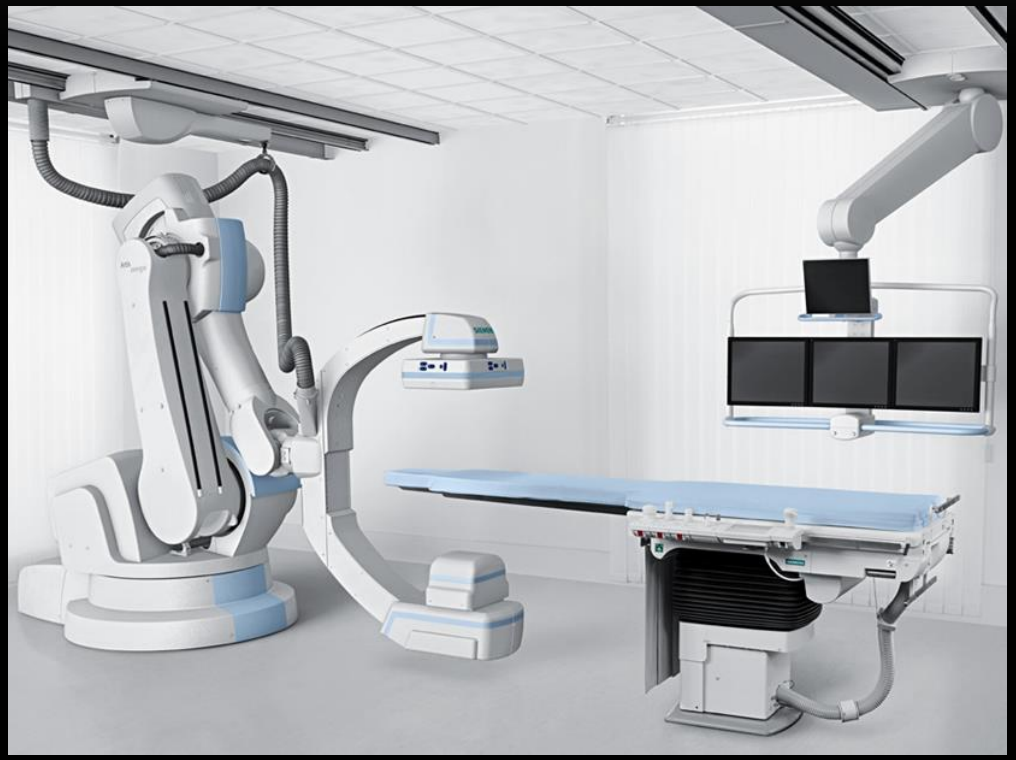
# C-ARM suspendu: +++ RxI



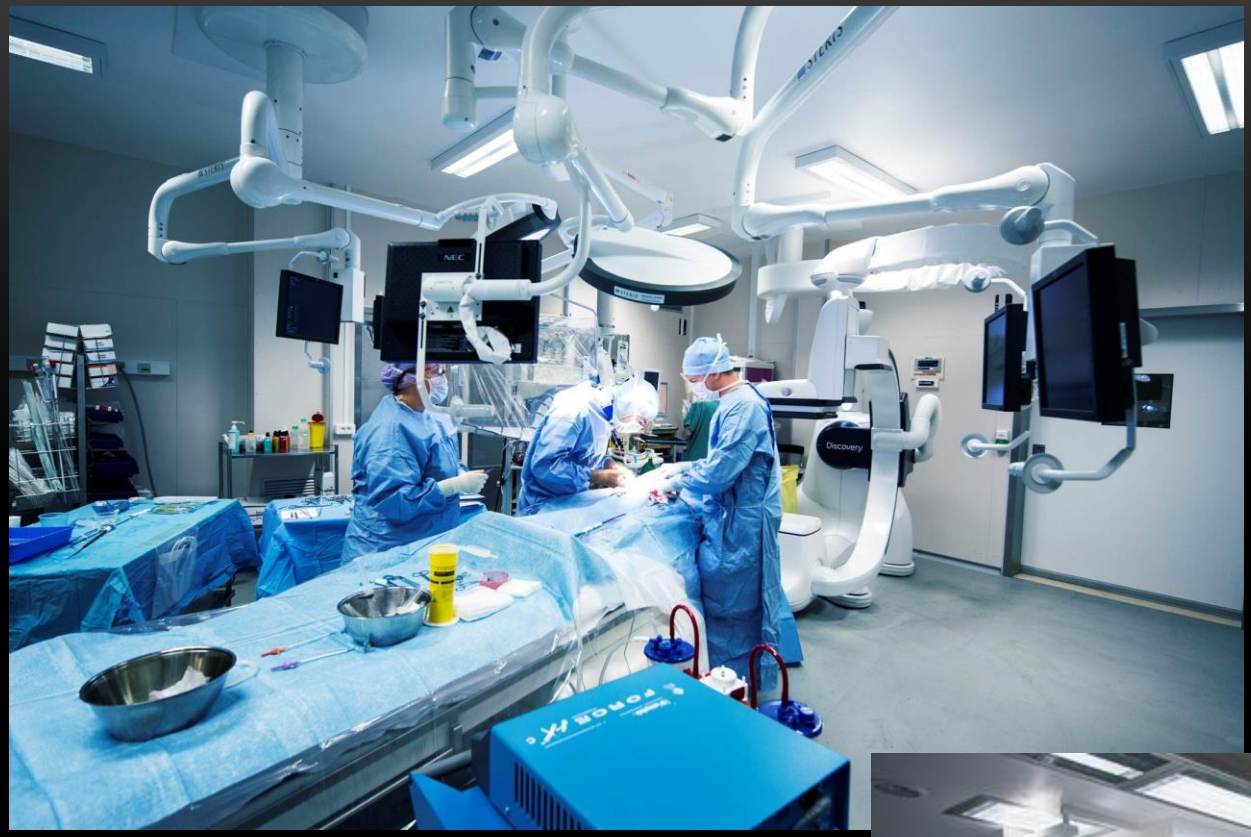
## **Salle hybride** = salle de RxI au bloc opératoire

Concept:  Mobilité +++ du C-arm pour ne pas gêner l'acte chirurgical lourd

(*GE* IGS 730)



(*Siemens* Zeego)

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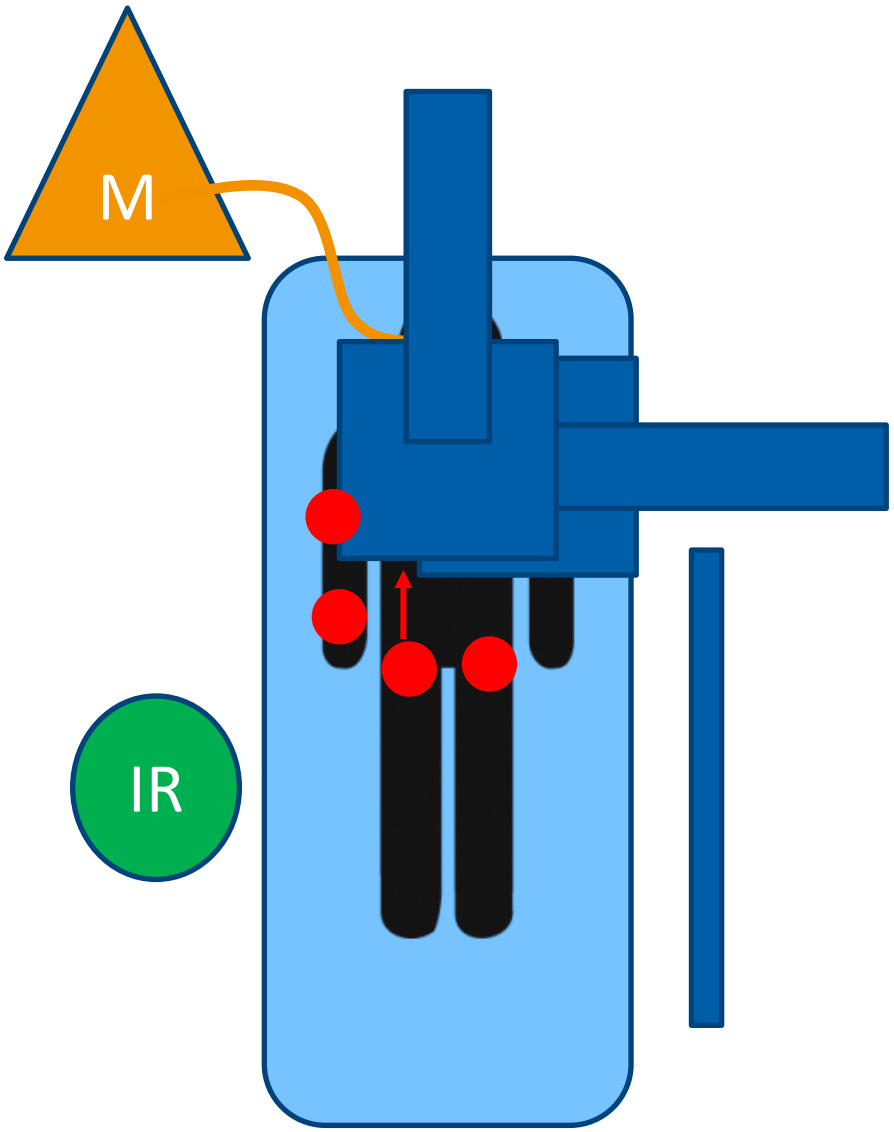
# C-ARM CBCT VS C-ARM + MDCT ?


Angio-CT Infinix-i 4D CT (MDCT Aquilion) – Canon®

# Vascular and percutaneous accesses in IR ?

***From the head to the toe !***



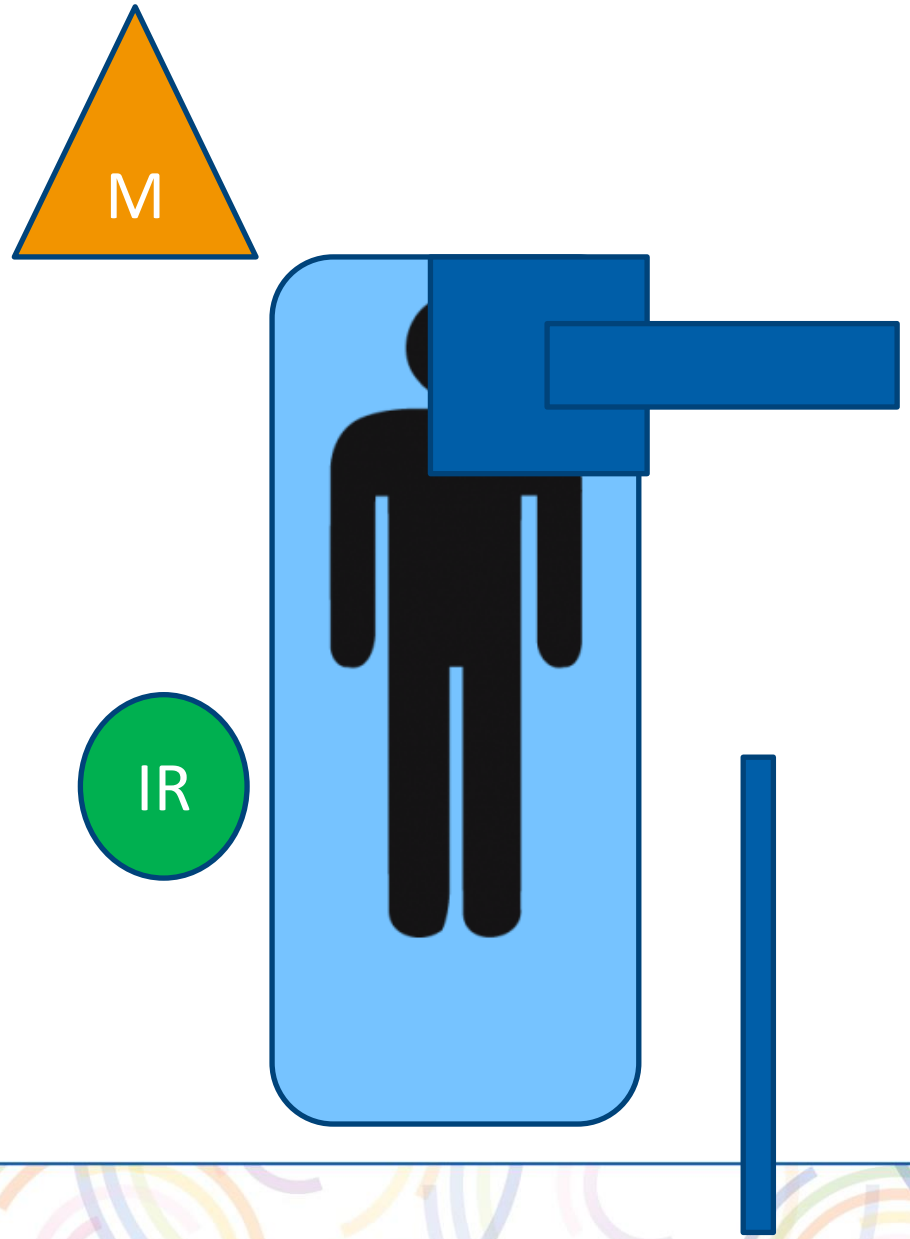

« Classical » configuration

- Femoral (A/V) retrograde access
- Right Radial or Humeral access

- Thorax/Abdomen percutaneous access
- Spinal access: patient flat on the stomach

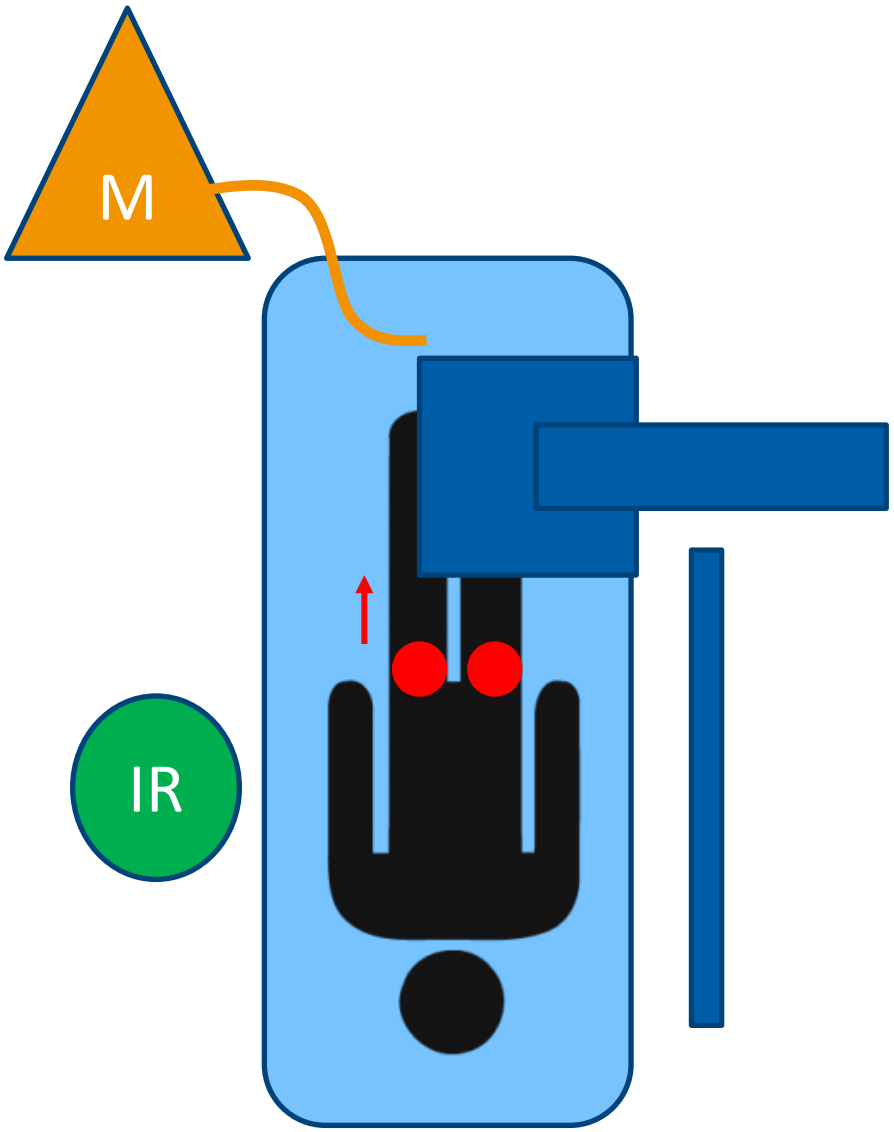
# Vascular and percutaneous accesses in IR ?

***From the head to the toe !***



# Vascular and percutaneous accesses in IR ?

***From the head to the toe !***

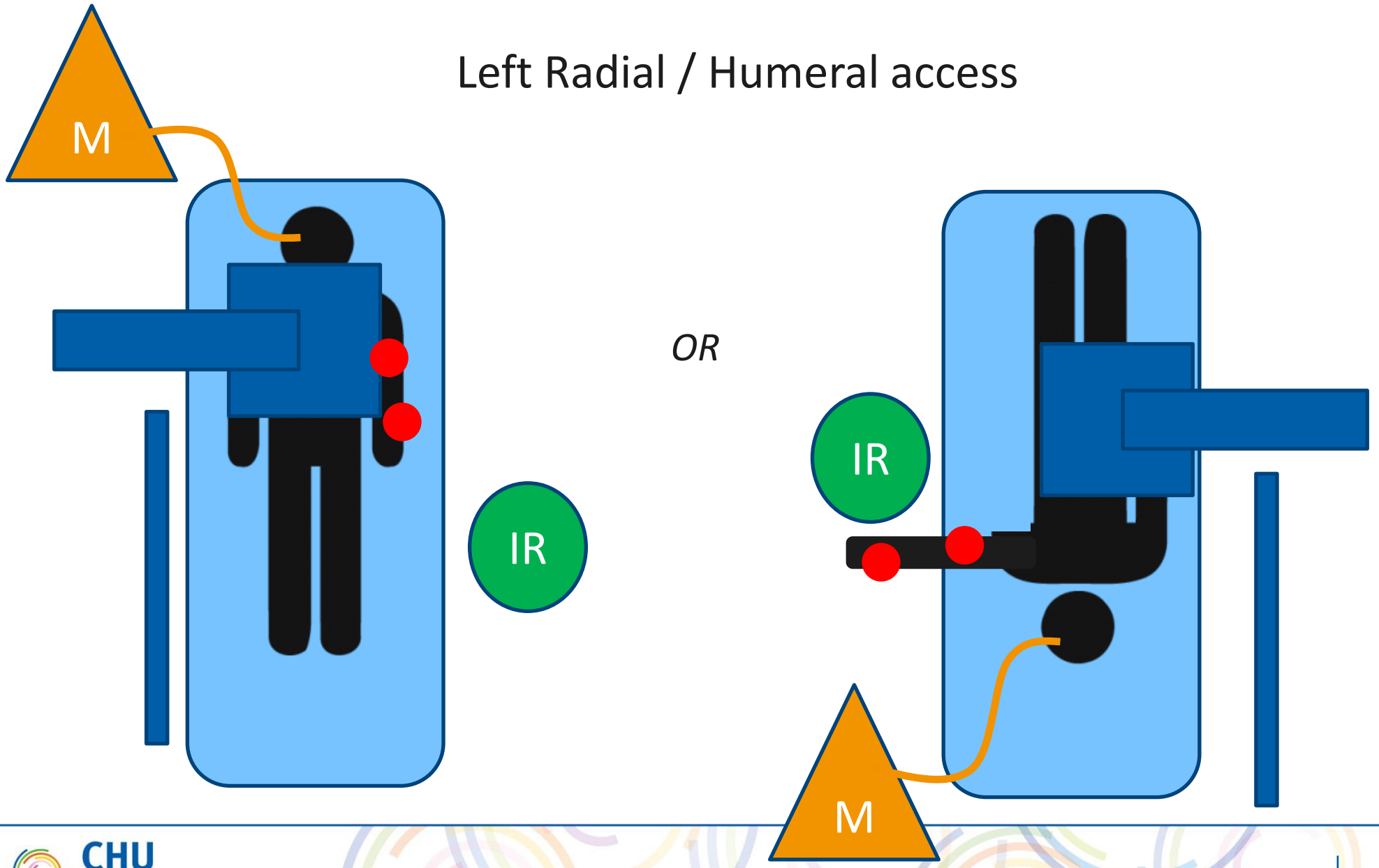



Femoral antegrade access

# Vascular and percutaneous accesses in IR ?

***From the head to the toe !***

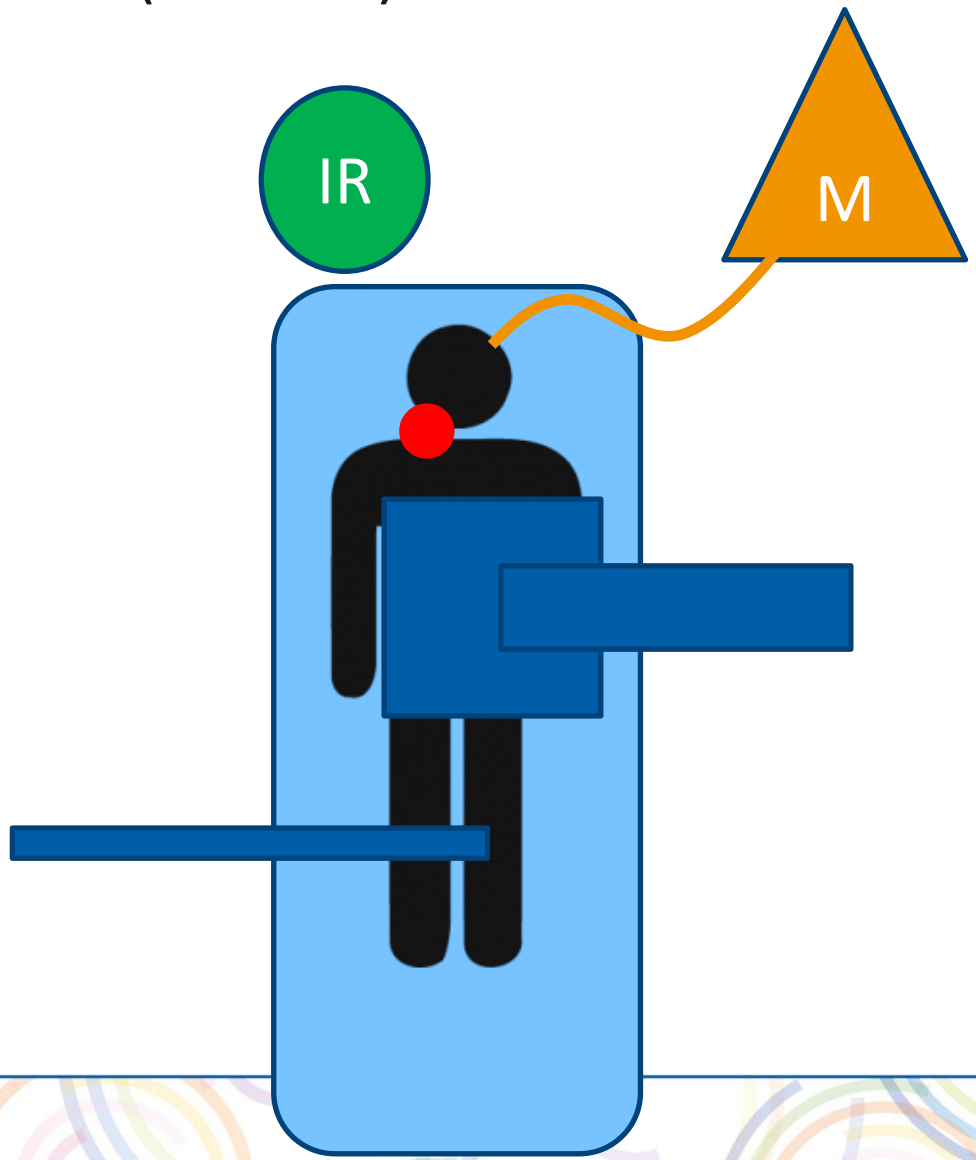
Left Radial / Humeral access



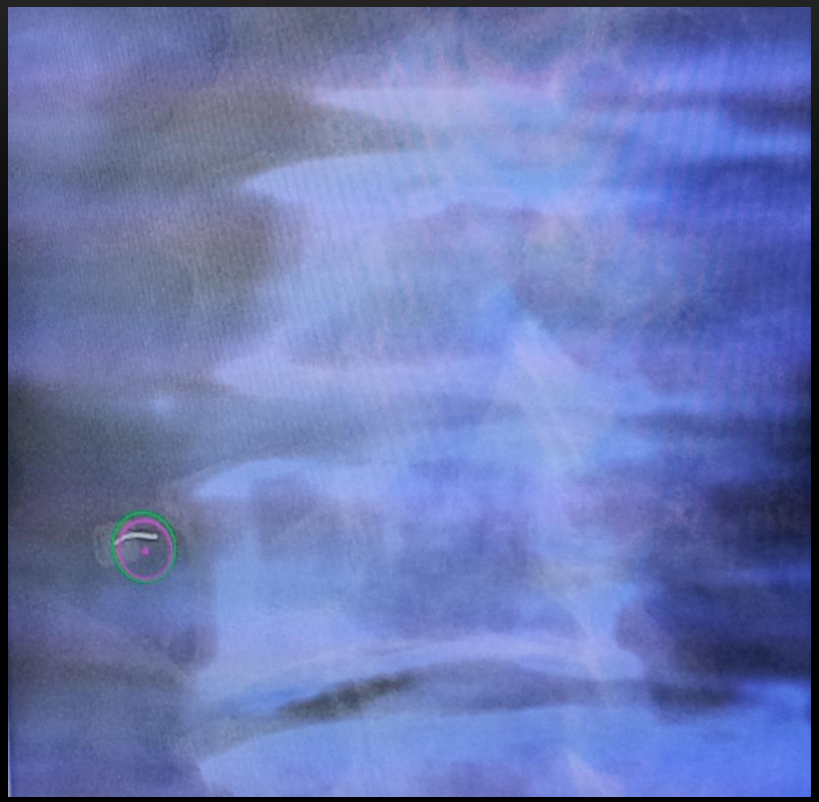
# Vascular and percutaneous accesses in IR ?

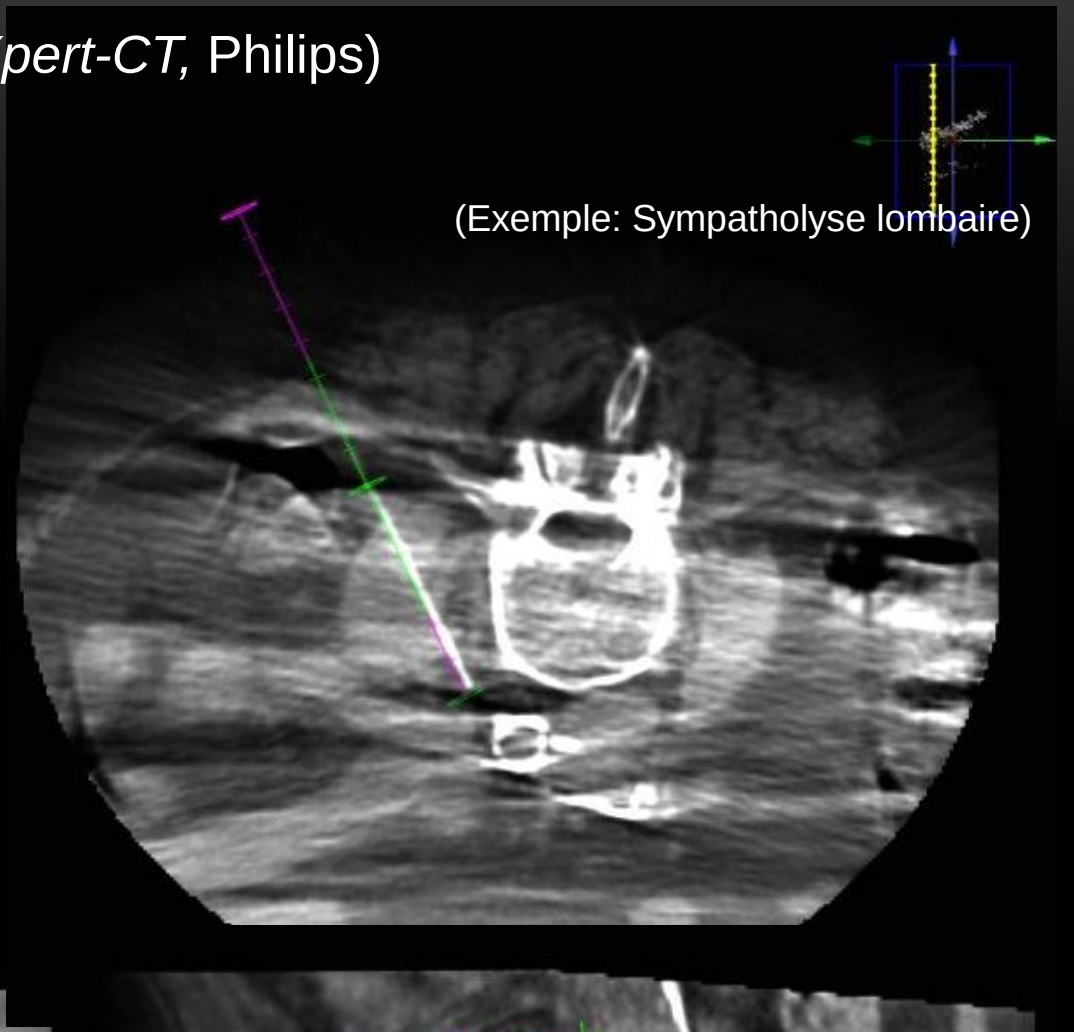
***From the head to the toe !***

Right jugular access (ex: TIPS)

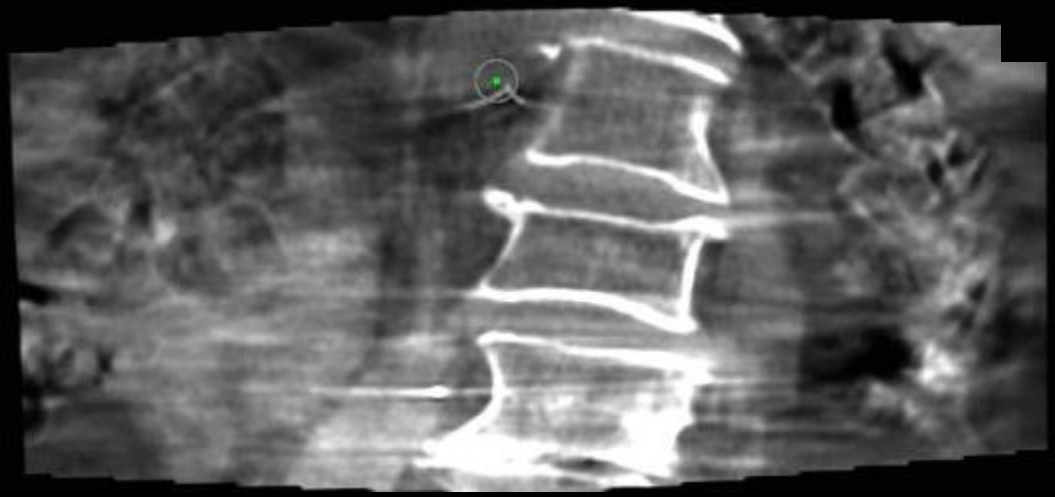


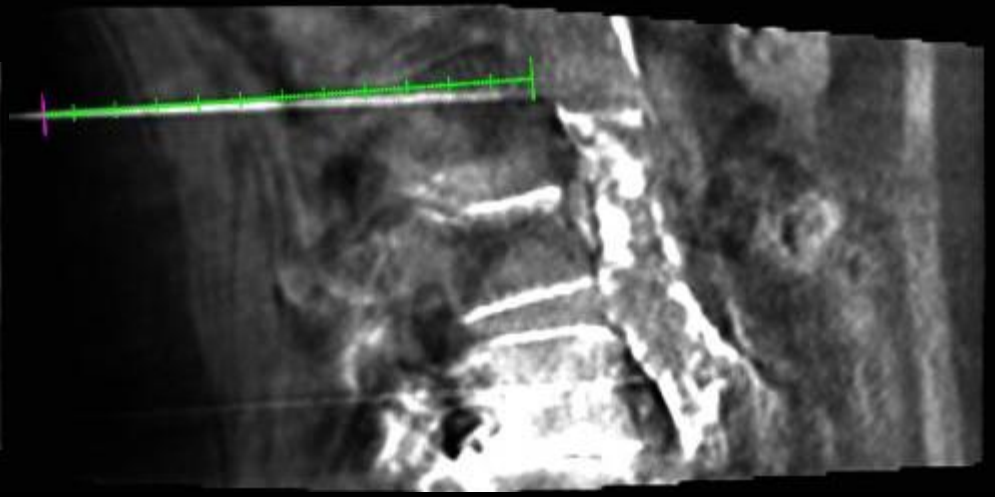
## 1- **Guidage abords percutanés** (ex: *Xpert-CT,* Philips)





(Exemple: Sympatholyse lombaire)

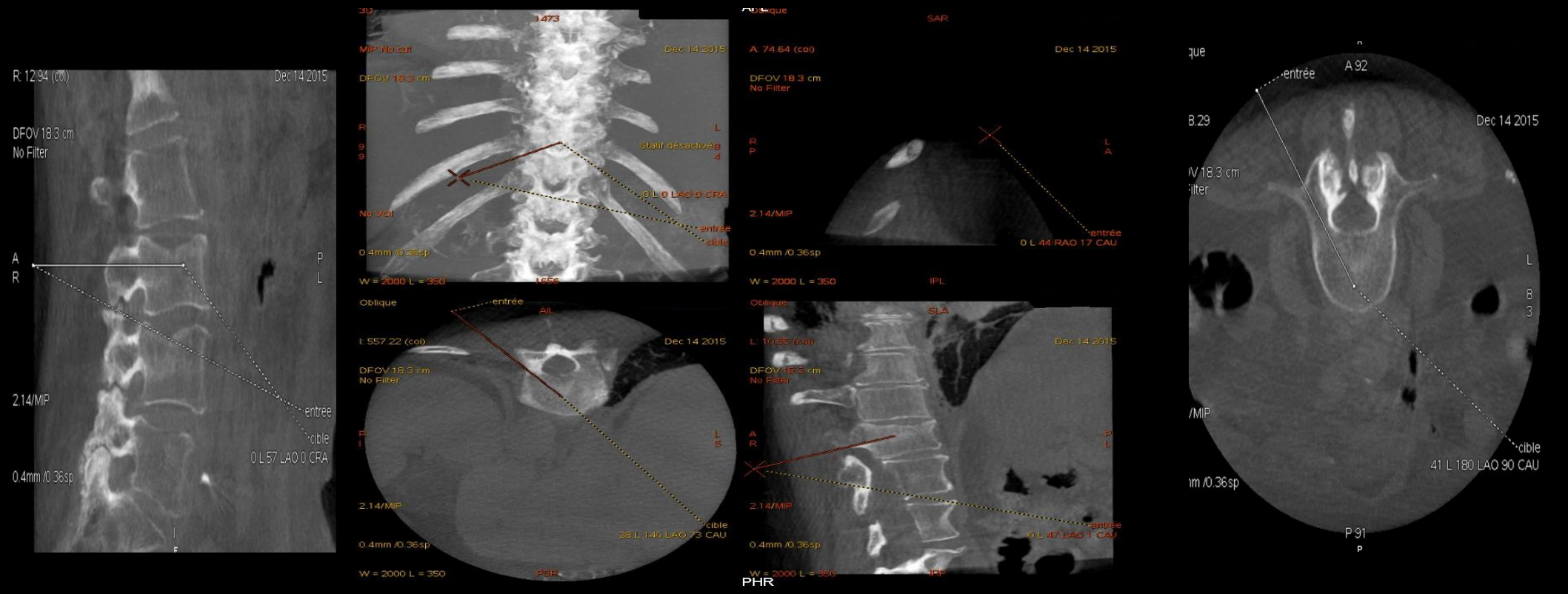




# PRINCIPE DE GUIDAGE PAR CBCT :

(Exemple: Vertébroplastie)

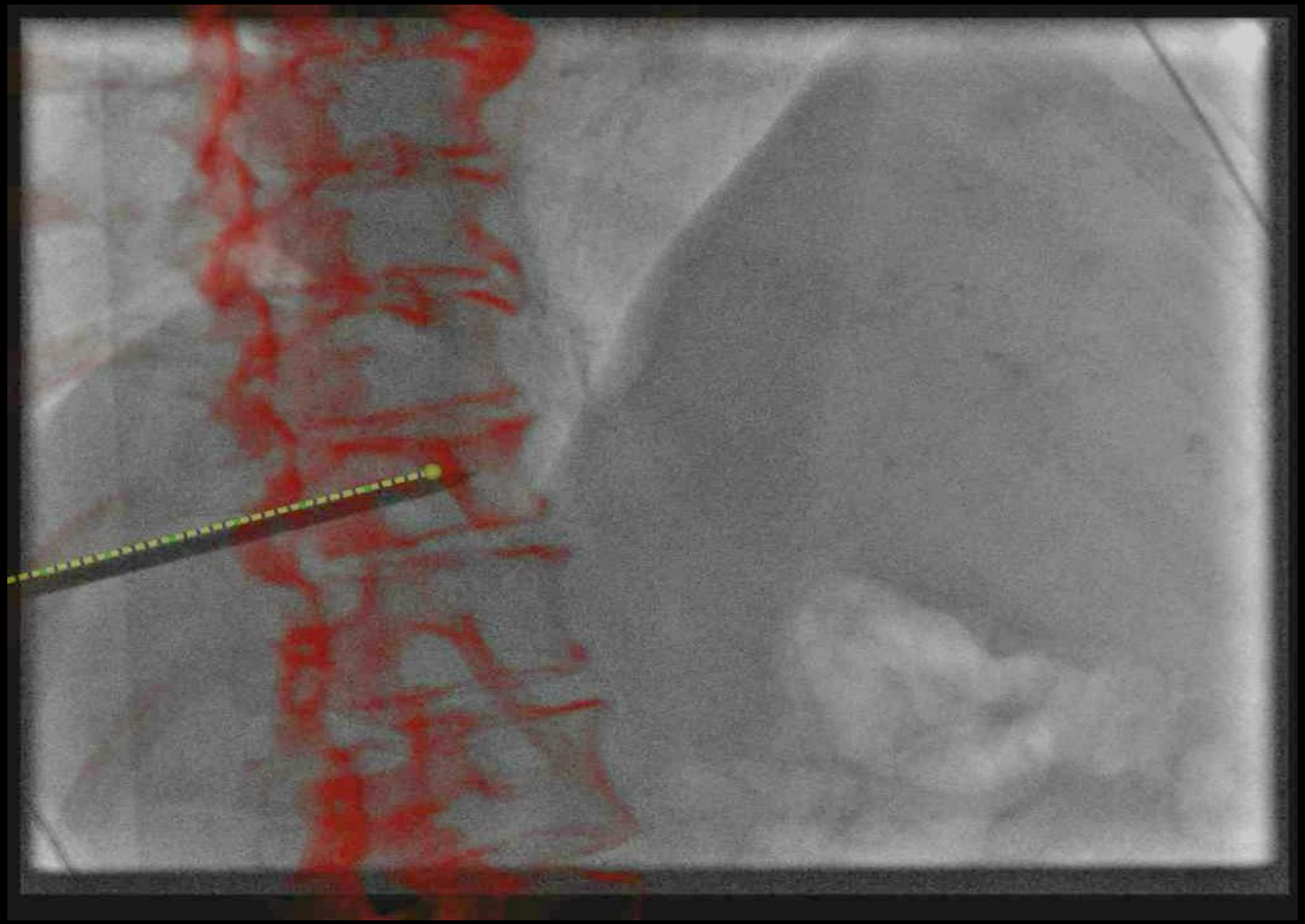
Première acquisition CBCT pour un repérage de la lésion et pour choisir la trajectoire la plus sûre pour l'intervention, dans les 3 plans



# PRINCIPE DE GUIDAGE PAR CBCT :

Superposition de la scopie en temps réel et du masque 3D issu du CBCT, ainsi que de la planification de la trajectoire

Deux possibilités de positionnement automatique de la scopie: en «entry point» et en «progress view»



# PRINCIPE DE GUIDAGE PAR CBCT :

Images CBCT avec l'aiguille en place

+/- Opacification visualisée par scopie en temps réel

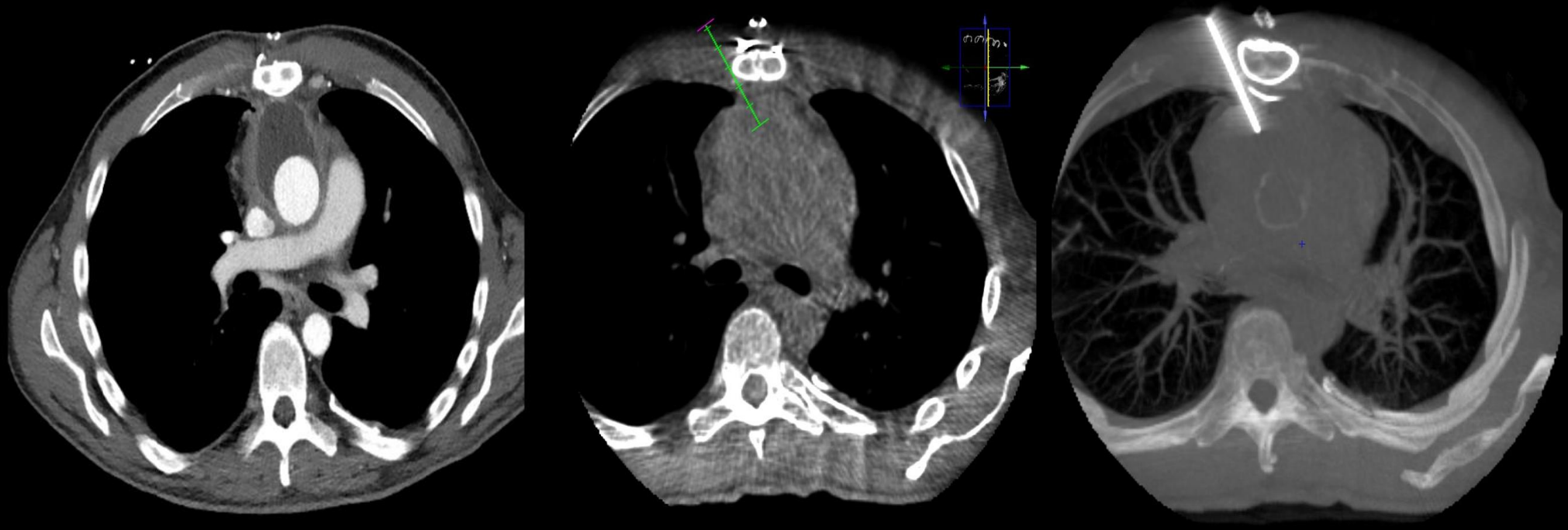
+/- Images CBCT en fin de procédure à visée diagnostique et médico-légale

# LES AVANTAGES DU CBCT:

→ **Couplage CBCT/ Fluoroscopie**

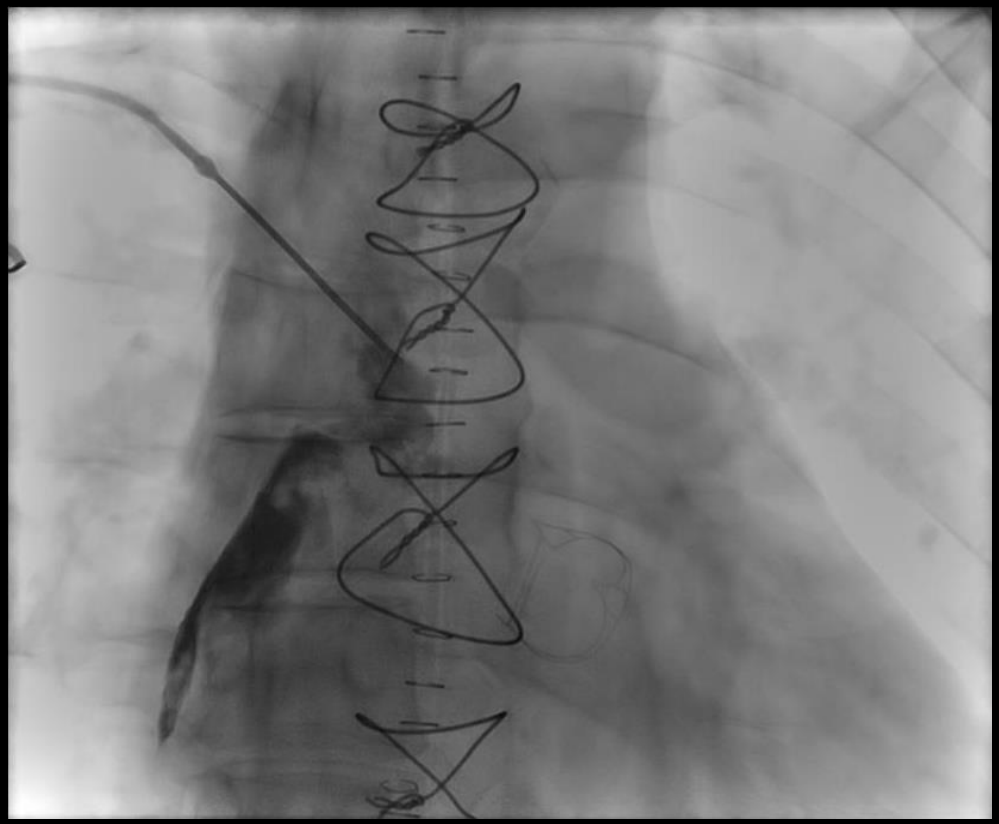
(Exemple: Drainage d'un abcès retro-sternal)

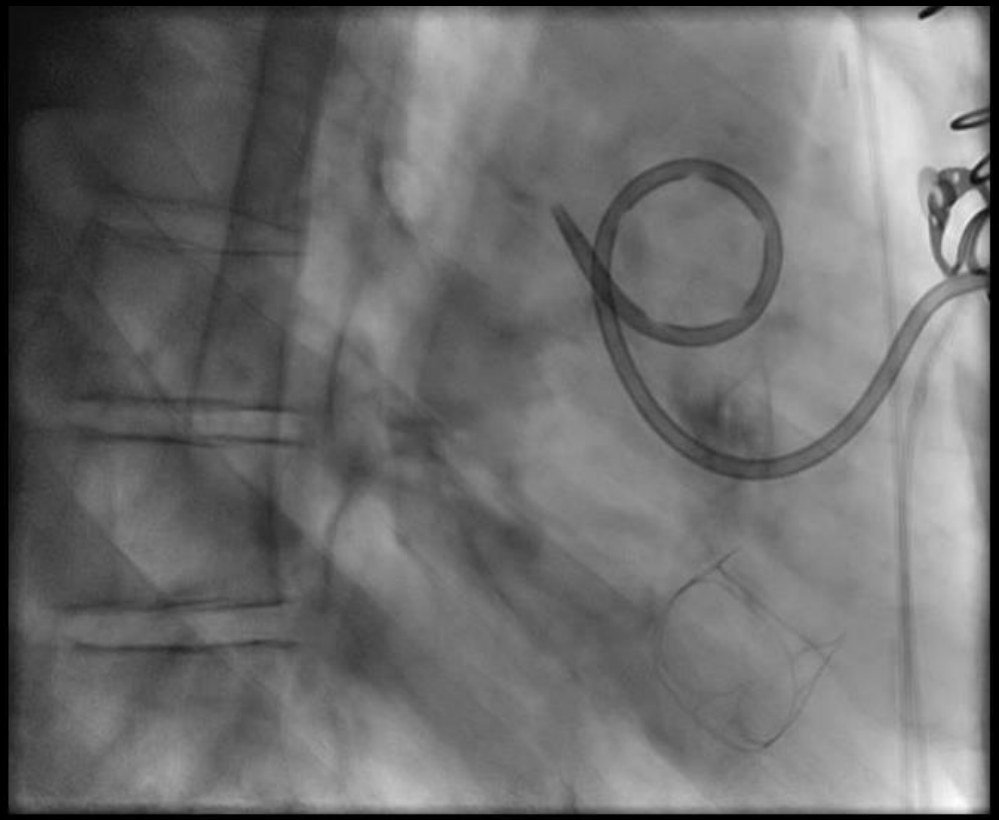
1- Ponction guidée par CBCT



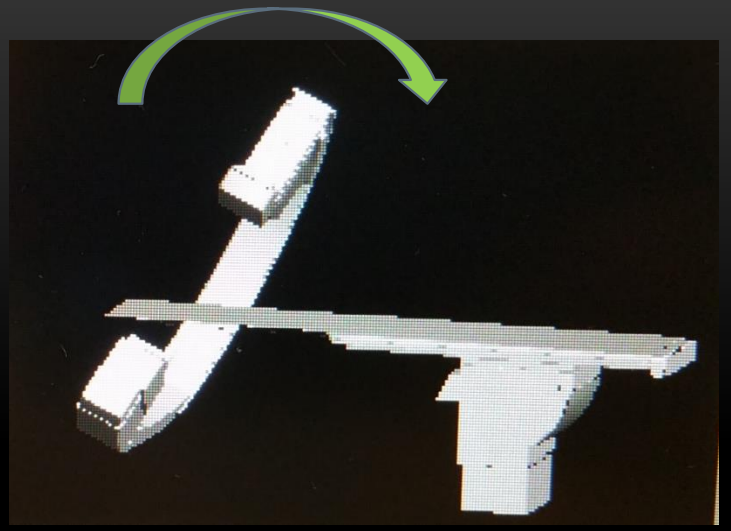
# LES AVANTAGES DE CBCT:

2- Sous **contrôle fluoroscopique**: opacification de la collection, mise en place d'un guide puis d'un drain par technique de Seldinger





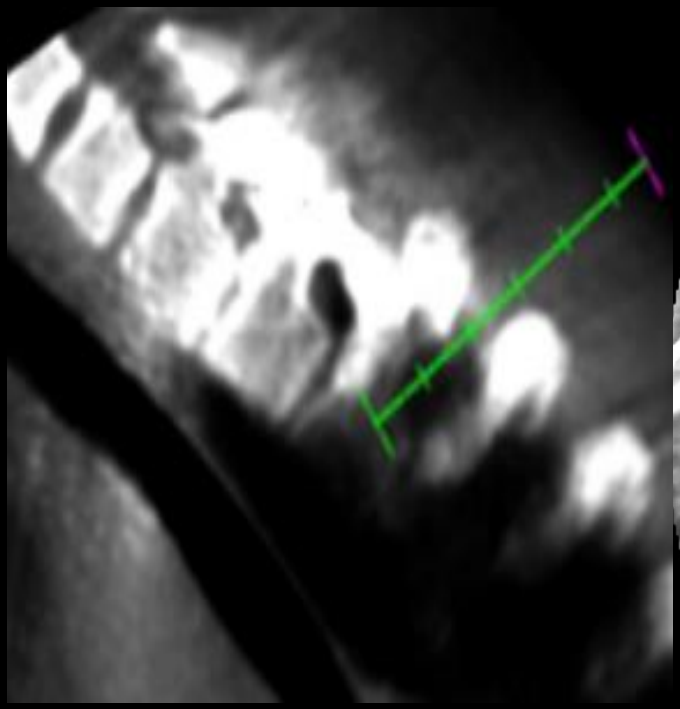
# LES AVANTAGES DU CBCT :

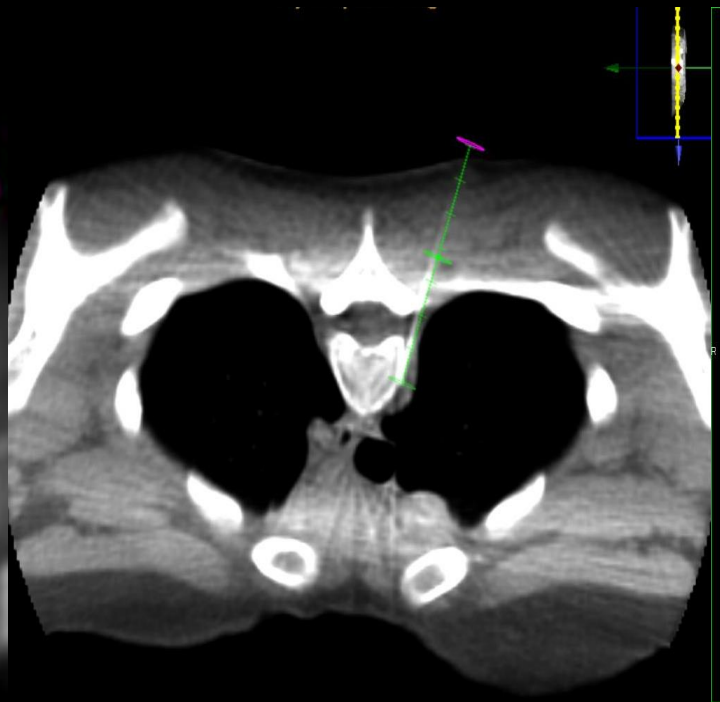


→ **Trajectoires obliques (cranio-caudale)**

*! (quasi) impossible en CT !*

(Exemple: Sympatholyse thoracique percutanée au phénol)

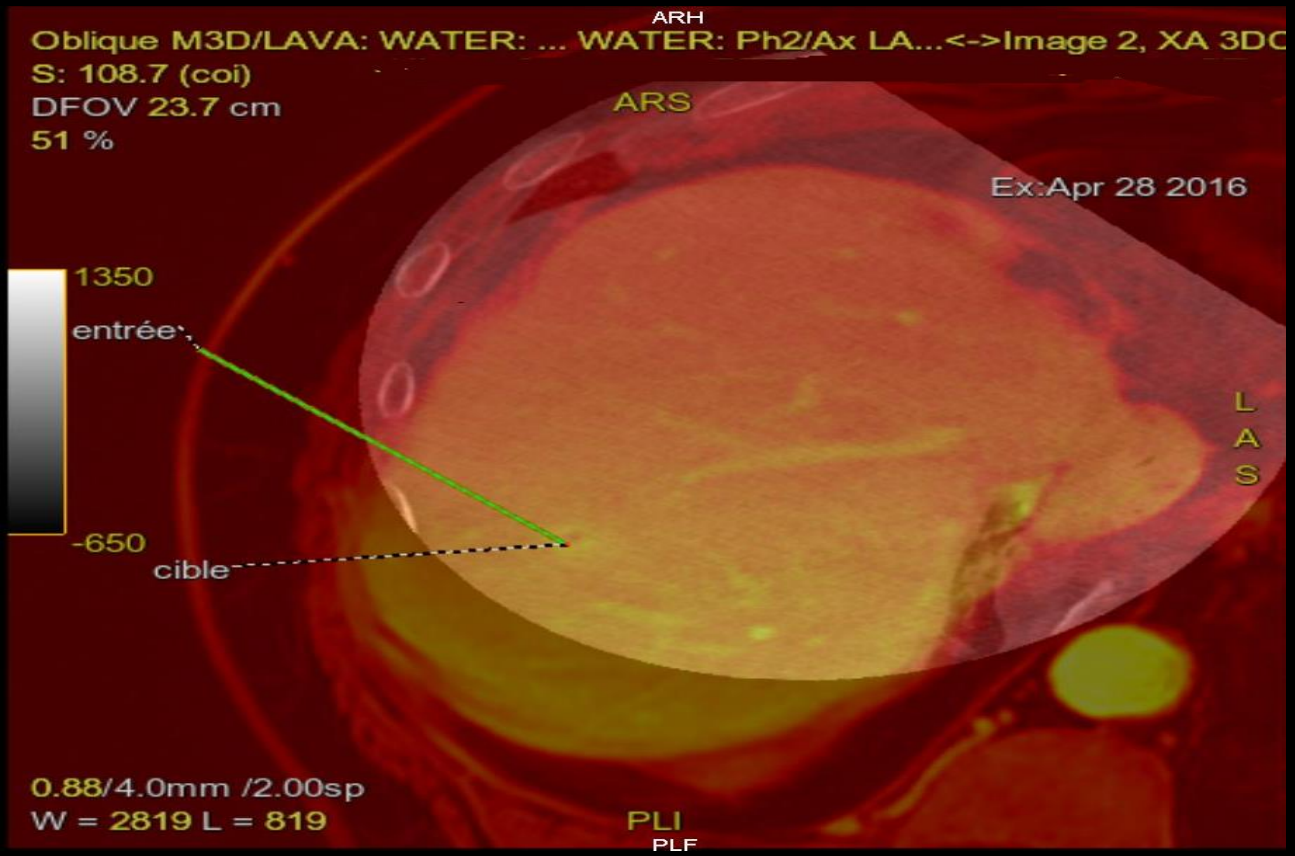


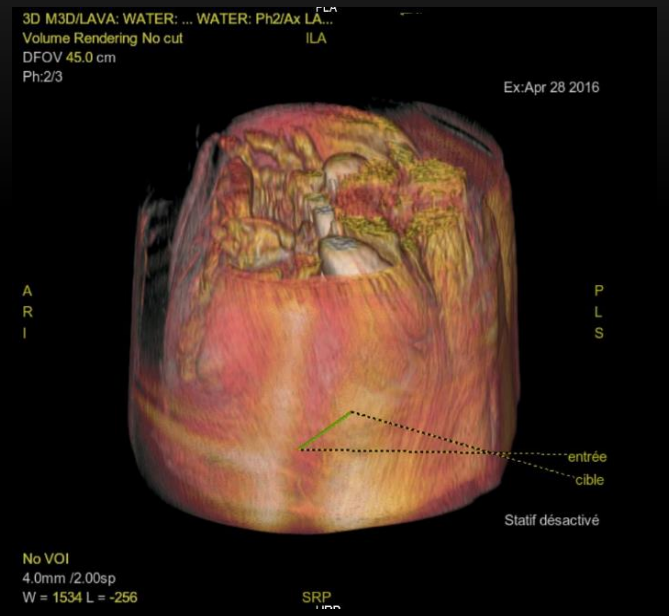


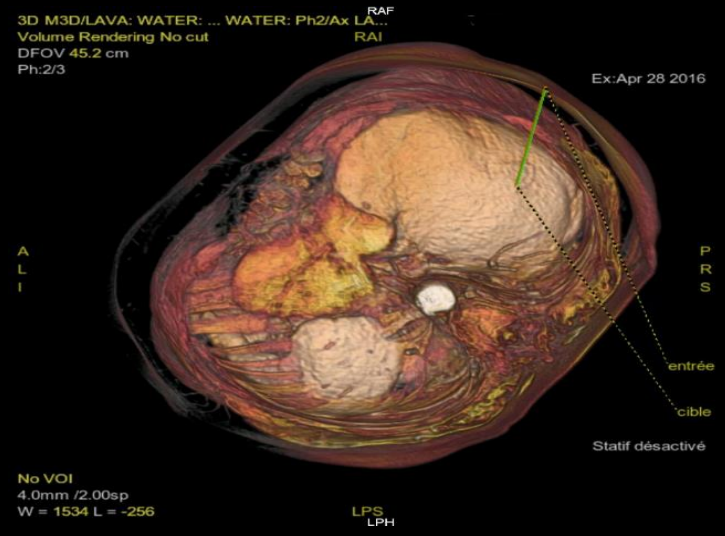
# LES AVANTAGES DU CBCT :

→ Possibilités de **fusions multimodales CBCT + CT, IRM ou PET**

(Exemple: Fusion CBCT-IRM - RFA lésion hépatique)



## 2- C-arm CBCT et navigation endovasculaire

Angiographie avec ou sans soustraction

→ Road-Map

→ 3D Road-Map

+/- MPR, MIP → mesures auto-calibrées ( ≠ DSA !)

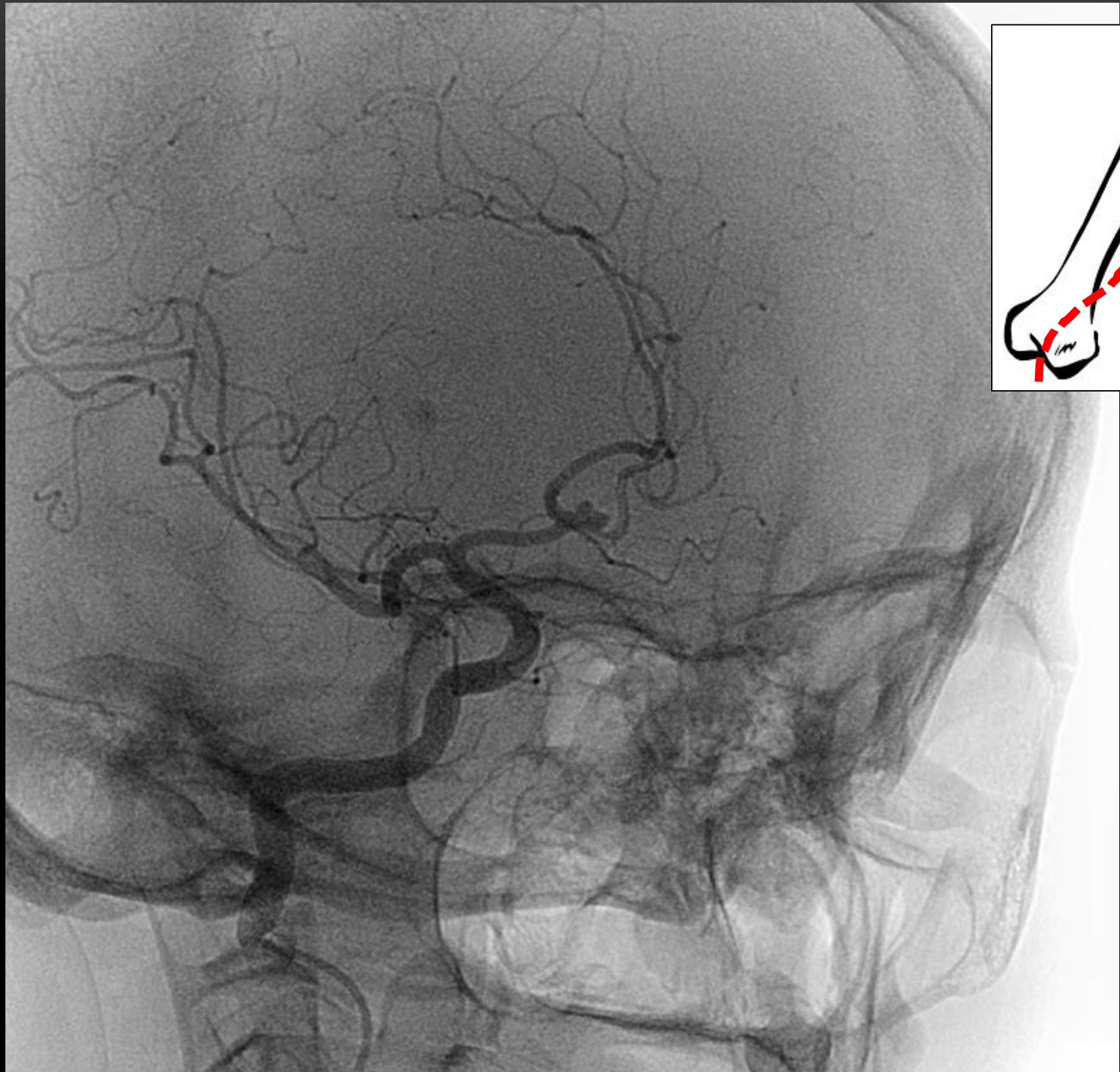
+/- vues endovasculaires

+/- analyse des vaisseaux (diamètre, sténoses, anévrysme)

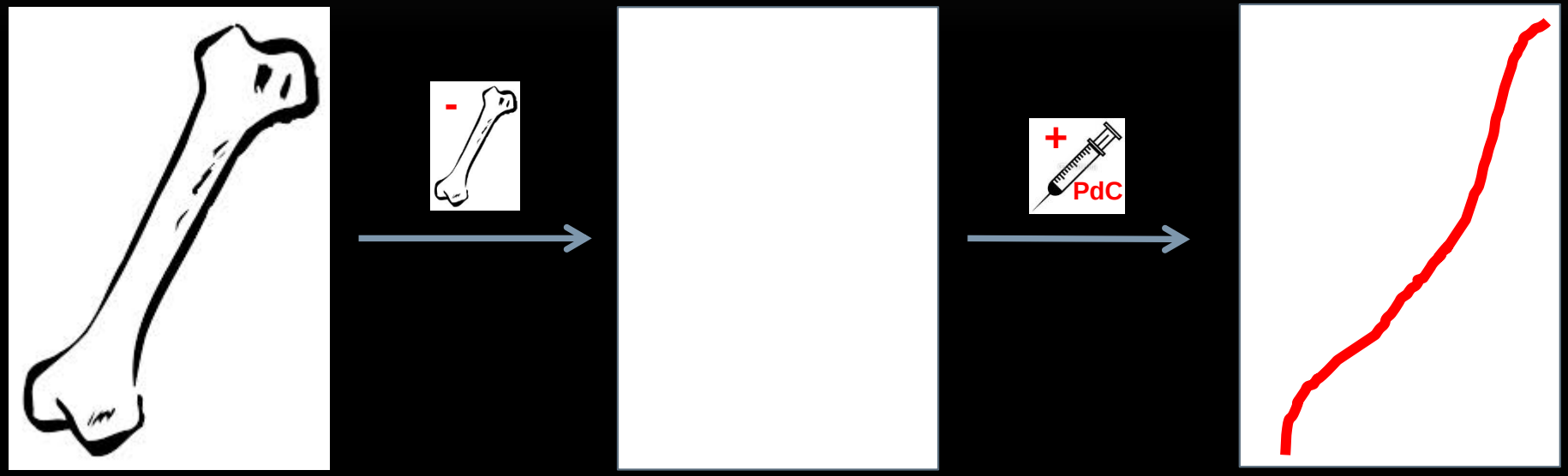
+/- planification d'endoprothèses

# Angiographie sans soustraction numérique


Sans soustraction



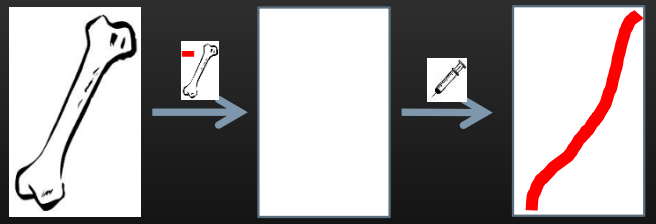
# Angiographie avec soustraction numérique

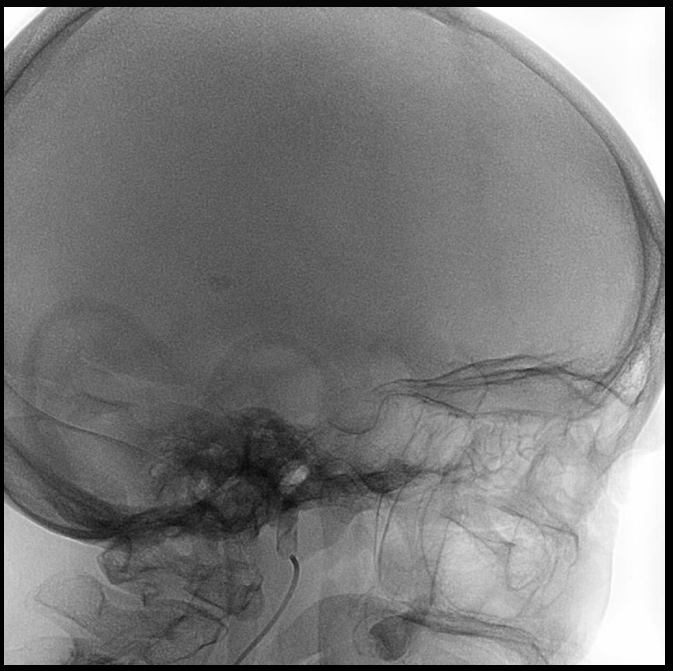


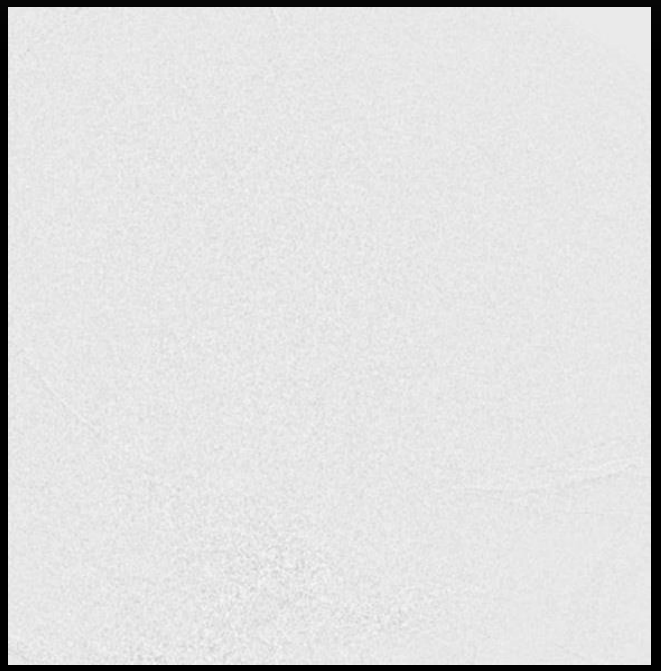

1ere image

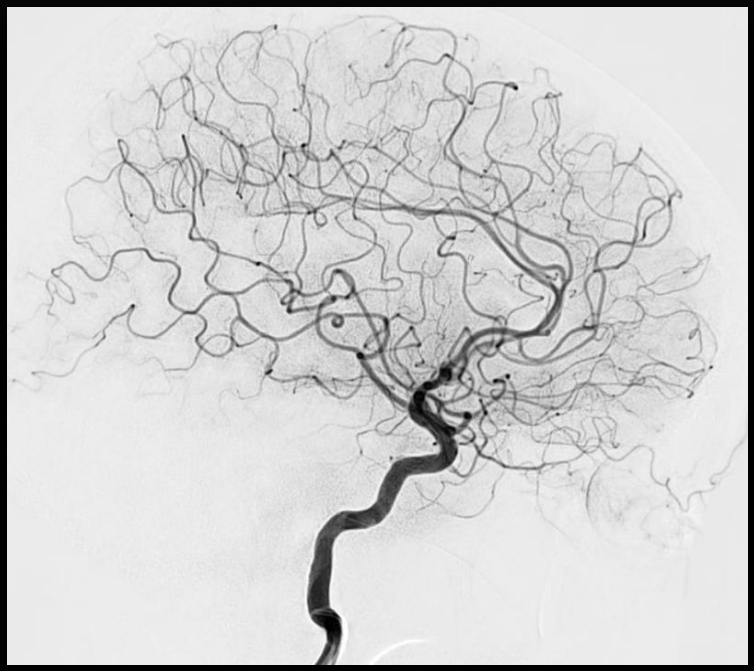
Images suivantes…

Avec soustraction

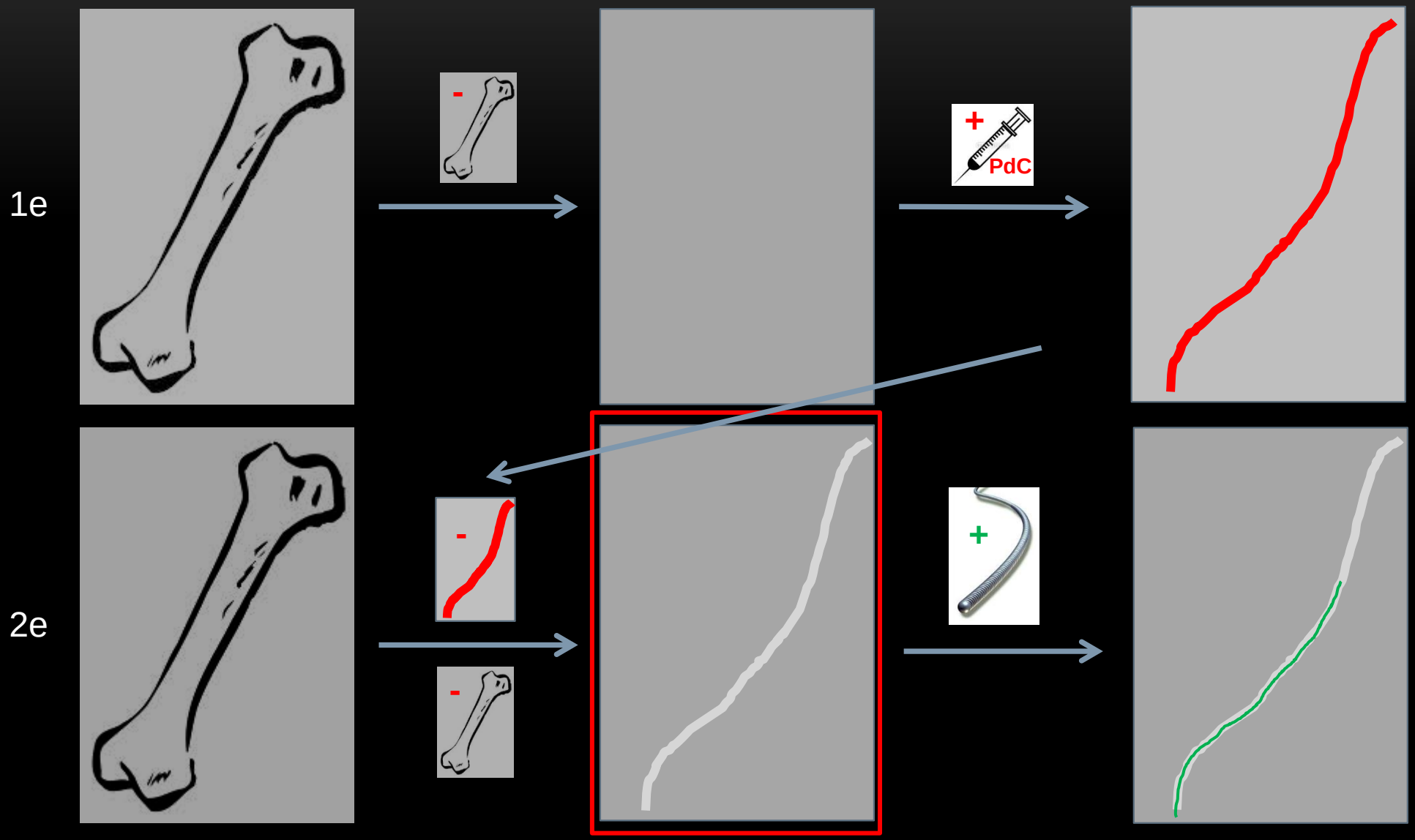


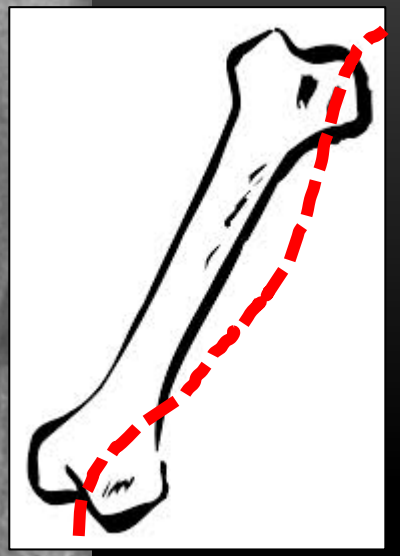


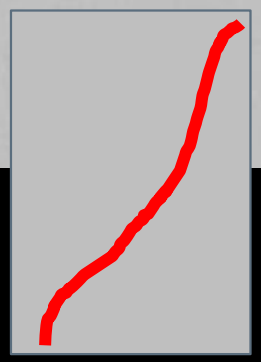


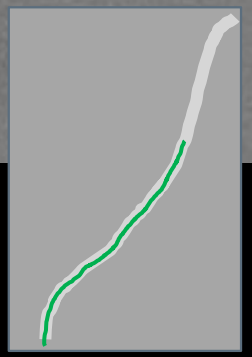


# Road-Mapping

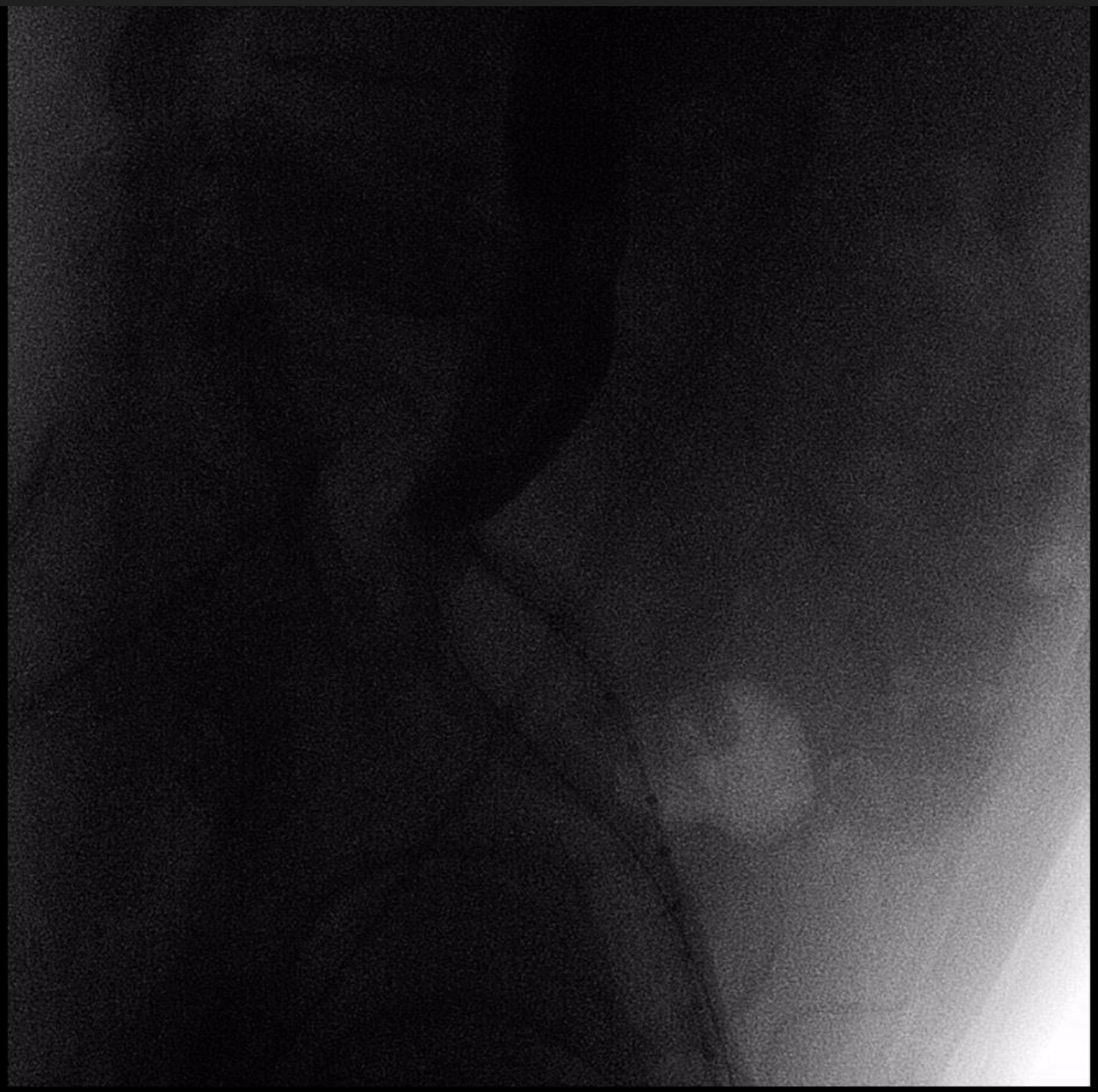






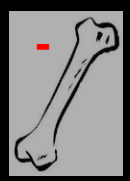


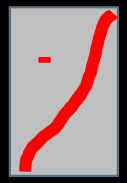
# Angio 3D…



# Angio 3D…

# … et 3D-Road-Mapping

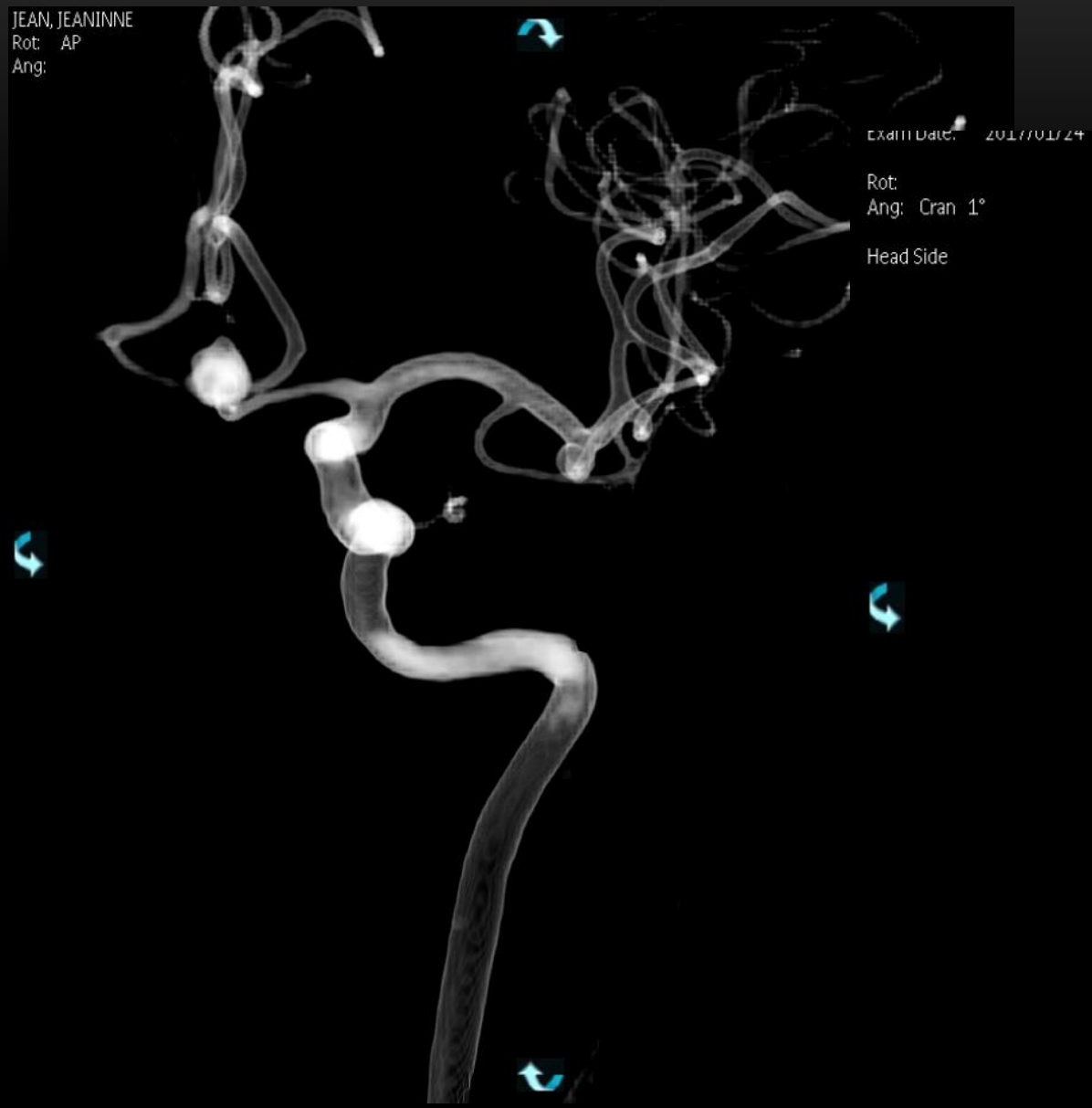


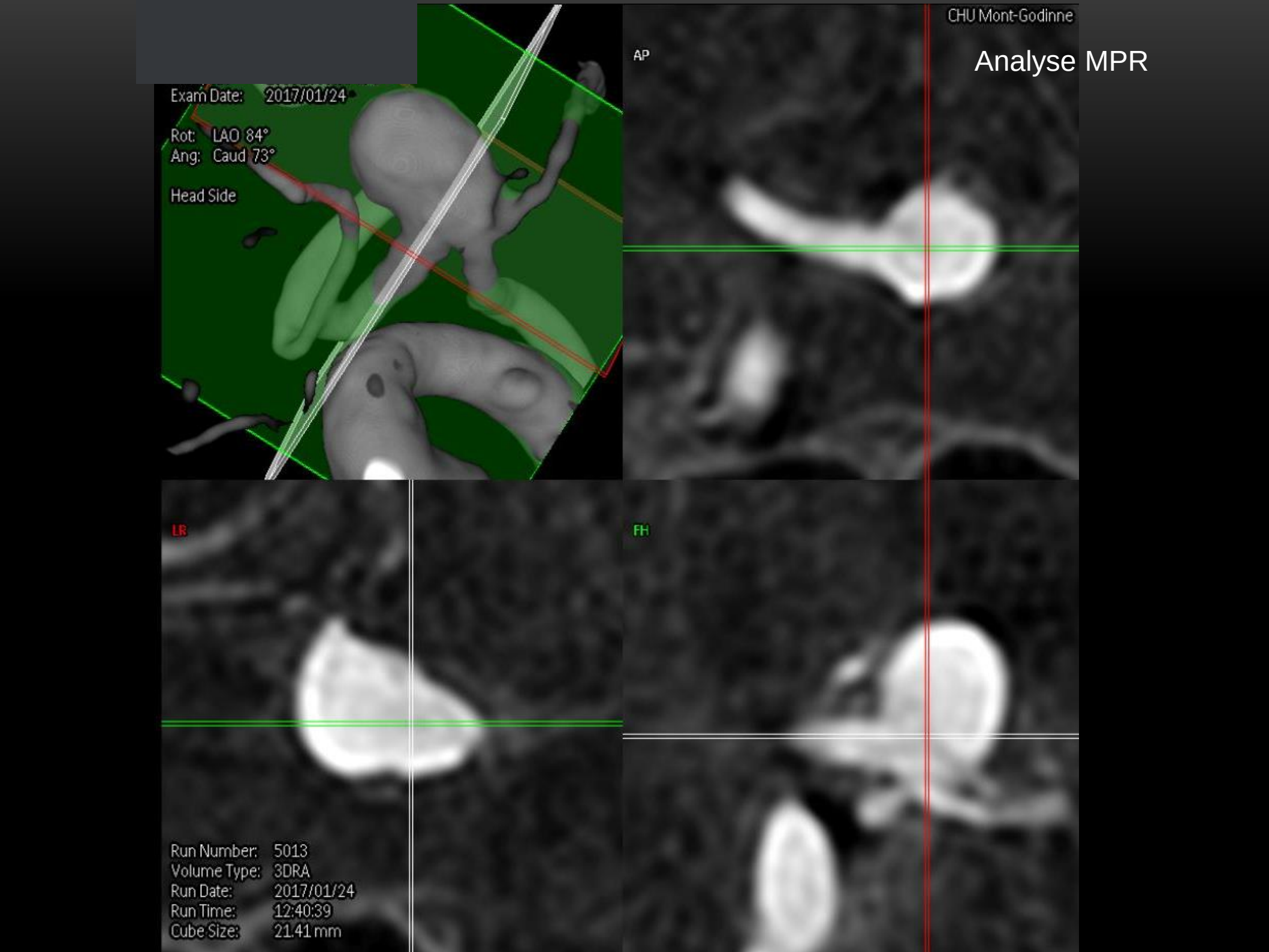
***Avantage***: le 3D-Road-Map suit les déplacements du détecteur (+ zoom) et de la table

*(Exemple: Anévrysme intra-crânien et embolisation)*

Reconstruction CBCT
Coupes 0,17mm

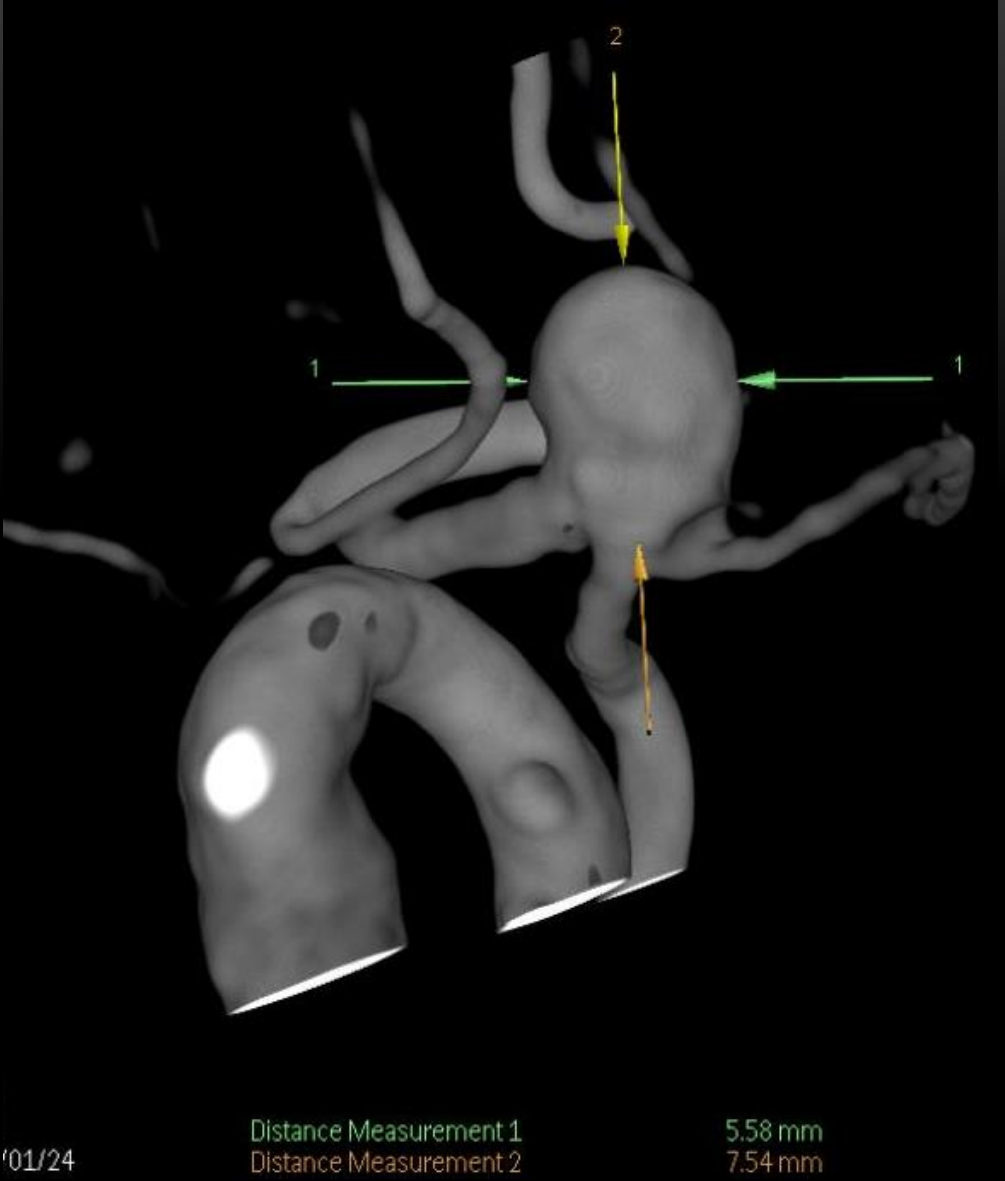
# VR et 3D RoadMap

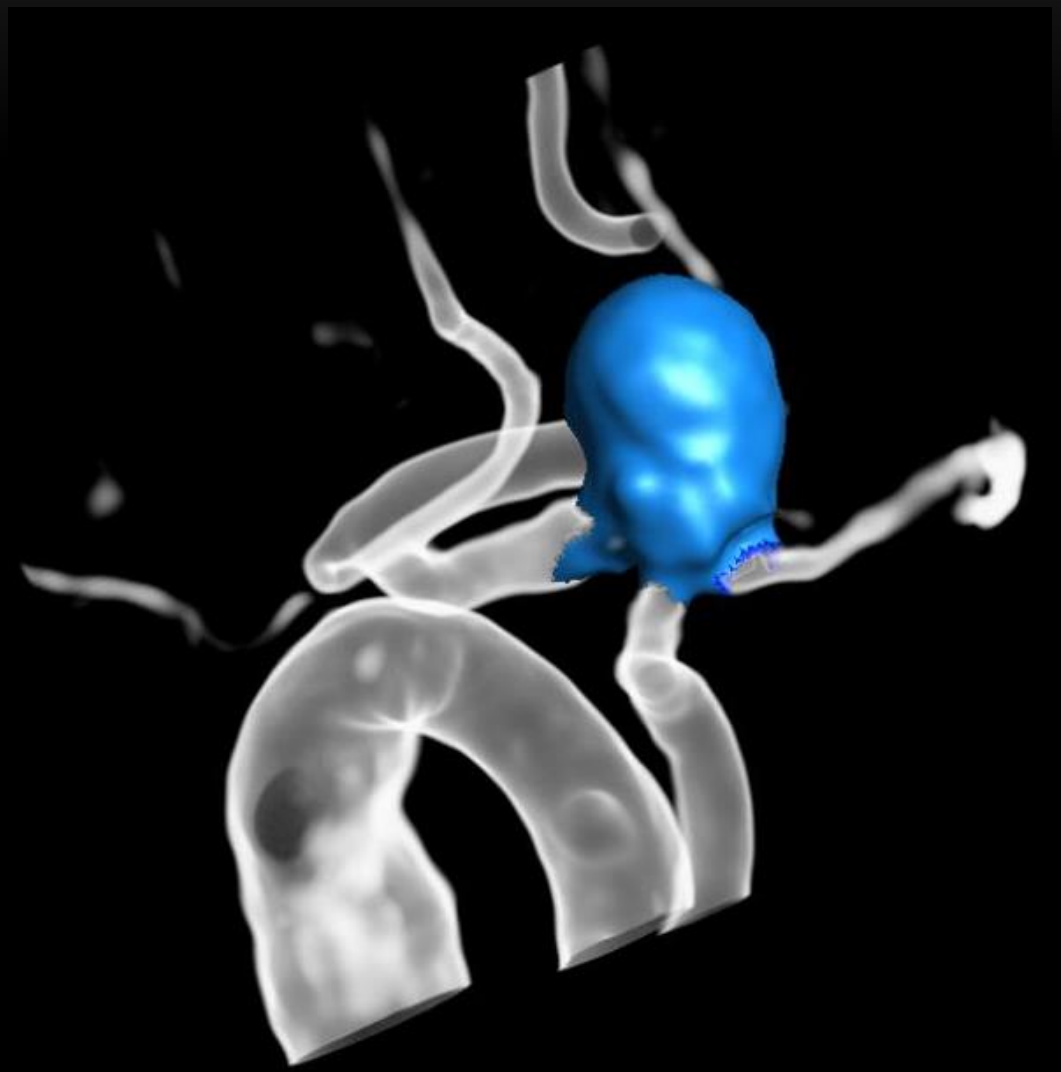




Exam Date: 2017/01/24
Rot: LAO 84°
Ang: Caud 73°
Head Side
CHU Mont-Godinne
AP
LR
FH
Run Number: 5013
Volume Type: 3DRA
Run Date: 2017/01/24
Run Time: 12:40:39
Cube Size: 21.41 mm

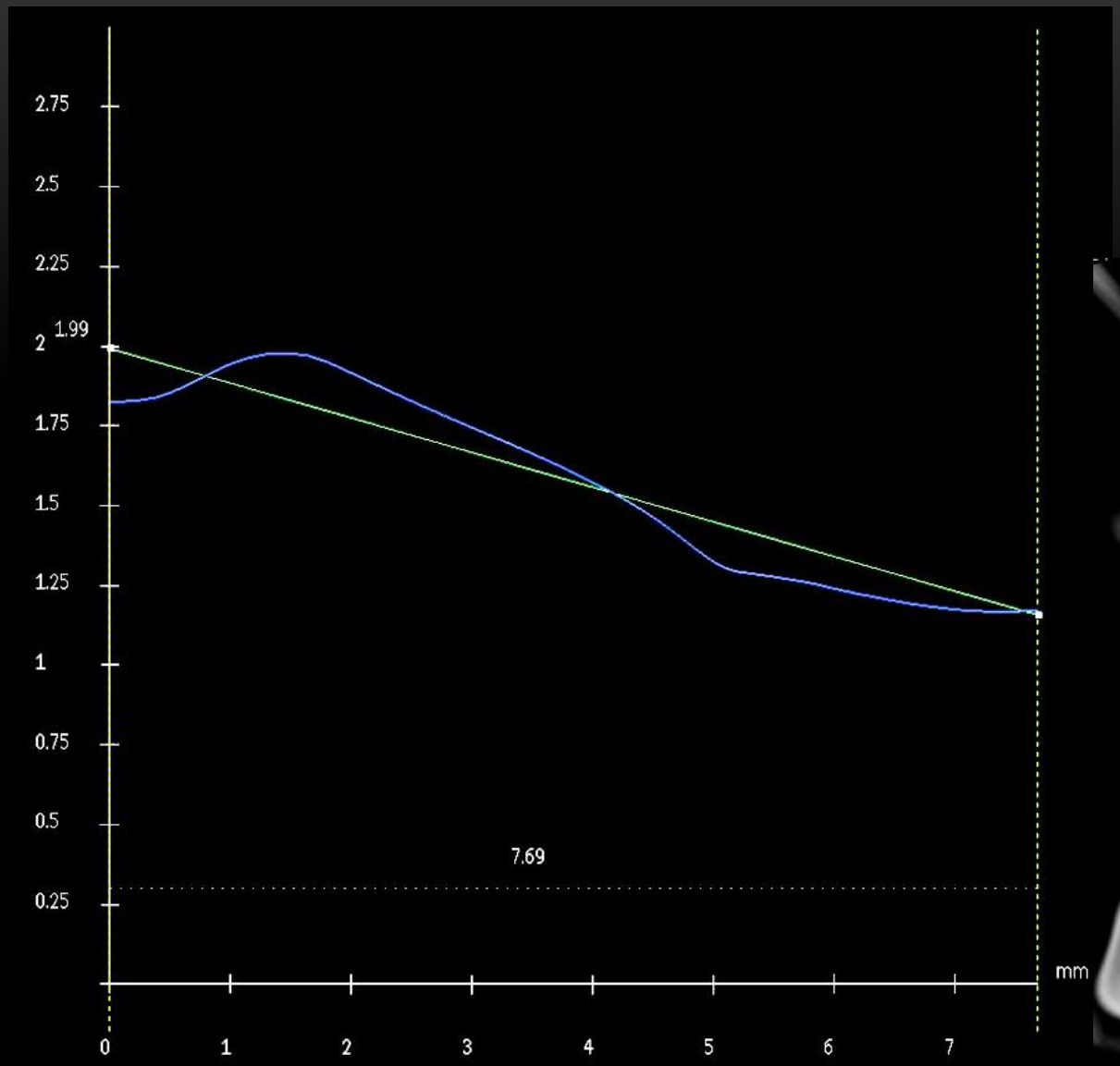
# Analyse MPR

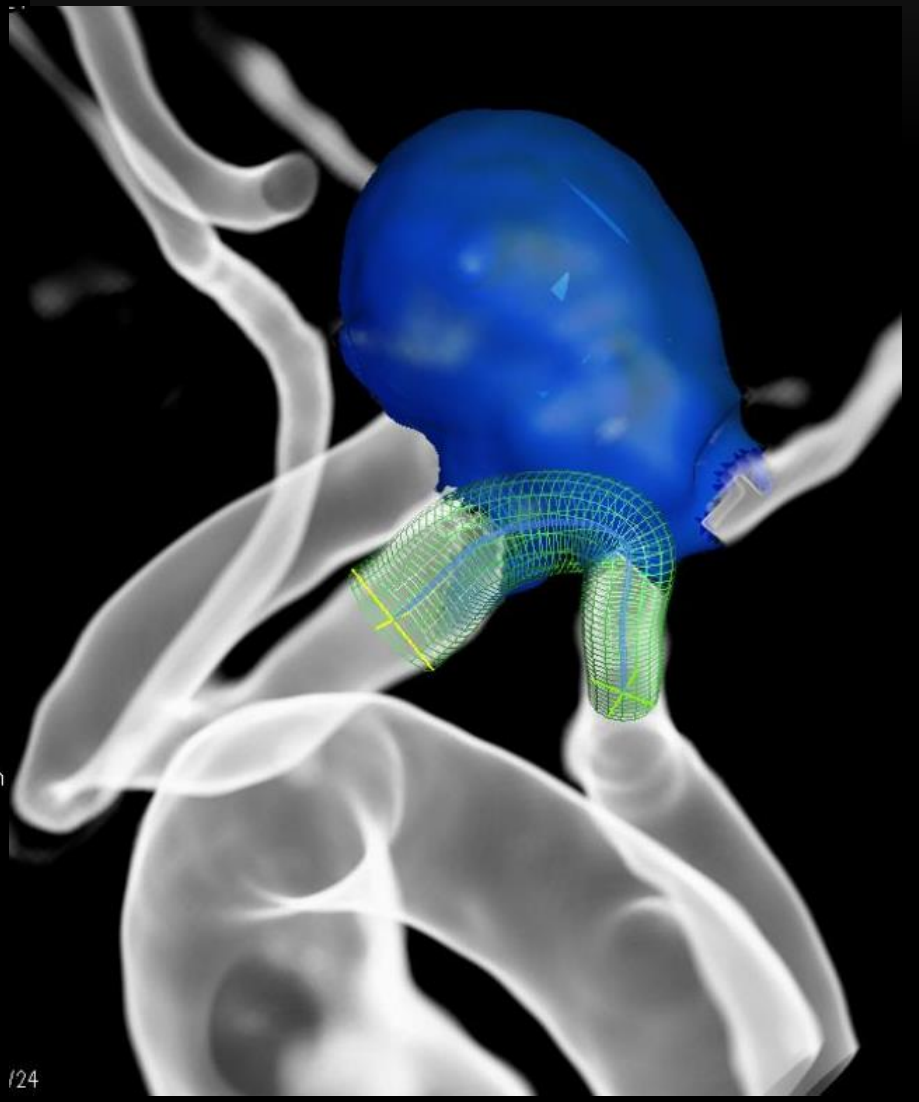
# Mesures distances et volume
# Détection automatique

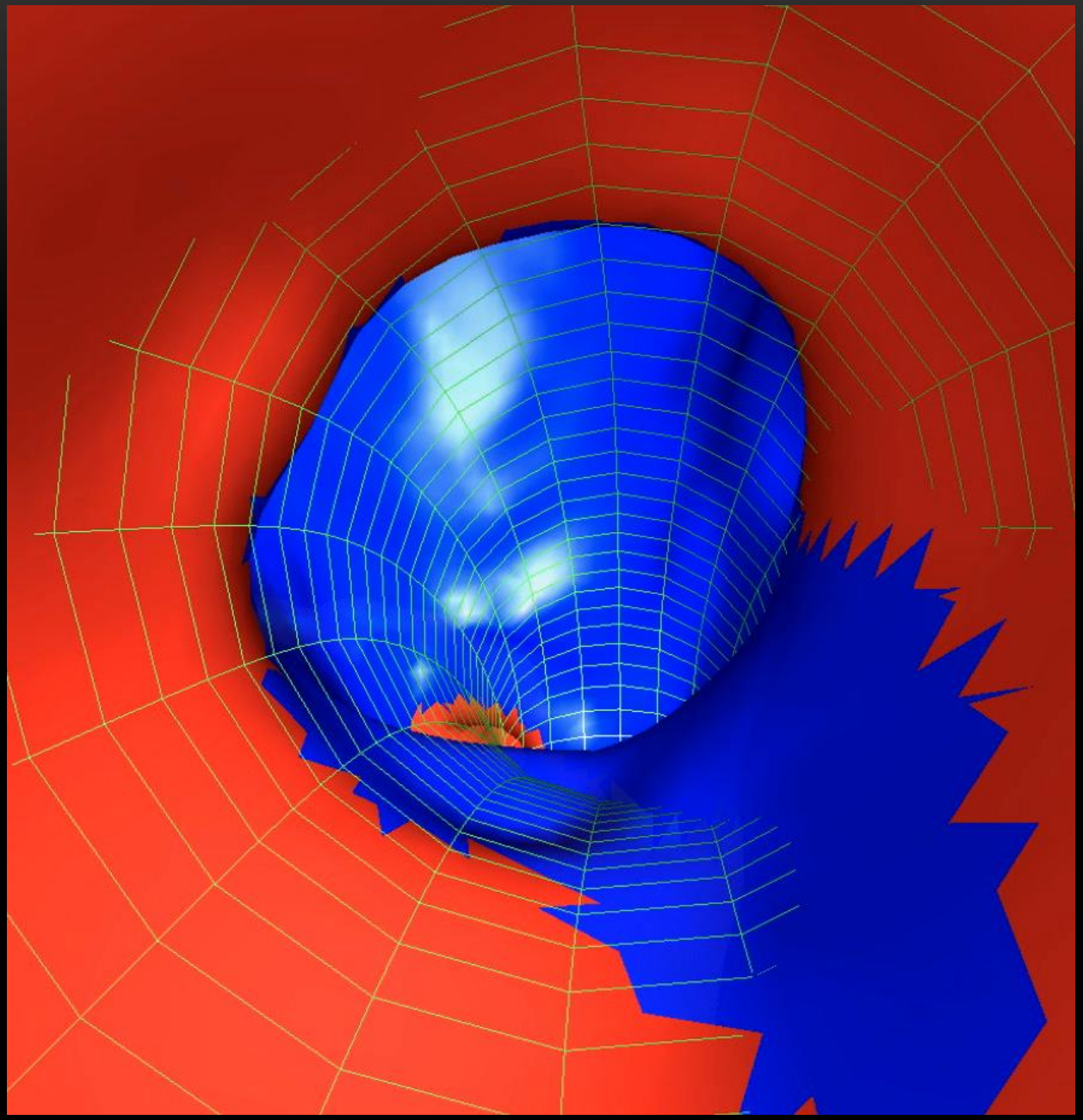


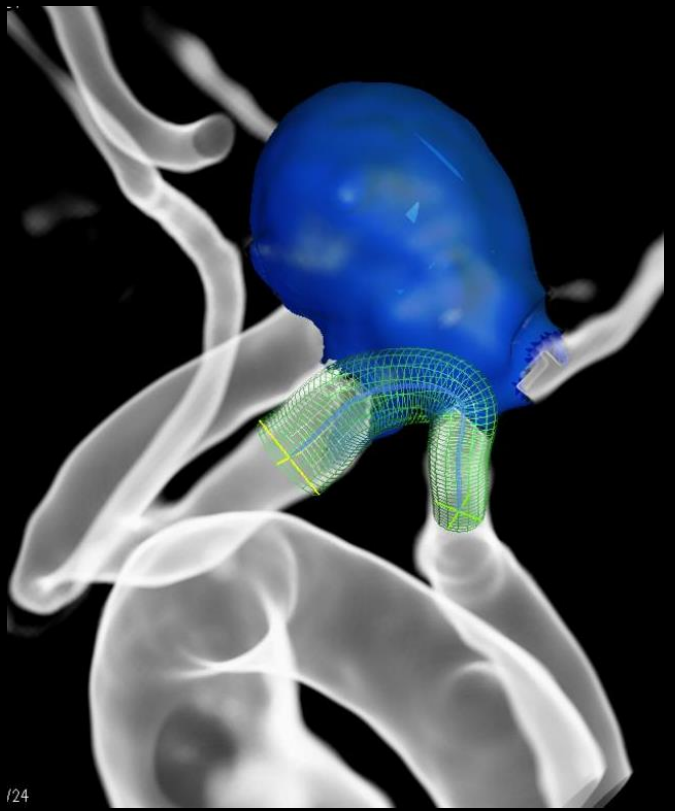
Simulation d’endoprothèse
Mesure automatique de la lumière



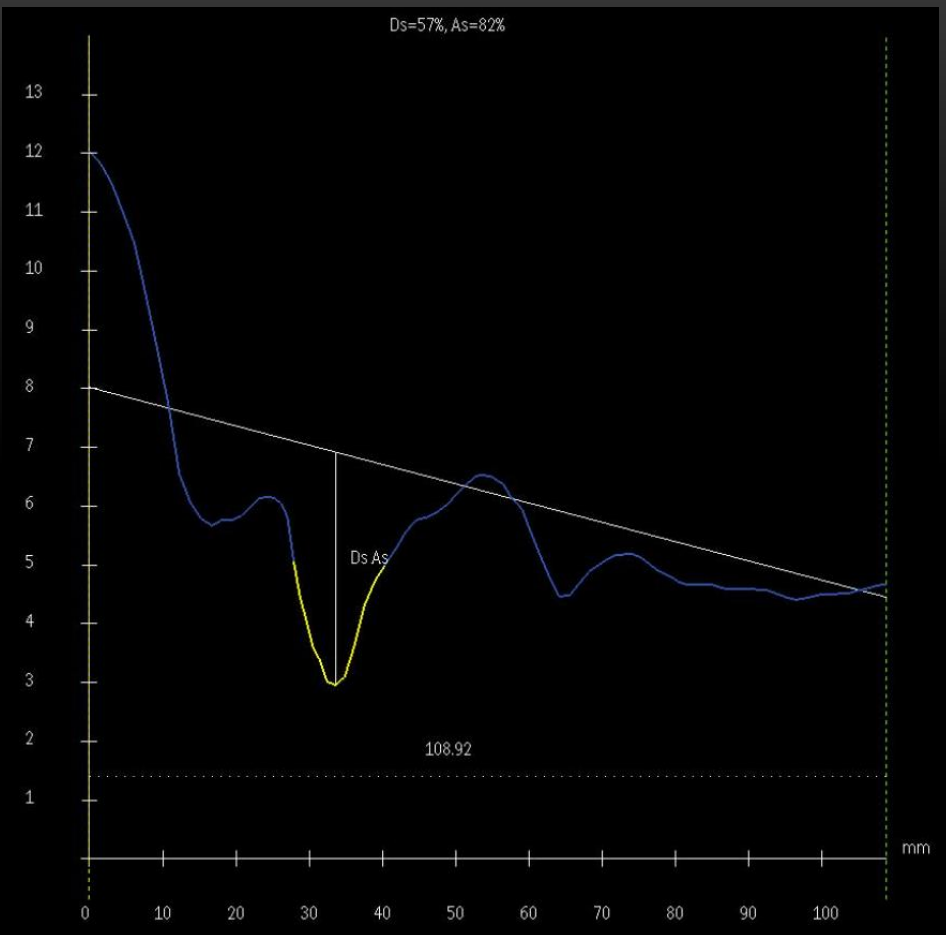


Vue endoluminale

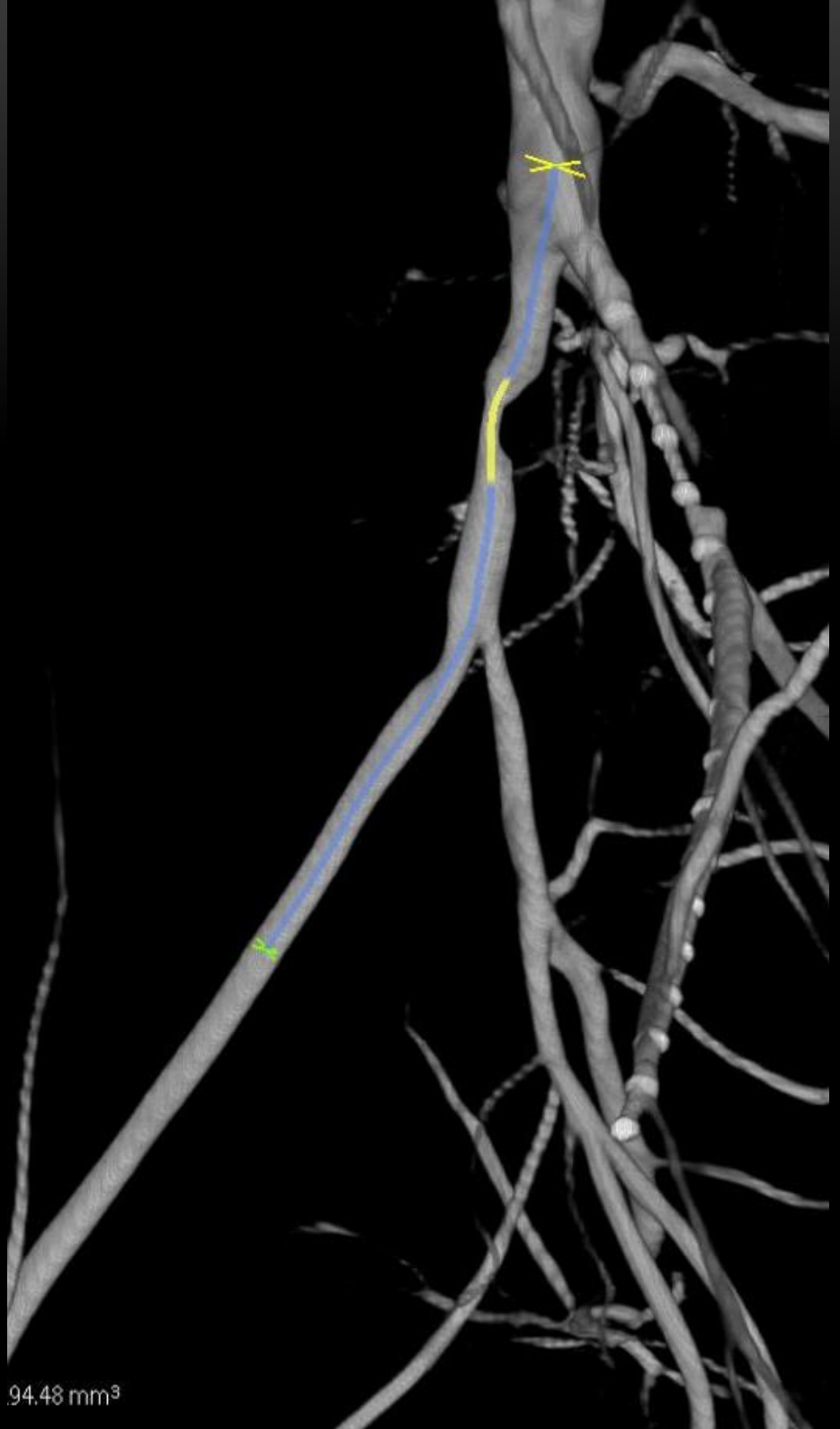


*(Exemple: PTA-stenting Aorto-iliaque)*

Acquisition rotationnelle




VR → 3D RoadMap
Détection des sténoses
Mesure automatique de la lumière



Vue endoluminale

… et pendant ce temps là, en salle de chirurgie vasculaire…

# 3- C-arm CBCT et embolisation

- Analyse en MPR
- Détection (+/- automatique) des vaisseaux

**Identification of Small Hepatocellular Carcinoma and Tumor-feeding Branches with Cone-beam CT Guidance Technology during Transcatheter Arterial Chemoembolization**

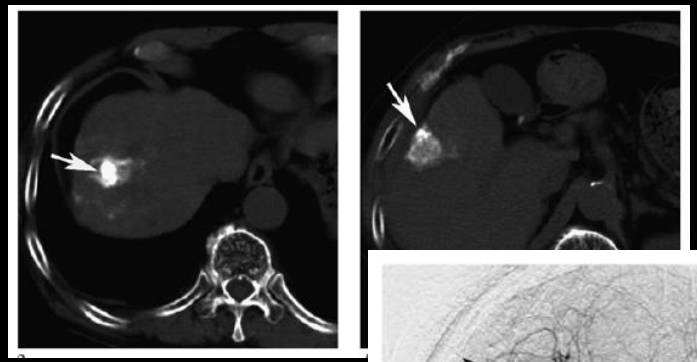
Shiro Miyayama, MD, Masashi Yamashiro, MD, Masahiro Hashimoto, MD, Nanako Hashimoto, MD, Masaya Ikuno, MD, Kenichiro Okumura, MD, Miki Yoshida, MD, and Osamu Matsui, MD

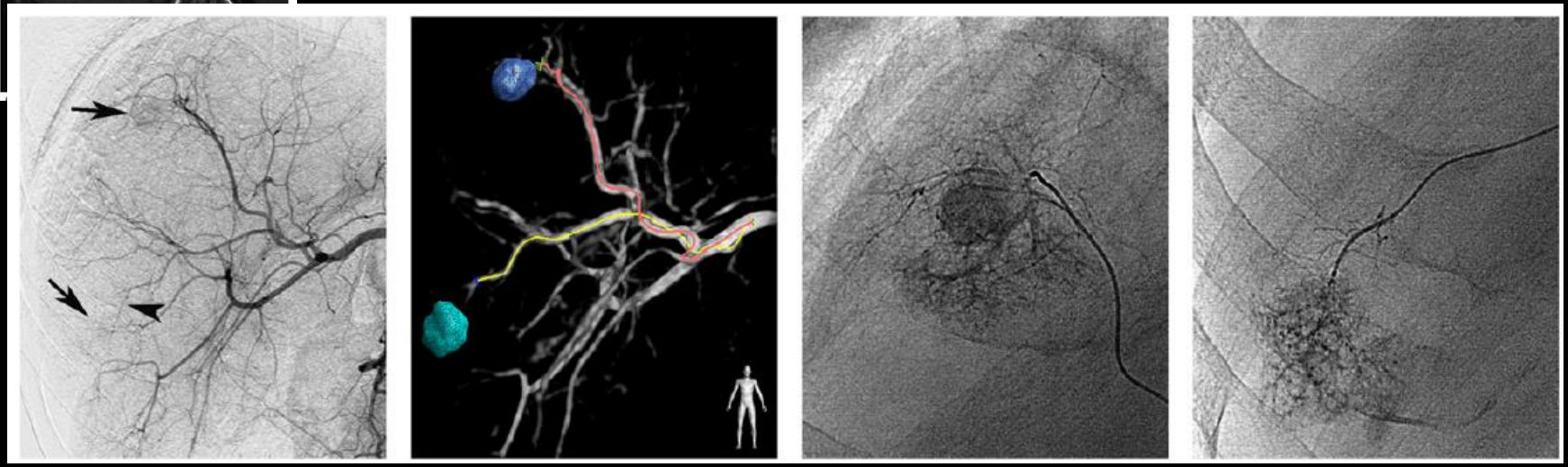
J Vasc Interv Radiol 2013;24:501–508
http://dx.doi.org/10.1016/j.jvir.2012.12.022

**Table 2. Detectability of Tumor-feeding Branches and Branches Embolized during Ultraselective Chemoembolization**

| Variable | Detected | Not Detected | False Positive |
|---|---|---|---|
| Nonselective DSA | 38 | 62 | 27 |
| [redacted] Vs | | | |
| Manual feeder detection | 81 | 19 | – |
| Automatic feeder detection | 88 | 12 | 8 |
| Level of embolization | | | |
| Subsegmental | 1 | – | – |
| Sub-subsegmental | 42 | – | – |
| Sub-sub-subsegmental | 45 | – | – |
| Sub-sub-sub-subsegmental | 12 | – | – |

**Prospective study**
**Patients n=36**
**HCC n=66**





CLINICAL STUDY

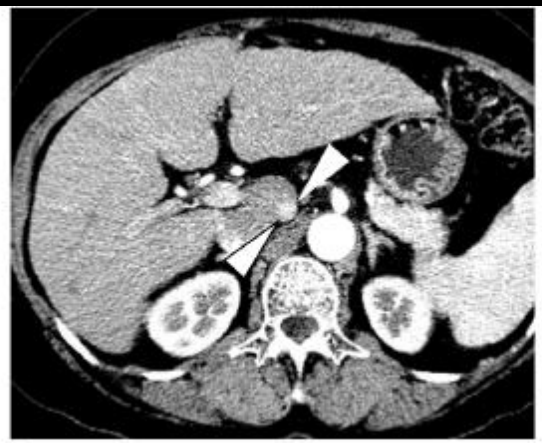
# Role of C-Arm CT in Identifying Caudate Arteries Supplying Hepatocellular Carcinoma

Won Seok Choi, MD, Hyo-Cheol Kim, MD, Saebeom Hur, MD, Jin Woo Choi, MD, Jeong-Hoon Lee, MD, Su Jong Yu, MD, and Jin Wook Chung, MD

J Vasc Interv Radiol 2014; 25:1380–1388
http://dx.doi.org/10.1016/j.jvir.2014.02.028

**Table 3.** Origins of 85 Tumor-Feeding Arteries in 52 Patients with HCC in Caudate Lobe

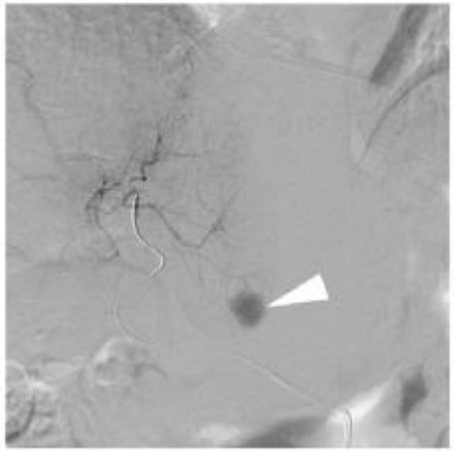
| Origin | Number |
|---|---|
| Right main hepatic artery | 23 |
| Right anterior hepatic artery | 11 |
| Right posterior hepatic artery | 10 |
| S8 hepatic artery | 10 |
| S7 hepatic artery | 10 |
| Left hepatic artery | 7 |
| S4 hepatic artery | 7 |
| S2 hepatic artery | 2 |
| Proper hepatic artery | 2 |
| S6 hepatic artery | 1 |
| S3 hepatic artery | 1 |
| Right inferior phrenic artery | 1 |



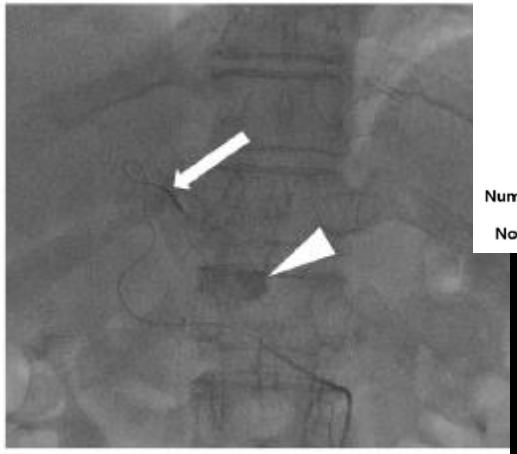
a.

b.

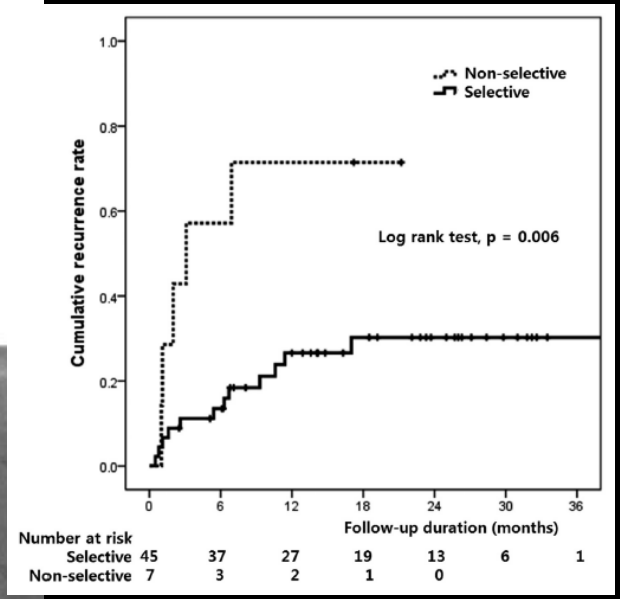
c.



d.



e.



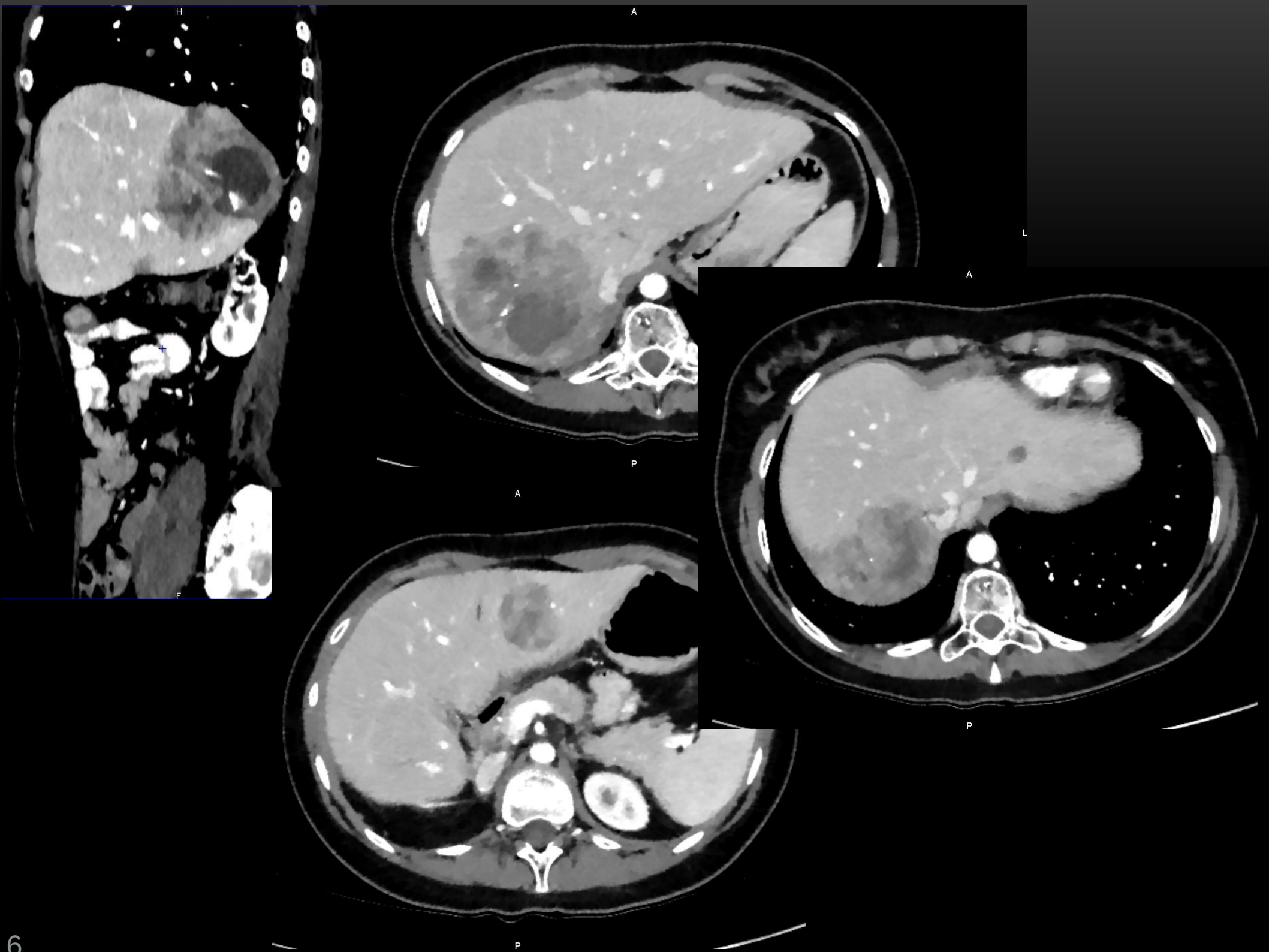
# USEFULNESS OF C-ARM CBCT FOR EMBOLIZATION
## SOME ILLUSTRATIVE CASES…

Case 1 – **Liver: DEBTACE (chemoEmbolization)**

- ♀, 30y
- Liver metastases of corticosurrenaloma

- Long medical history, multiple past treatments…

- CMO: DEBTACE under general anesthesia (patient demand), RL then LL


H
F
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L
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H
H
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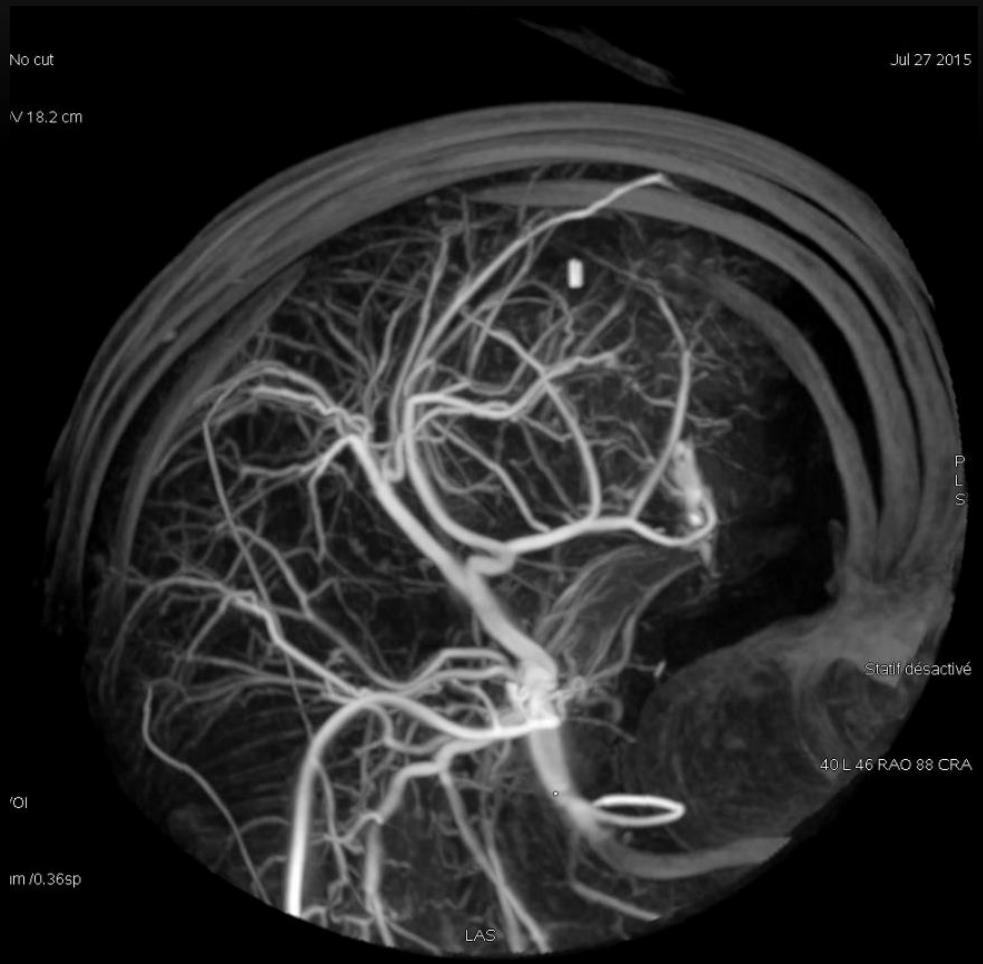
F
(Filt

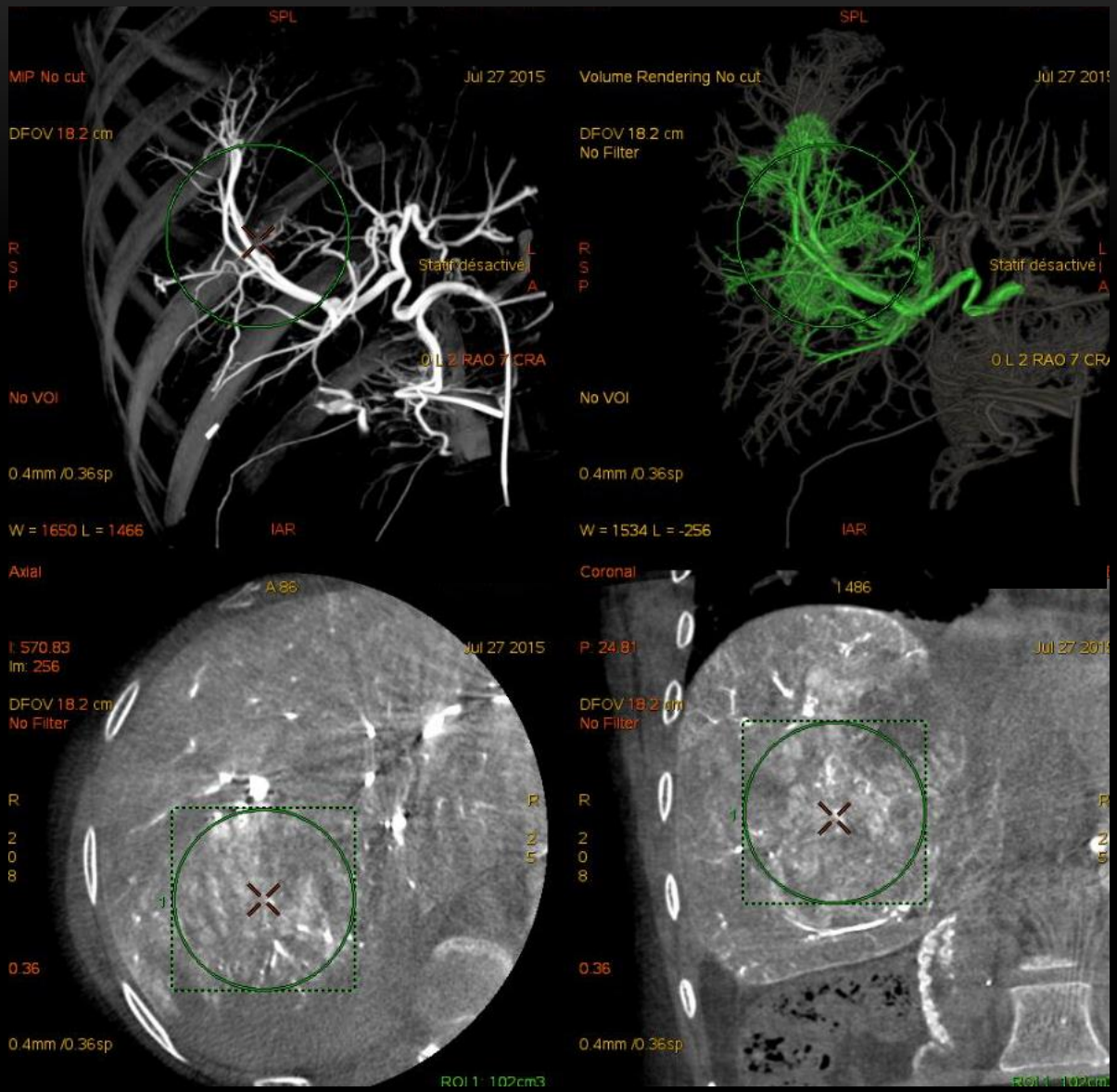
# Analyse MPR + MIP

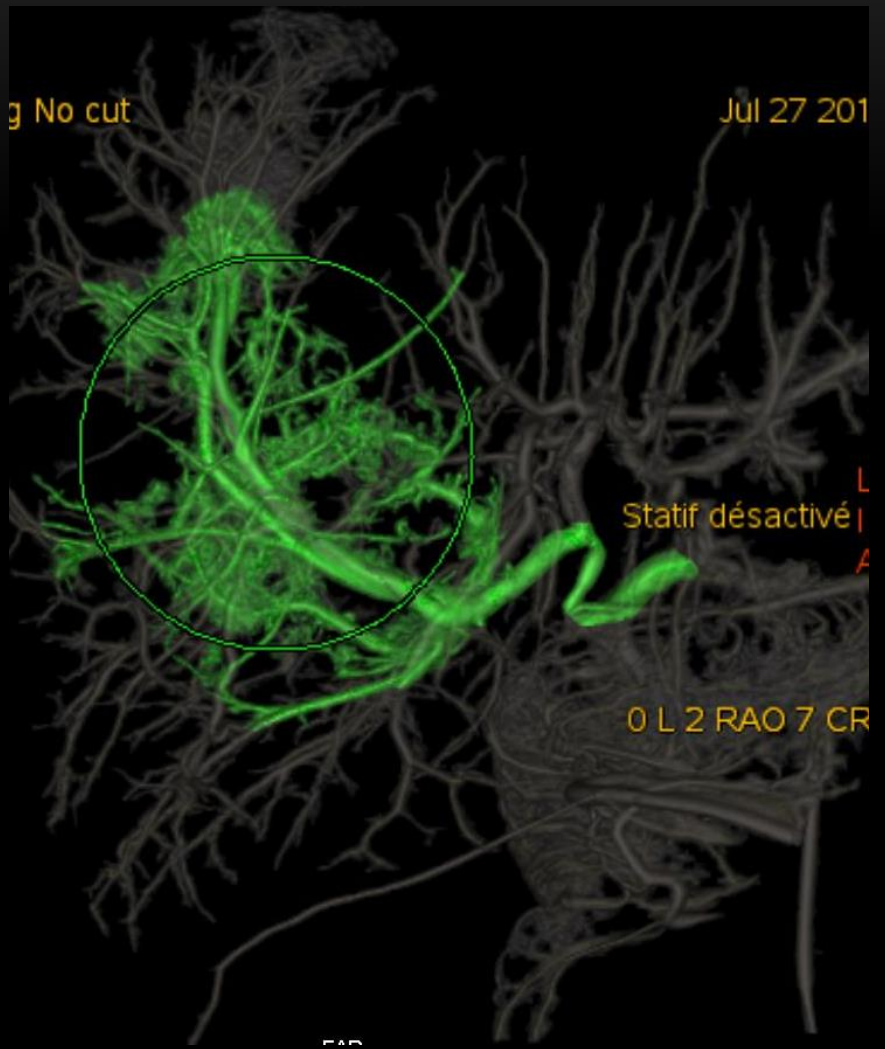

FPL


LAH

# Tumor vessels automatic detection + 3D RoadMap




KT: TC → Artère hépatique commune

CBCT

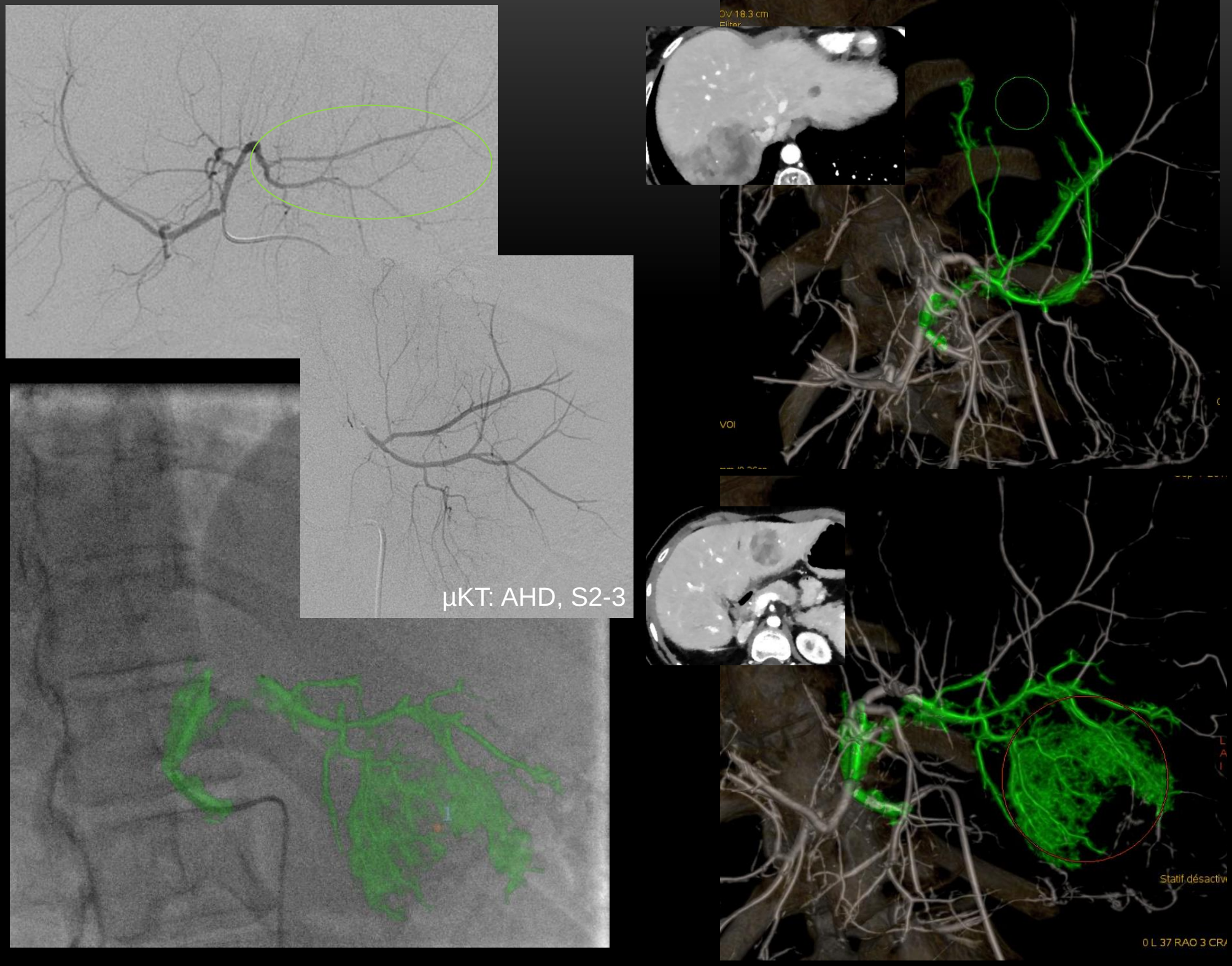


KT: Artère phrénique Dr


A
P

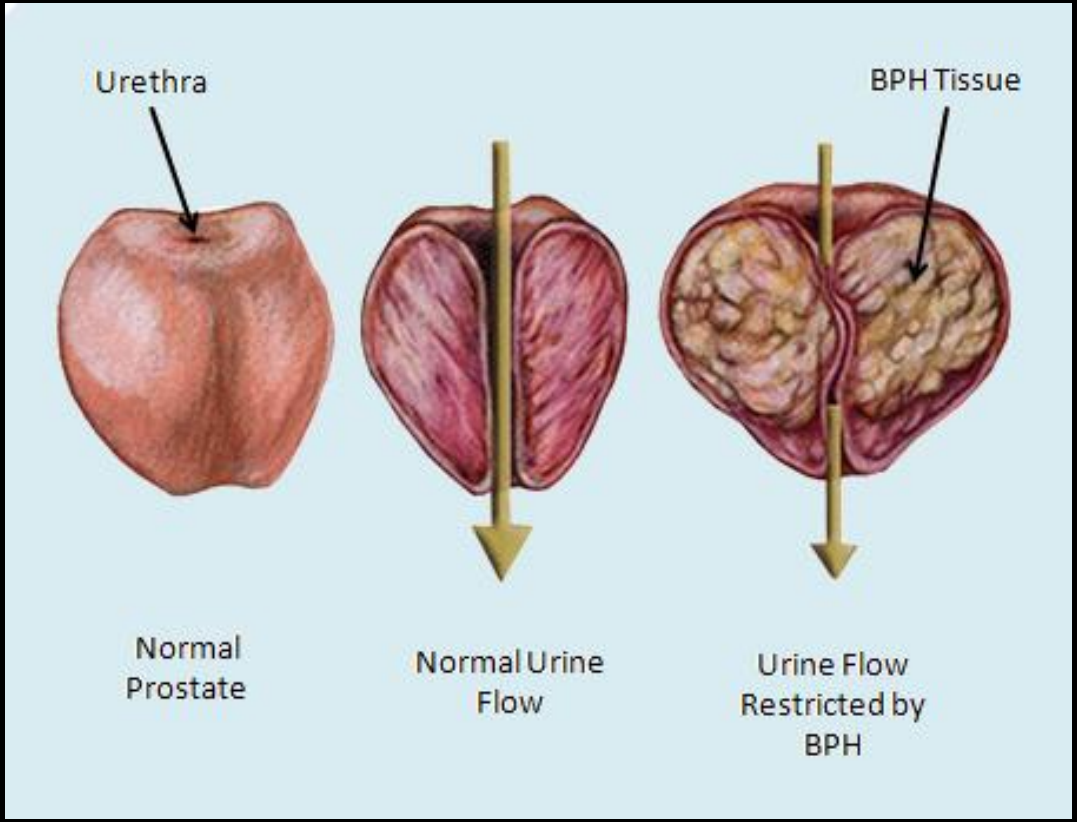

A
P


(Filt.

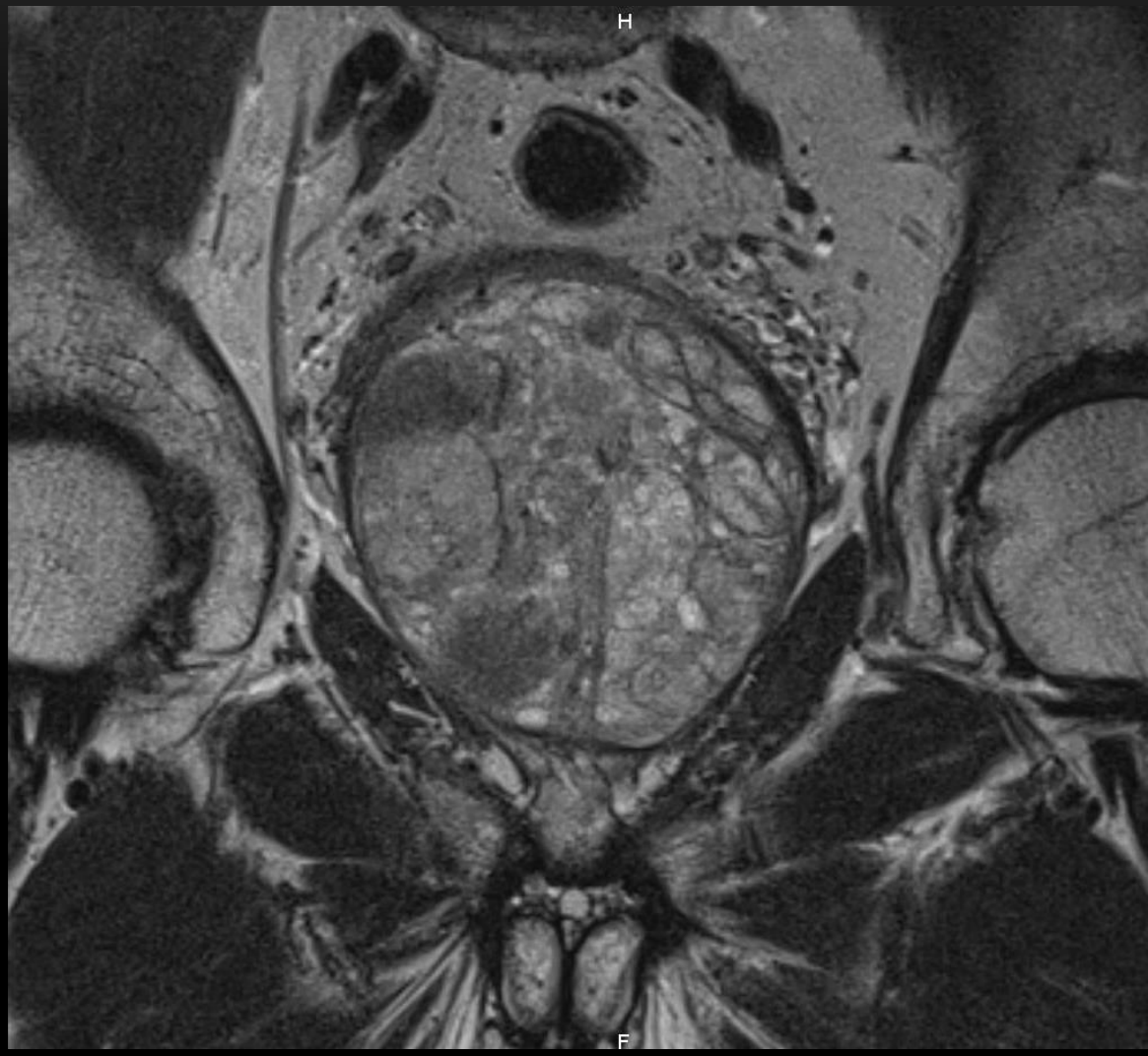

µKT: AHD, S2-3

# Case 2 – **Prostate Embolization**

- ♂, 85y
- Very large BPH (140g)



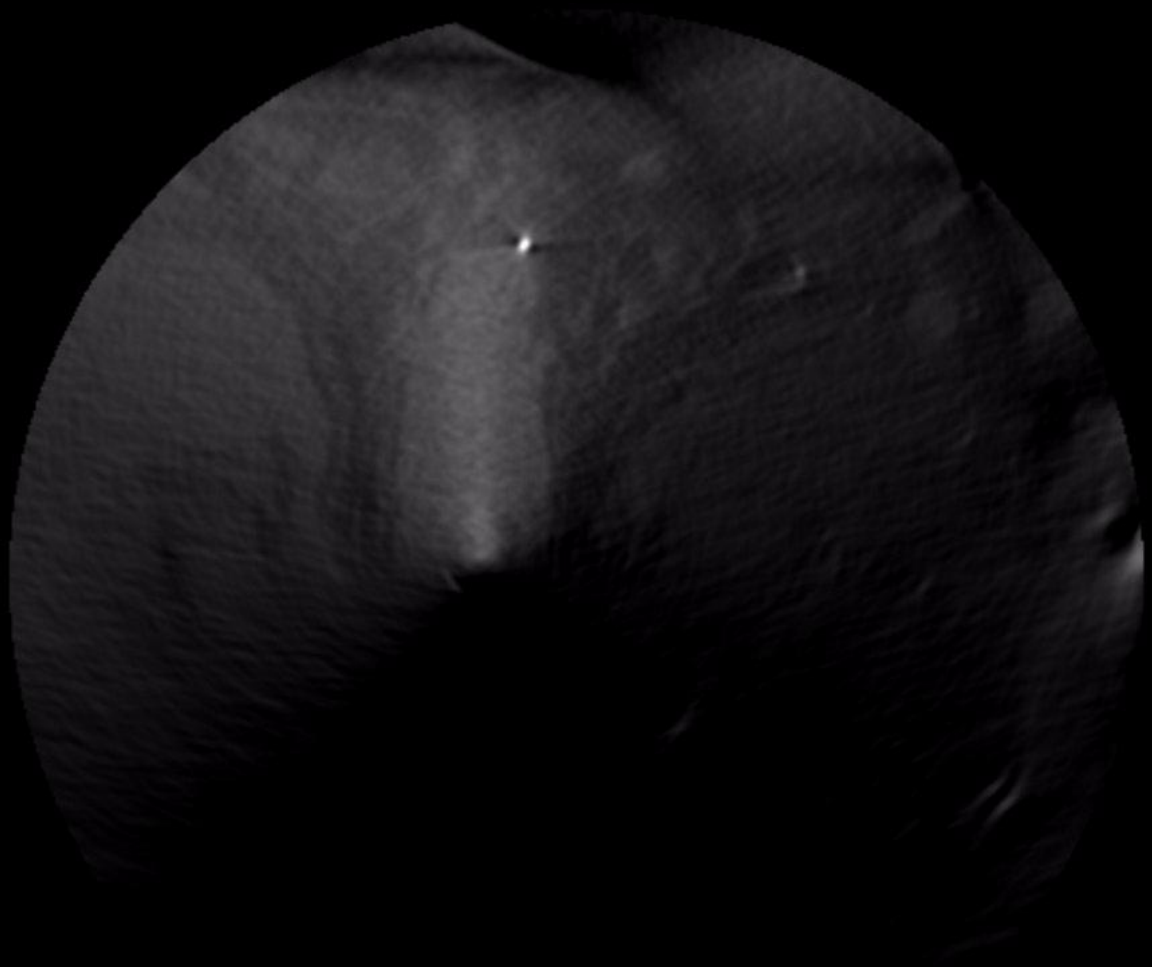

93.5 mm
F


H
F

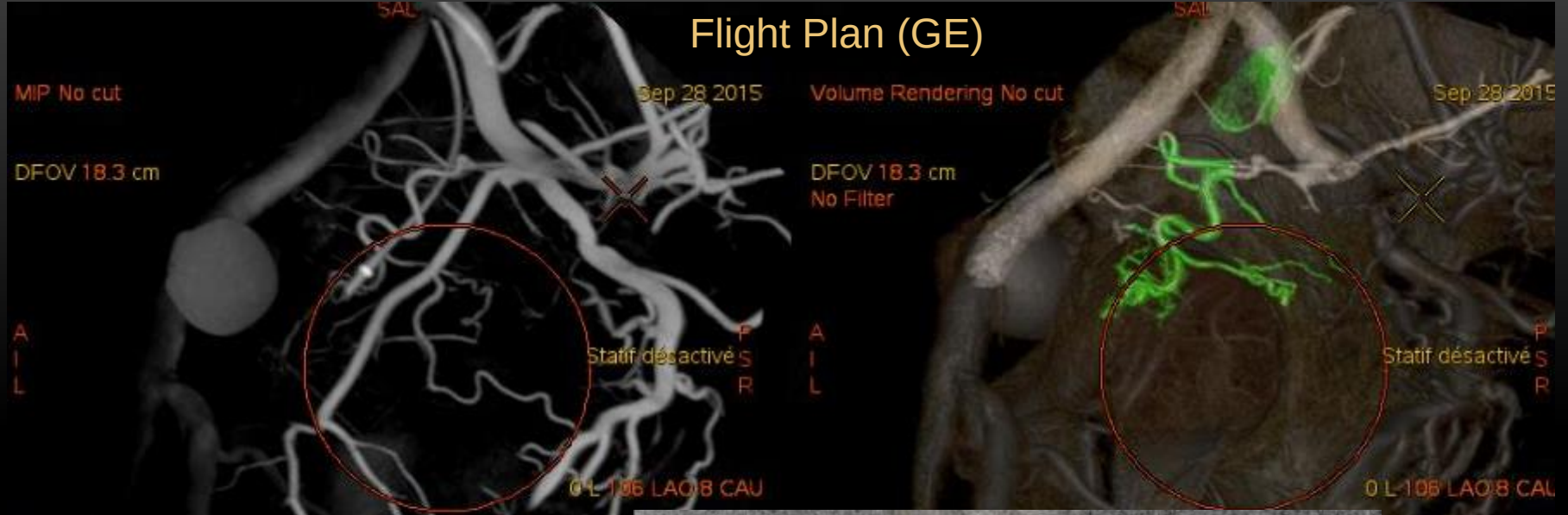

Prostatic artery ??

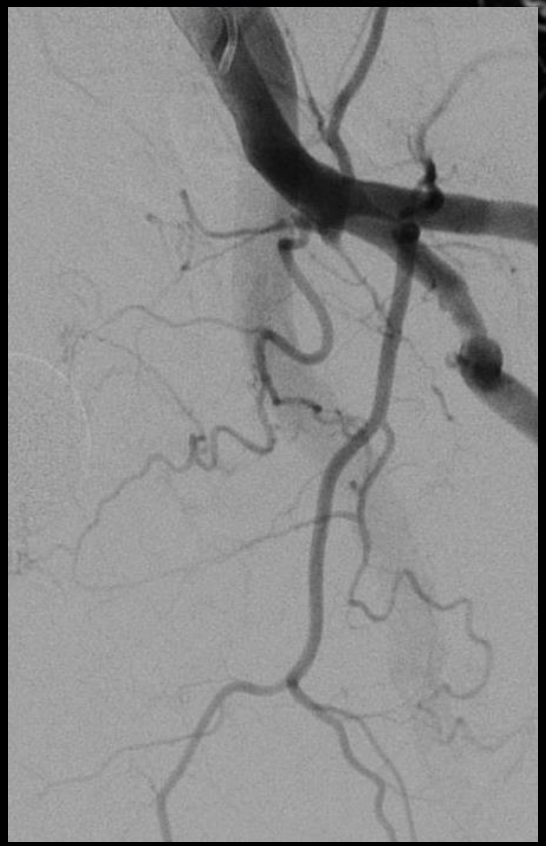
?


(Filt. 6)



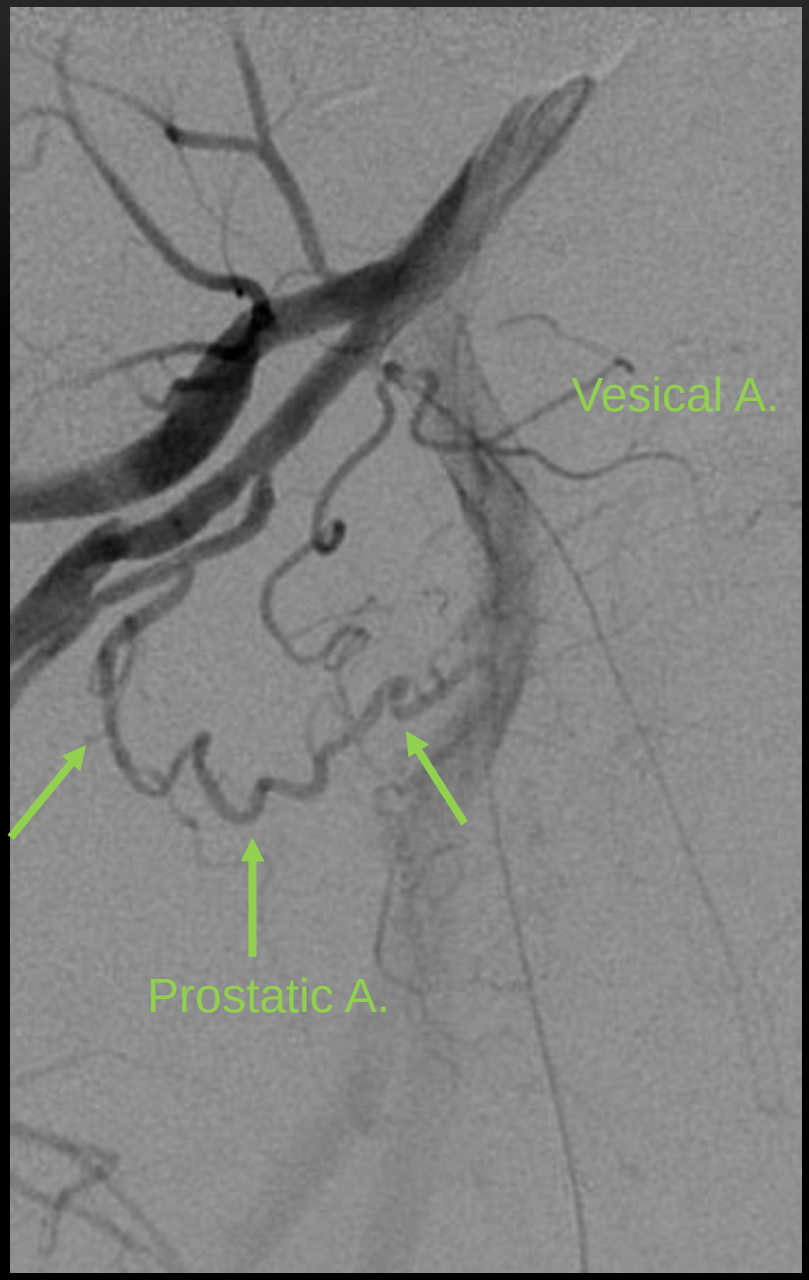
# Flight Plan (GE)

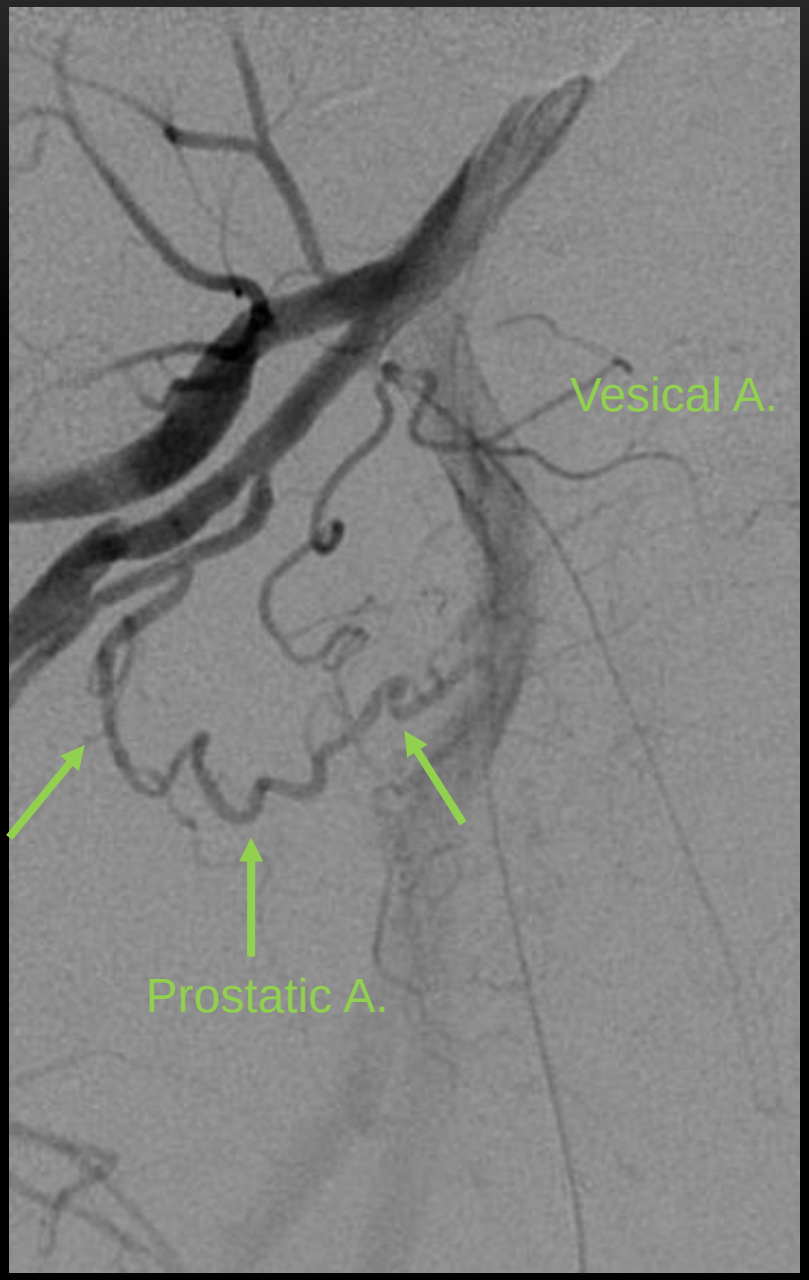


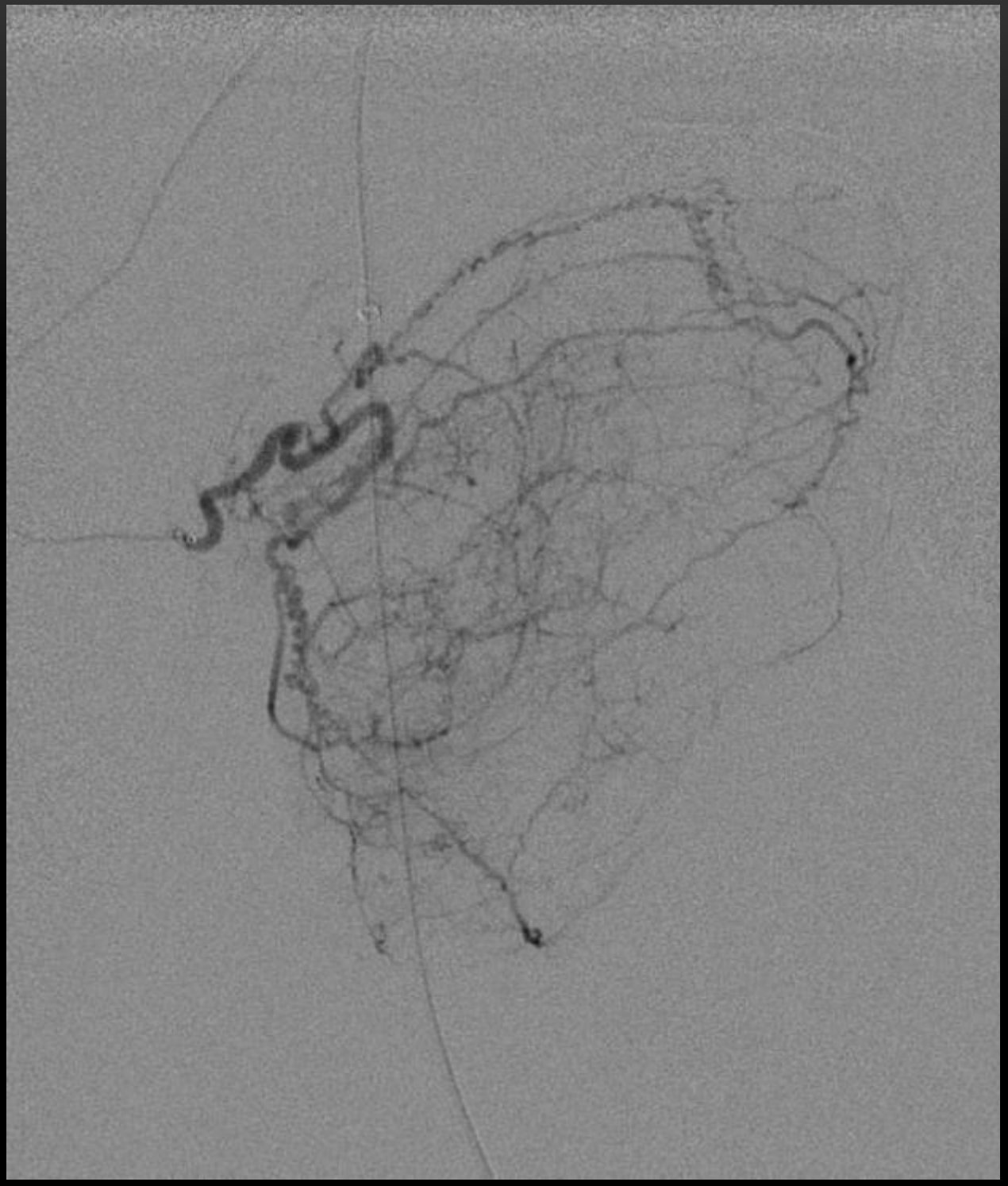



3D RoadMap

RAO 35°
Caud 10°

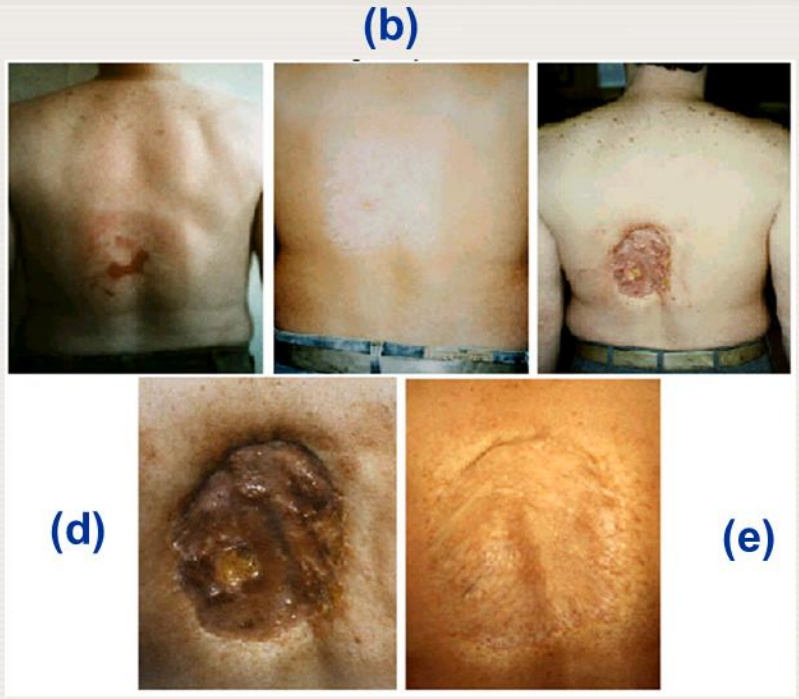

Vesical A.
Prostatic A.


Vesical A.
Prostatic A.



# ! RADIOPROTECTION EN RI

## Coronary angioplasty twice in a day followed by bypass graft because of complication. Dose ≈ 20 Gy (ICRP 85)

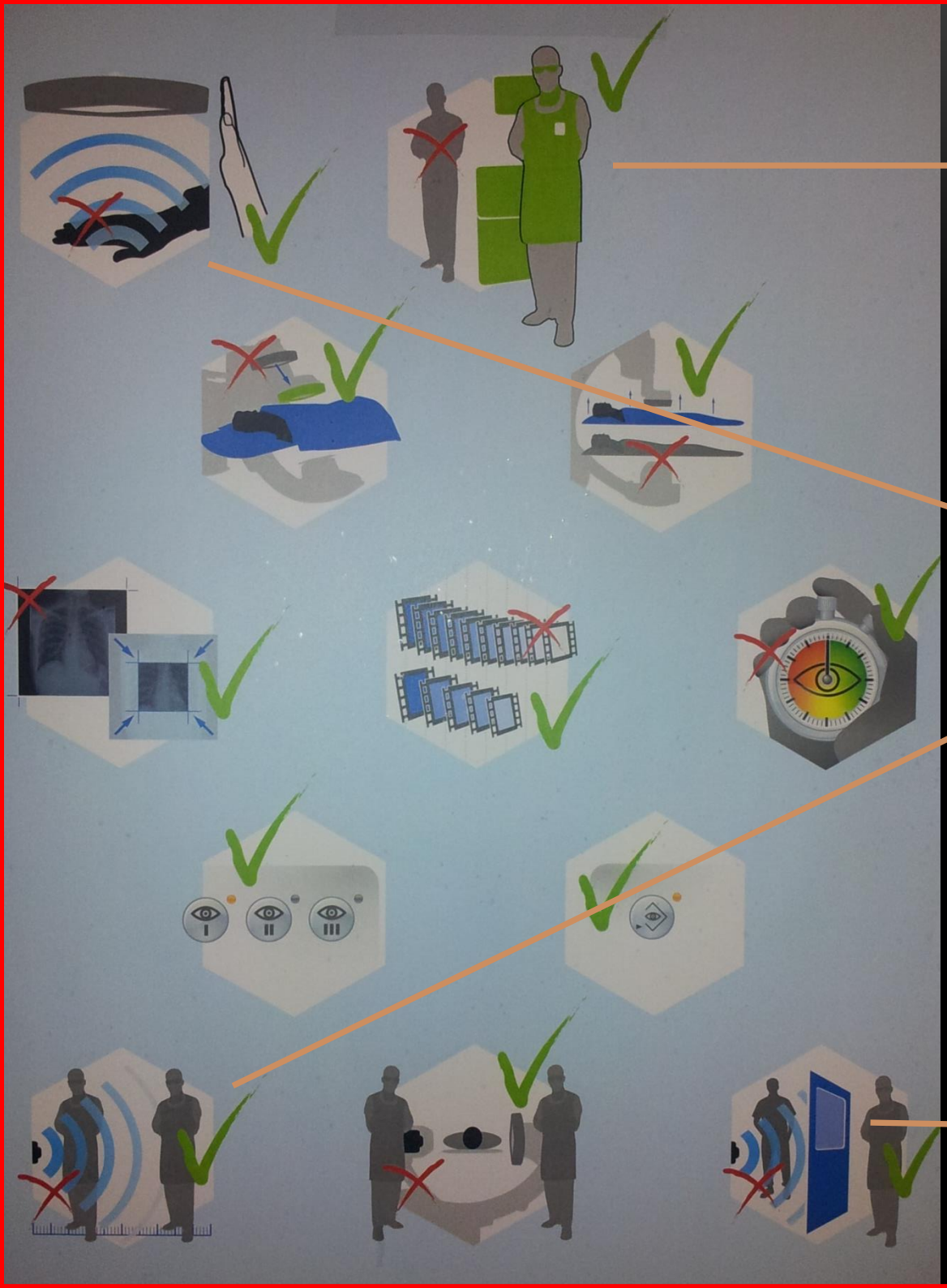



(a) 6-8 weeks after multiple coronary angiography and angioplasty procedures.
(b) 16-21 weeks
(c) 18-21 months after the procedures showing tissue necrosis .
(d) Close-up photograph of the lesion shown in (c).
(e) Photograph after skin grafting. (Photographs courtesy of T. Shope & ICRP).

IAEA


QUIZZ

***Comment optimiser la radioprotection en RxI ?***



<u>Protection du personnel:</u>

- Tablier plombé + cache-thyroïde
- Lunettes (médecin)
- (Gants, manchettes)

+ Dosimètres externe & interne
(idéalement dosimètre en tps réel)

Ne pas s'exposer directement aux Rx !

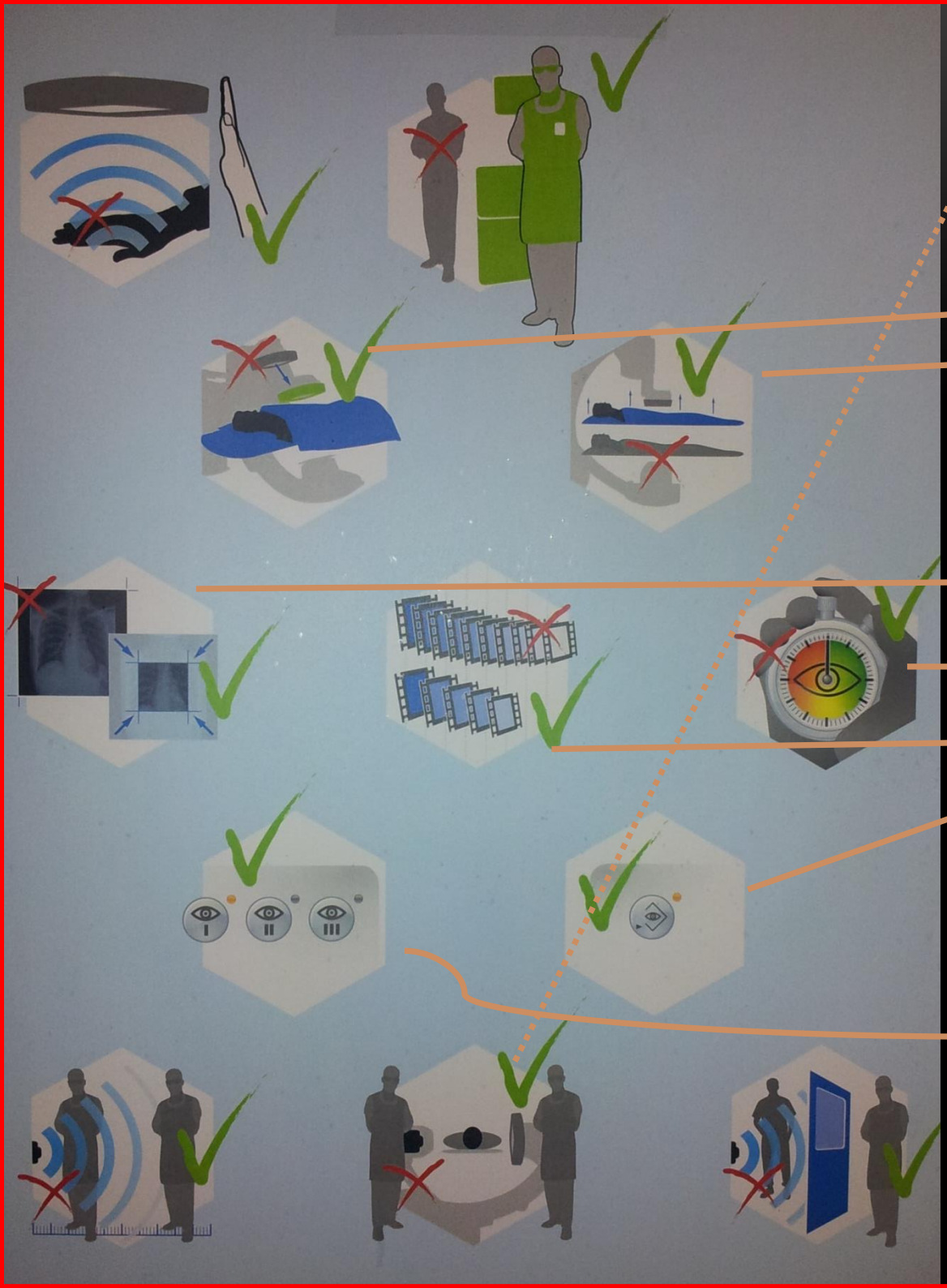
S'éloigner le + possible de la source des Rx (tube… mais aussi patient !)

↓dose ≈ ↑ (distance)²

Ecrans plombés fixes et mobiles

- suspendu entre le radiologue et le détecteur
- sur roulettes en salle
- jupe de table

+ Ne pas rester dans la salle si inutile
(ex: pdt les injections à la pompe !)



<u>Position tube-détecteur:</u>
Détecteur au dessus ou du côté radiologue – Tube en dessous ou du côté opposé au radiologue
= ↓ exposition au diffusé

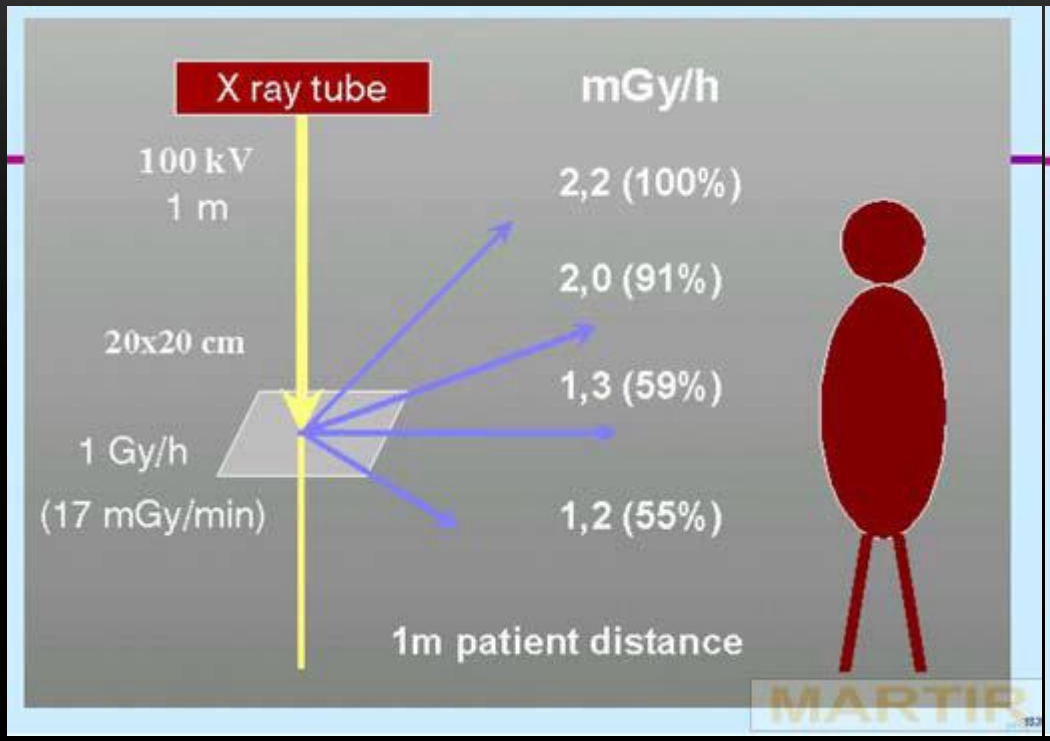
+ Détecteur le + près possible du patient
+ Tube le + loin possible du patient
= (↓ exposition au diffusé)
↑ qualité image

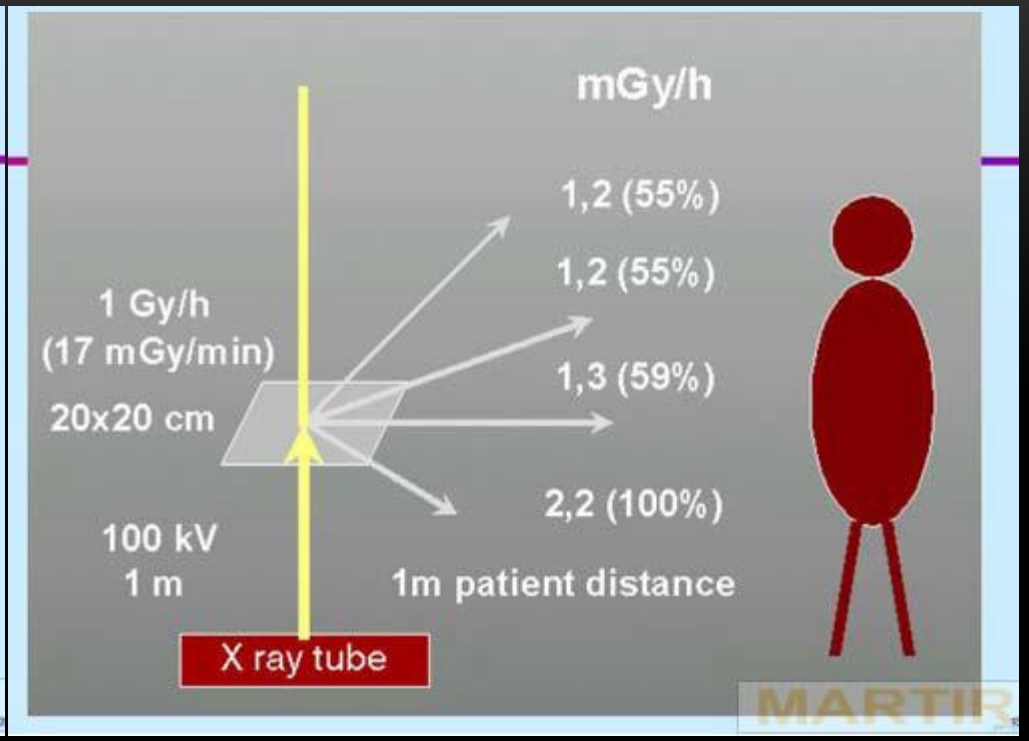
<u>Acquisition des images:</u>
- Diaphragmer, ↓champs d'irradiation
- Limiter le temps de scopie/graphie
- Limiter le nombre de pulses (i/s)
- Scopie plutôt que graphie
- Limiter le zoom (magnification)
- (aides à la navigation – ex: roadmap)

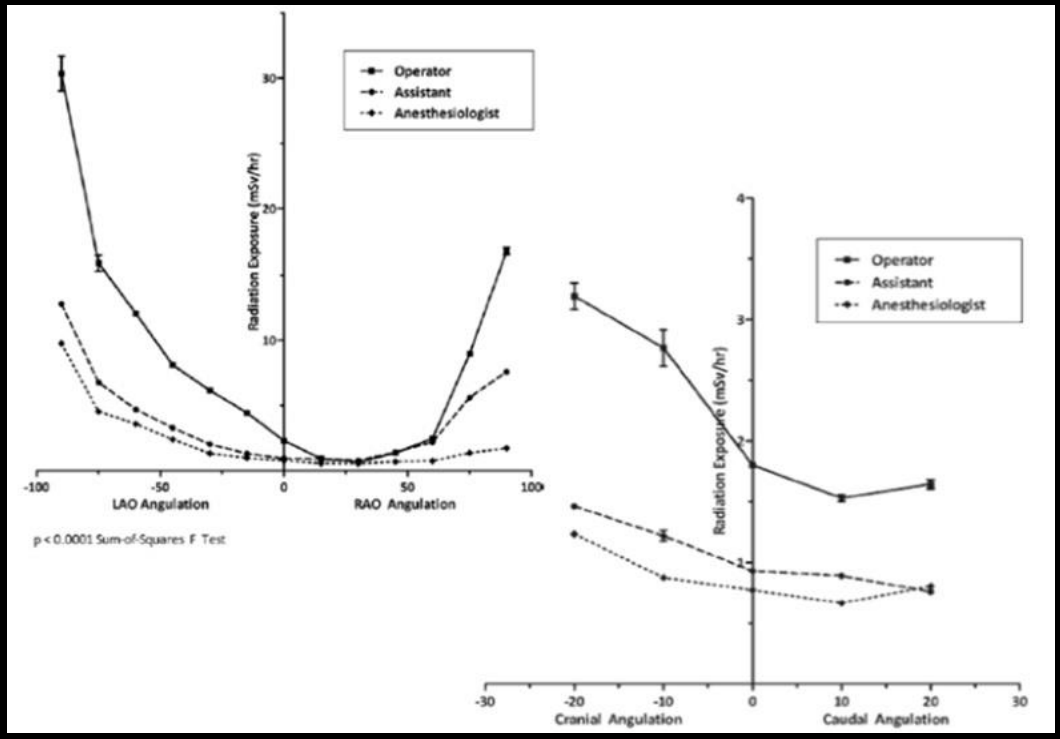
<u>Réglages machine (scopie / graphie):</u>
kV, mAs, limites de doses…
dose ~ mAs
dose ~ $kV^{2 \text{ à } 3}$

+ Filtres Cu (automatique)

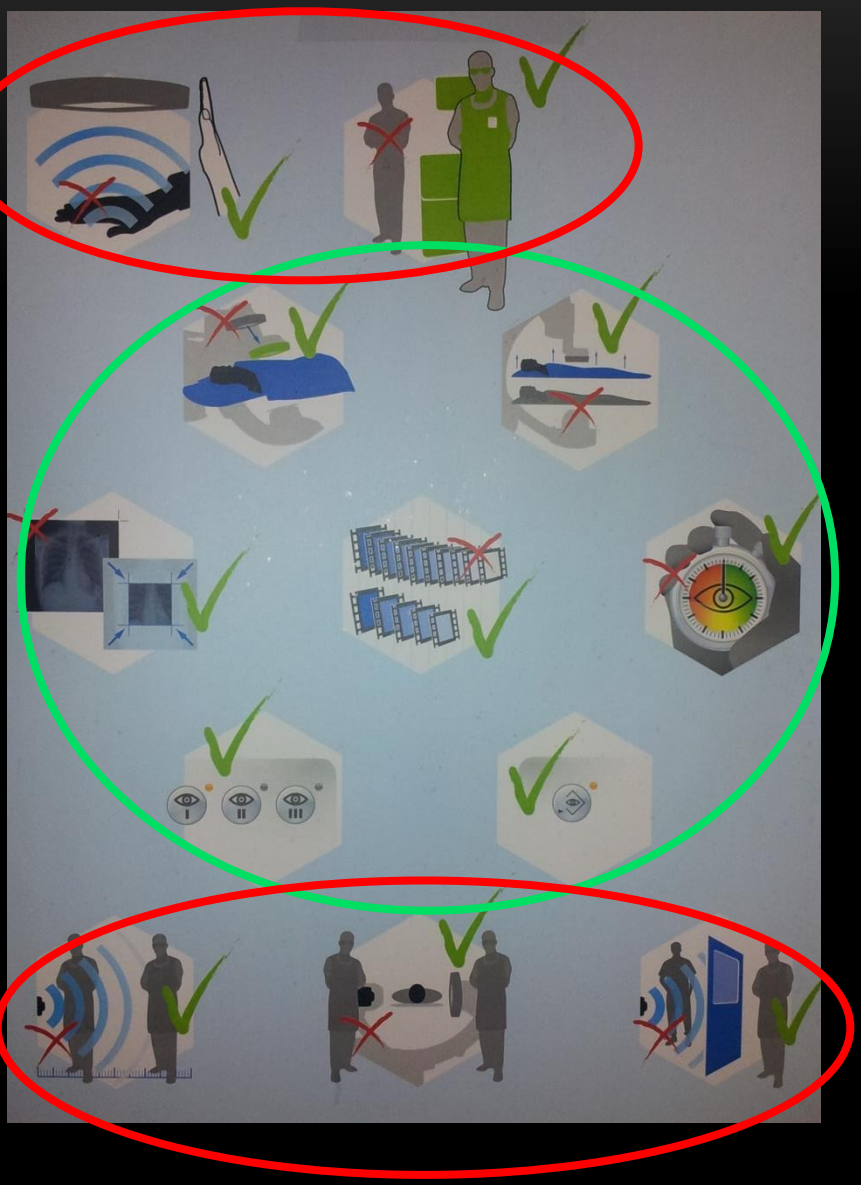
# A propos du rayonnement diffusé et de la position tube / détecteur…



# … radioprotection du patient ou du personnel ?



Radioprotection PATIENT = Personnel !
car ↓↓ Rx diffusés

Radioprotection PERSONNEL
sans effet sur la protection du patient

# Injecteur automatique de produit de contraste (1)

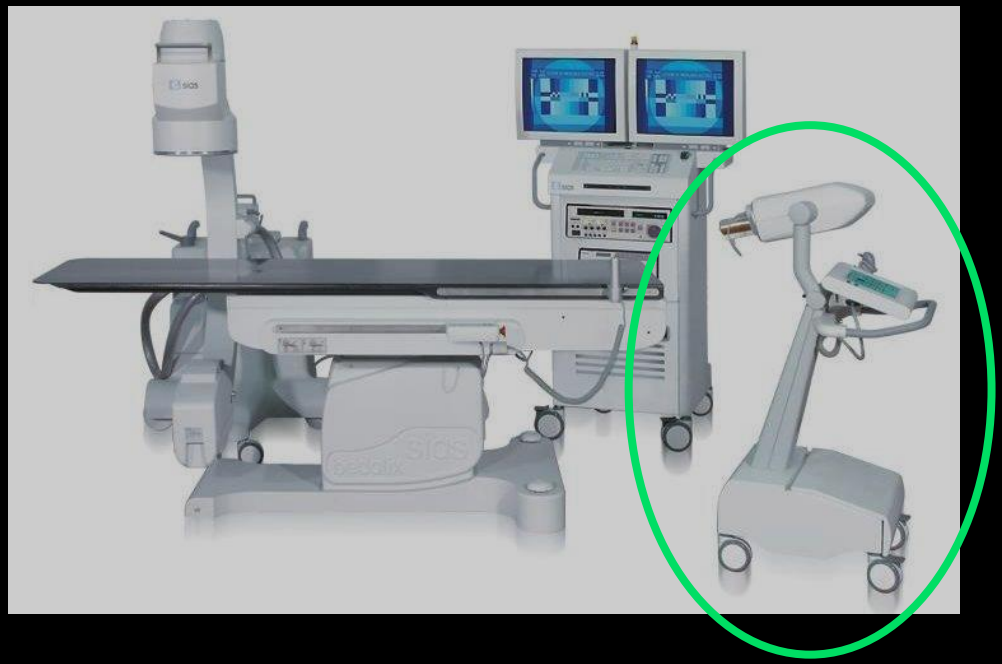
- **Couplé au C-arm**: injection automatique synchronisée avec l'acquisition des images
- Commande à distance (hors zone d'irradiation) ou pédale d'acquisition
- Réglages:
  - Volume injecté (mL)
  - Débit (mL/sec)
  - Pression maximale (PSI) – 750 (µcathéter >2,8Fr) à 1200 (cathéter 4Fr ou >)
  - Délai // acquisition image (injection anticipée ou retardée)

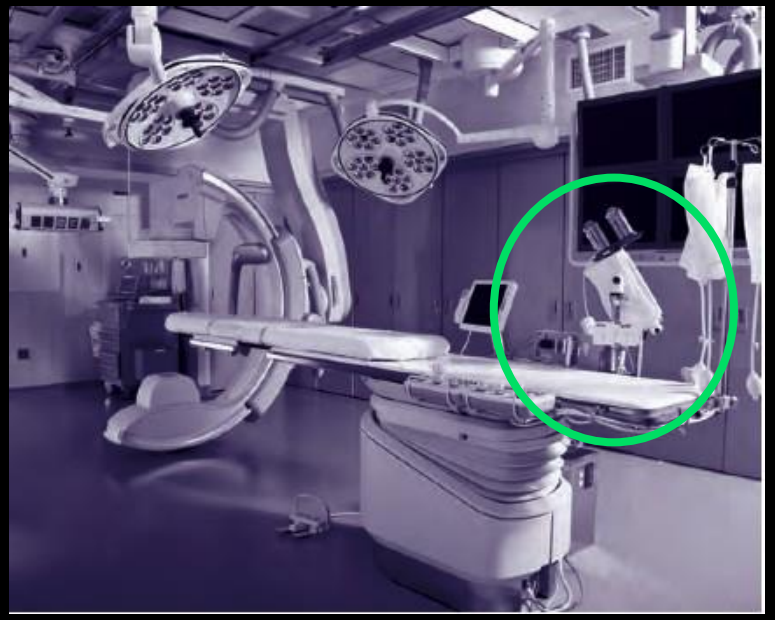

| Site d'injection | Débits(mL) / Volume(mL/sec) |
|---|---|
| Aorte | 12/24 |
| Iliaque | 6/15 |
| Carotide interne | 3-4/8-12 |
| Tronc coeliaque | 4/12 |
| Hépatique Dr ou G | 3/8 |
| *µcathé* | *0,5 à 3 / 4* |
| *CBCT / angio 3D* | *Volume suivant durée acquis.* |

# Injecteur automatique de produit de contraste (2)

- Fixé sur la table de RI *ou* mobile; en dehors du champ opératoire, sans contact direct avec le champ stérile
- Seringue, kit d'injection et tubulure stériles, à *usage unique*…

(… ou si seringue et kit d'injection à usage multiple en Belgique – 1x/j – avec *valve anti-reflux*)





# Produit de contraste iodé

- **« Hypo- » (700 mOsm) ou iso- (300 mOsm) osmolaire, non-ionique**
  - Basse osmolalité (LOCM): Ultravist, Xenetix, Omnipaque, Iomeron, Optiray
  - Iso-osmolalité: Visipaque
- Chauffé à température corporelle dans l'injecteur (↓ viscosité)

- BUT: minimiser les effets secondaires *immédiats*, en particulier *les nausées et vomissements* (mouvement du patient)

→ le + souvent = Visipaque 320 (hors neuro) ou Visipaque 270 (neuro)

| | Produits haute osmolalité, ioniques IV | Produits faible osmolalité, non ioniques IV |
|---|---|---|
| **Réactions immédiates *** | | |
| Réaction Modérées | 3.8–12.7 % | 0.7–3.1 % |
| Réaction sévère | 0.1–0.4 % | 0.02–0.04 % |
| Décès ? | 1/100 000 | 1/100 000 |
| **Réactions non-immédiates †** | | |
| Exanthème ‡ | 1 à 3 % | |

# GUIDAGE: US

- Avantages

  - **temps réel, pas de contrainte de plan de coupe**
  - possible au lit du patient
  - **+/- fusion images** CT injecté, IRM, PetCT...
  - **+/- contraste échographique** (Sonovue)
  - disponibilité +++, non irradiant

- Inconvénients

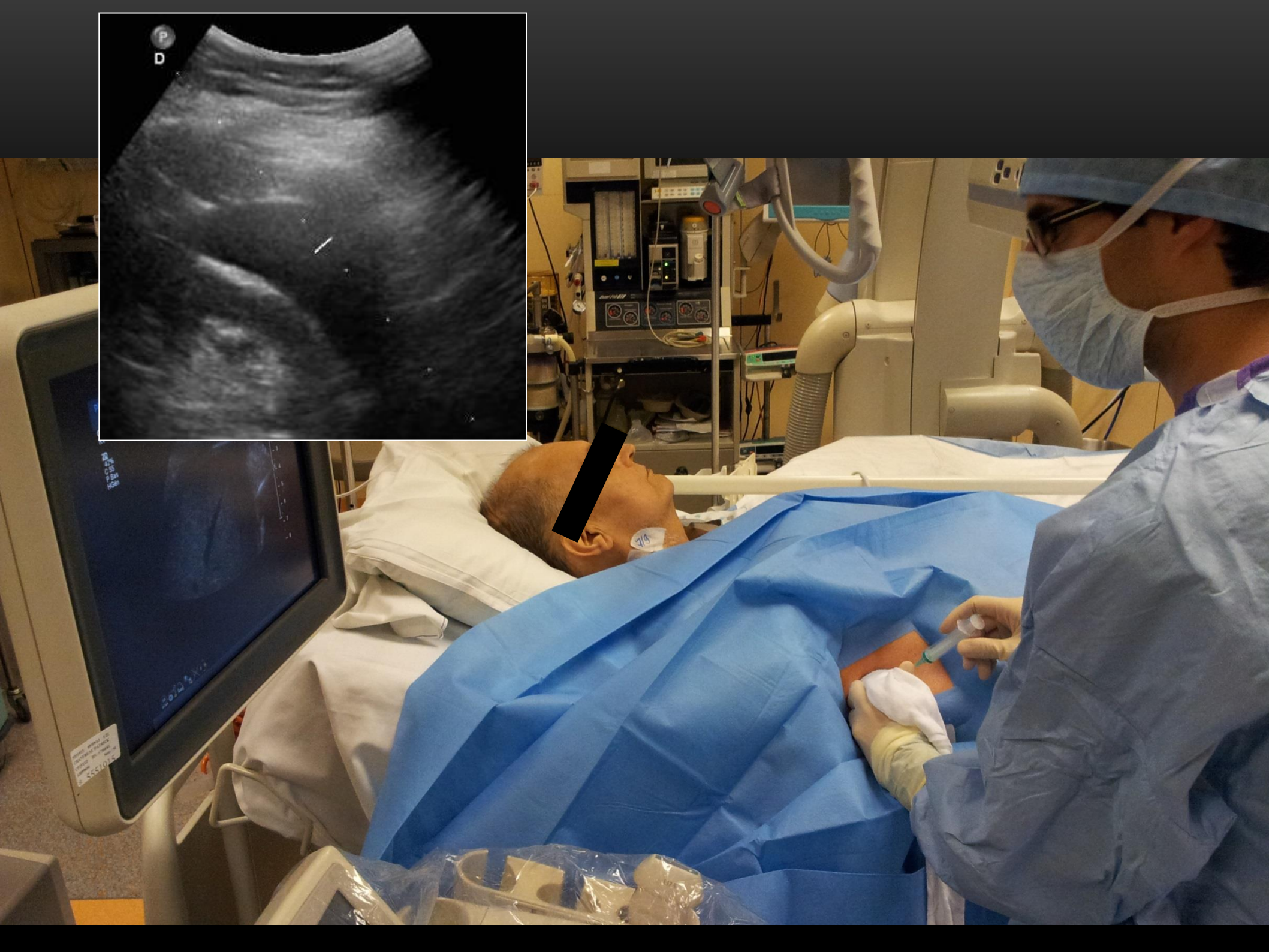
  - Conditionné par la visibilité de la lésion ET de la voie d'accès
  - Visibilité du matériel utilisé ? → matériel « écho-type » dédié, ligne de guidage

- Indications:

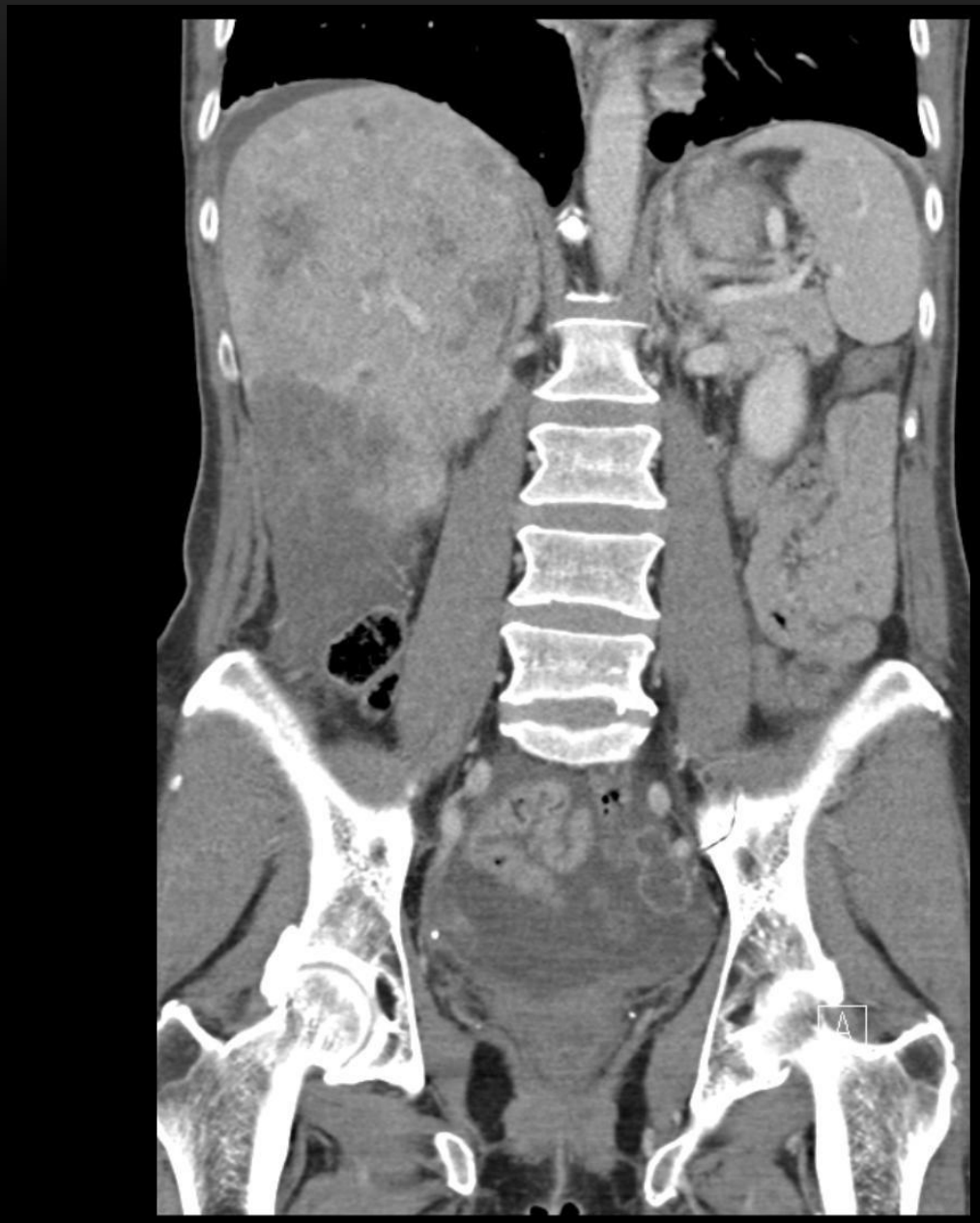
  **Abdomen**, **Cou**, Thorax (plèvre), Ostéo-articulaire

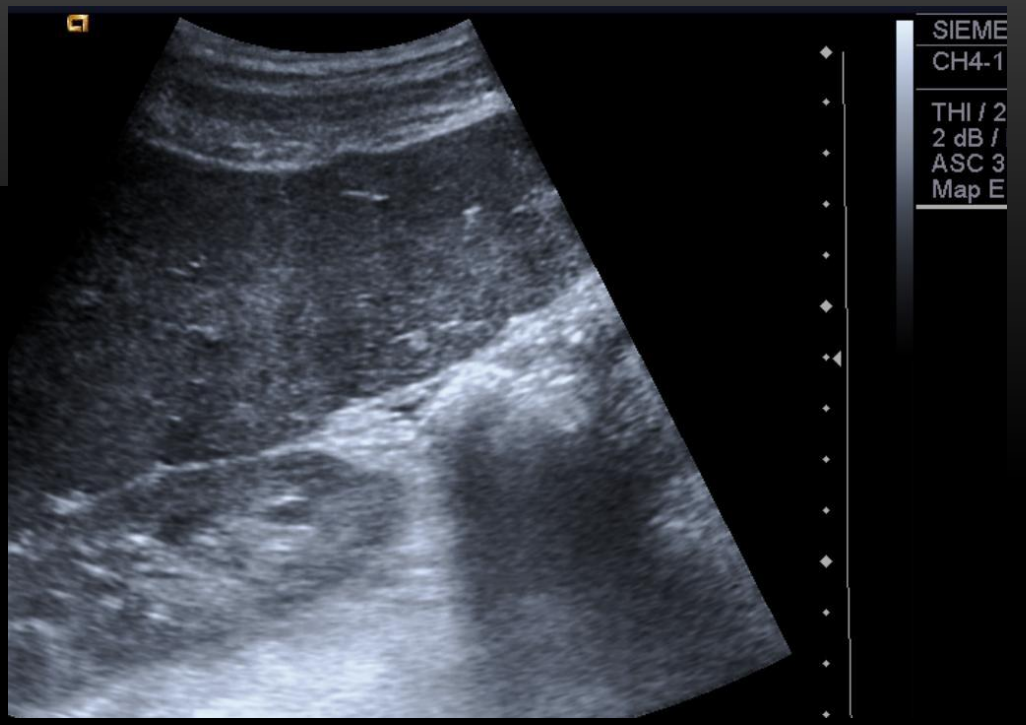

B
A
4C1

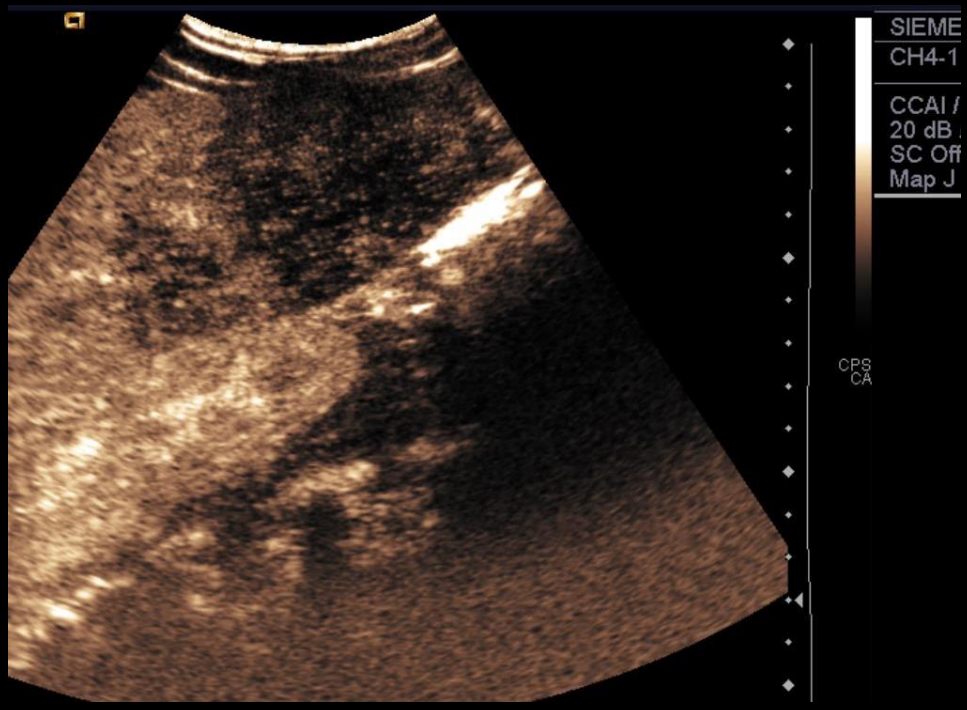

Aquaseal


P
D

→ **Contraste échographique** (Sonovue)

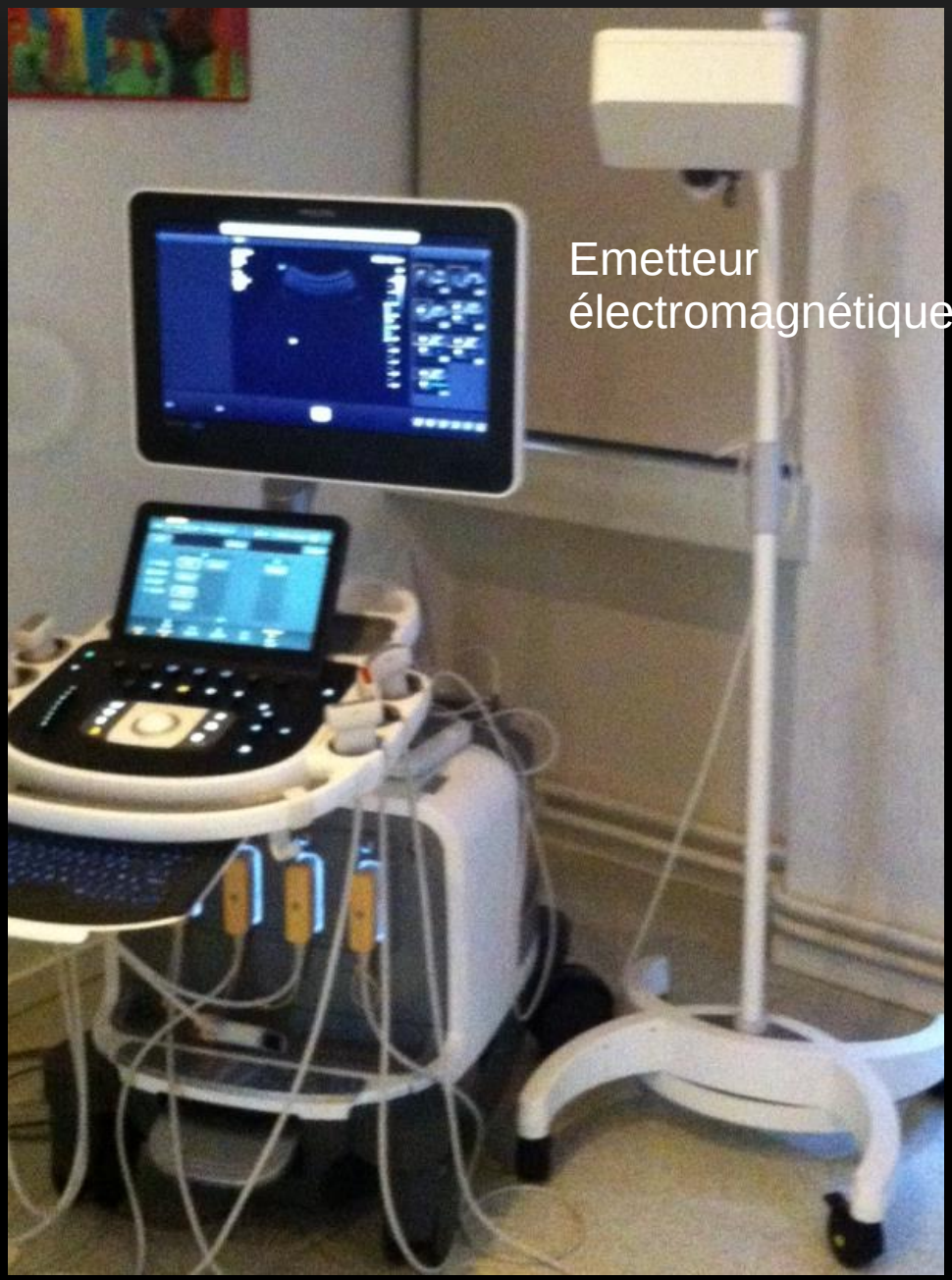


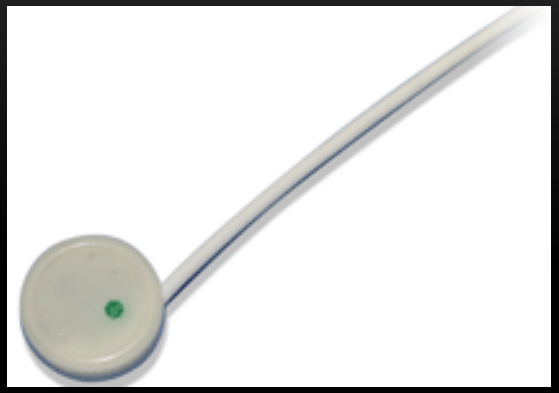



Courtesy Dr S.Drisis
Institut Jules Bordet

→ **Navigation contrôlée + Fusion multimodale**
(ex: Percunav Philips)

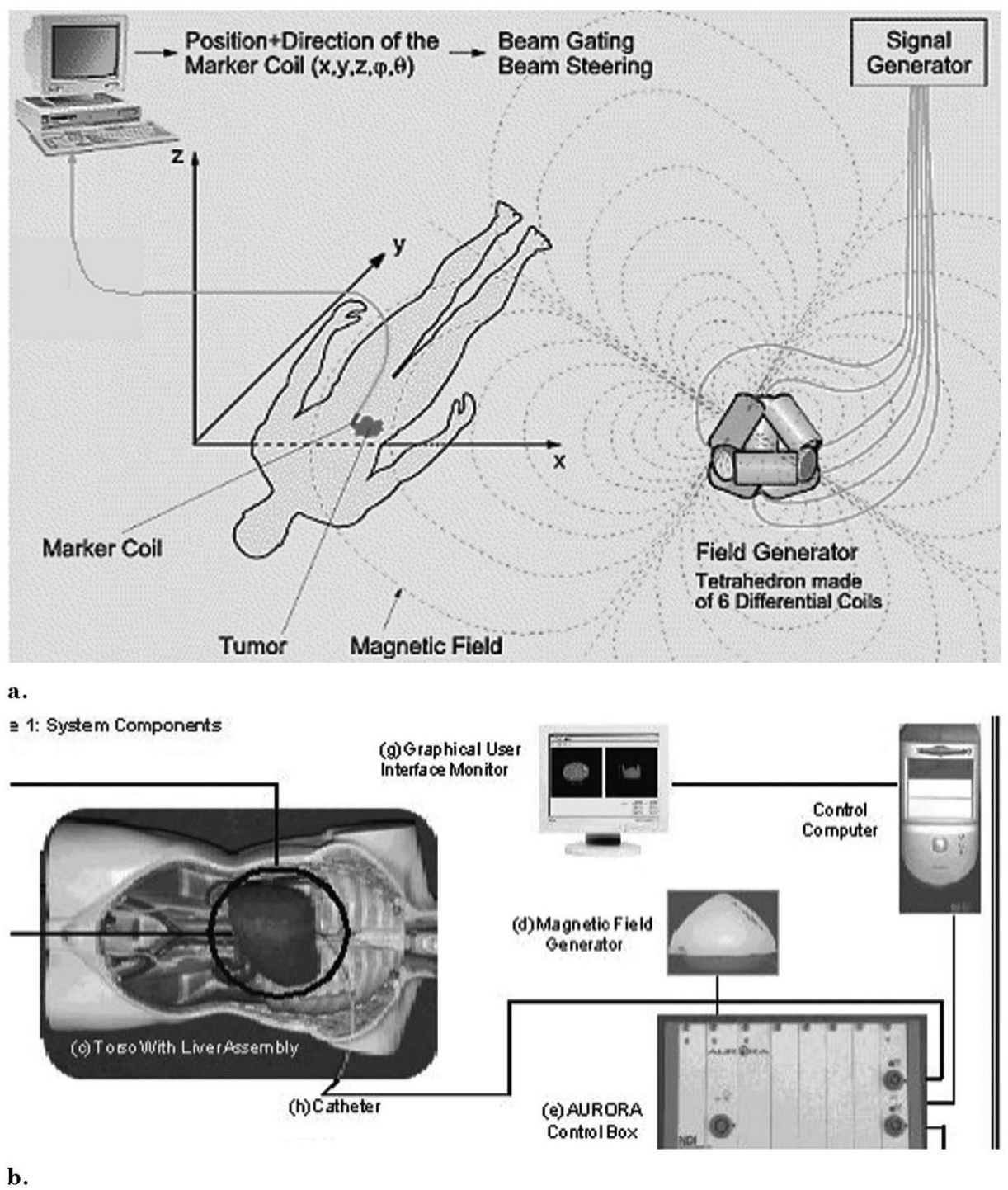


Capteurs électromagnétiques
(patient et sonde +/- aiguille)

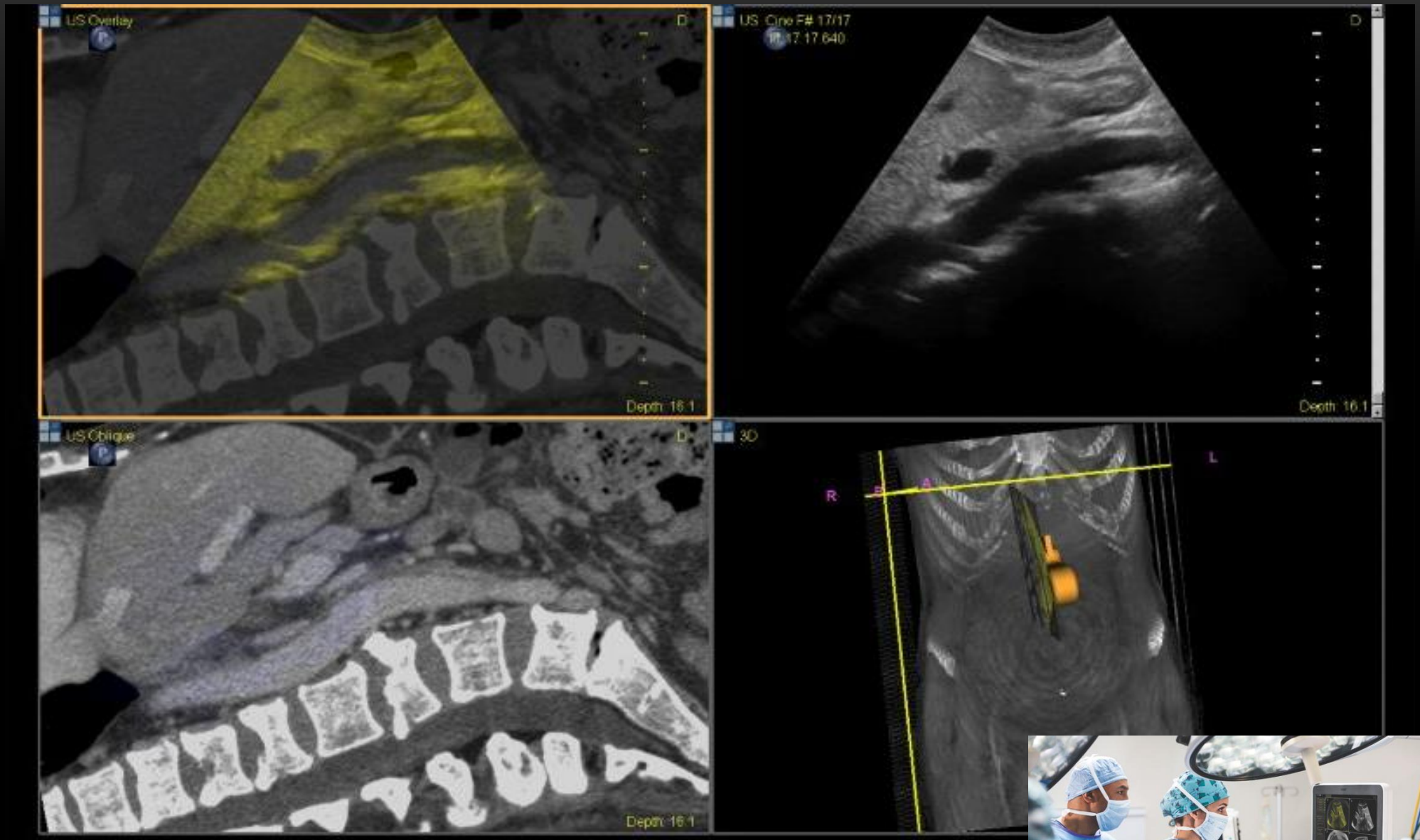
Courtesy Dr S.Drisis
Institut Jules Bordet

# Le système détermine la position du capteur mobile par rapport à un émetteur fixe



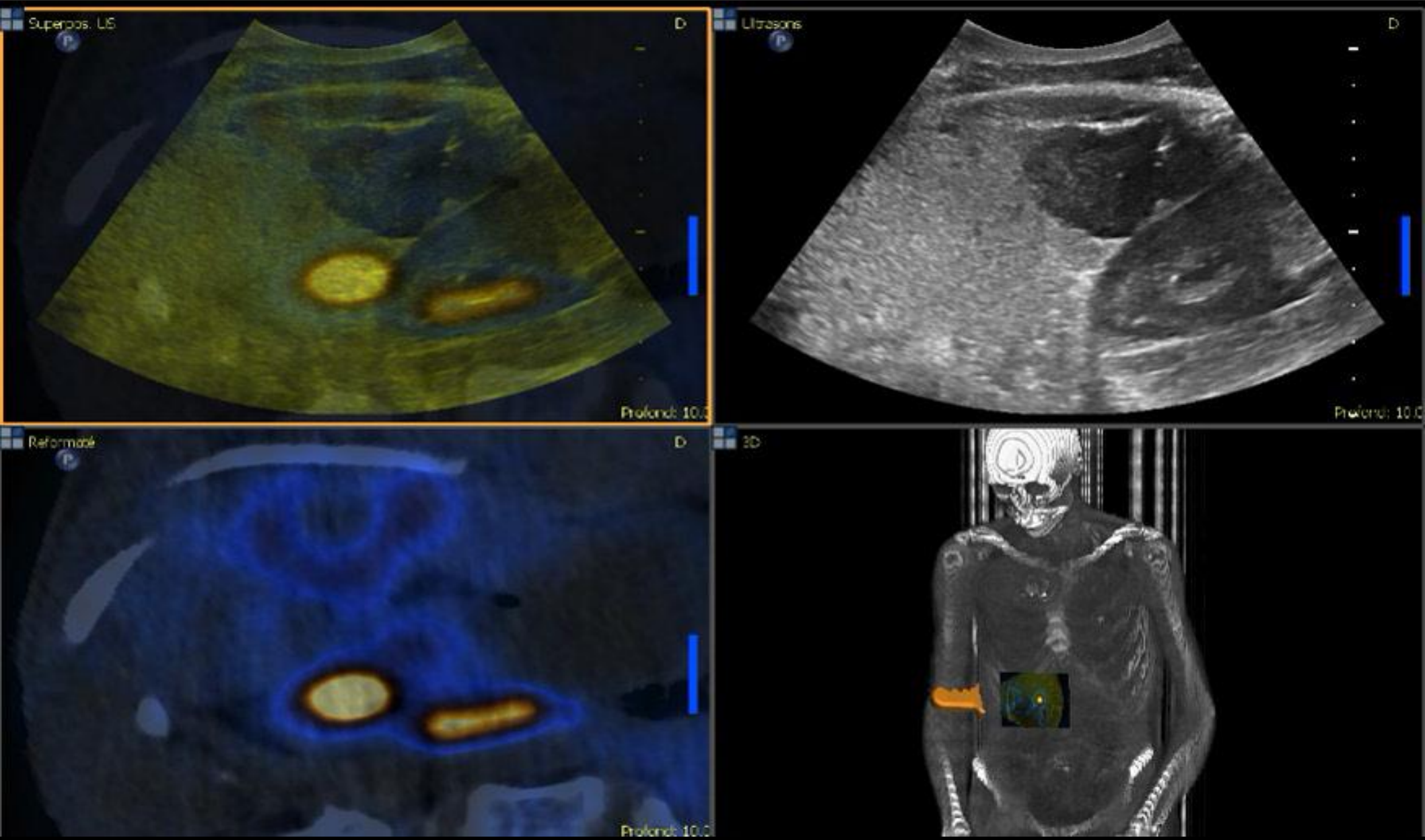

Wood BJ, et al. Navigation with electromagnetic tracking for interventional radiology procedures: a feasibility study. J Vasc Interv Radiol. 2005 Apr;16(4):493-505.

Une fusion des images US est alors possible avec un volume CT, IRM ou PET



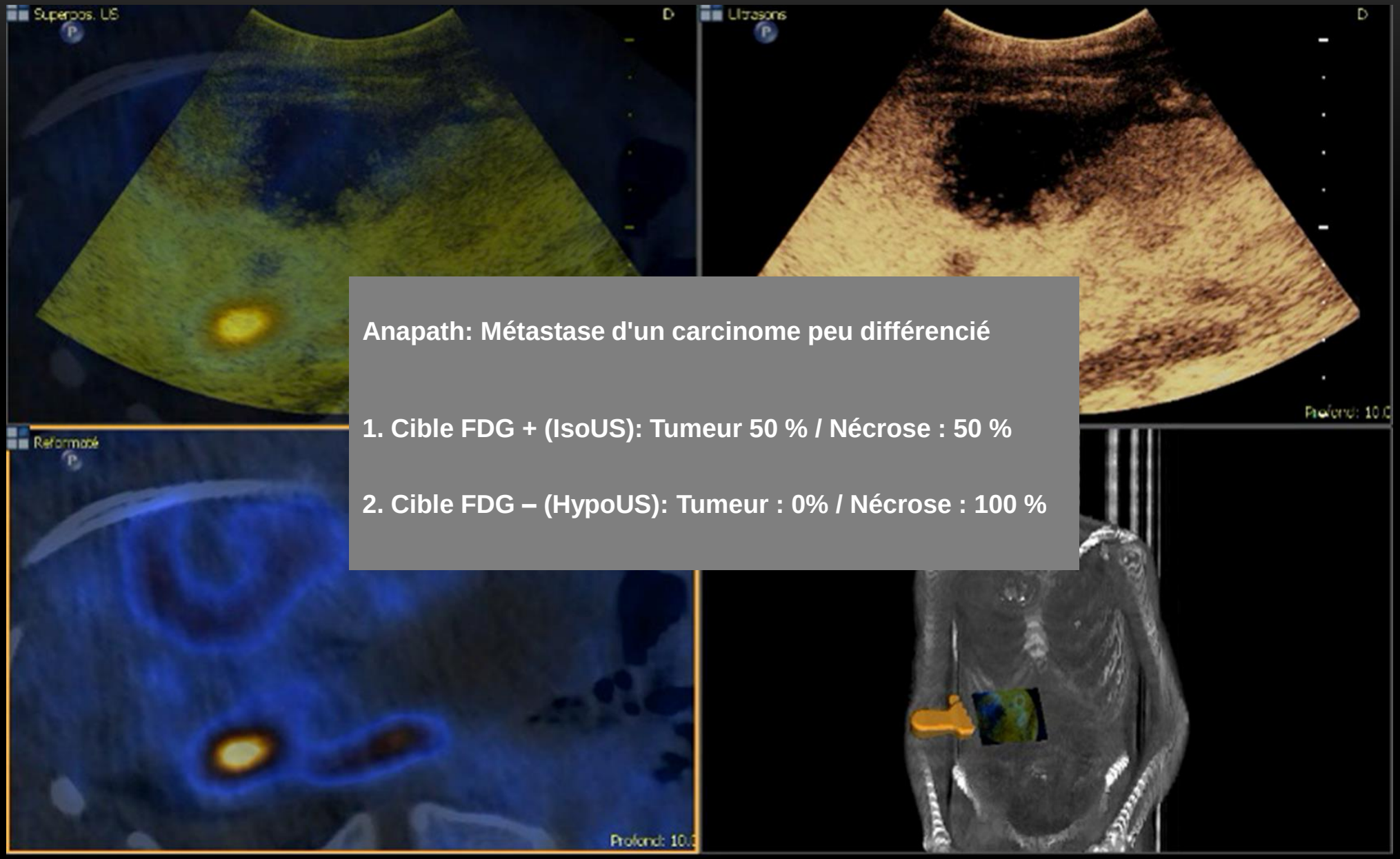

CT AND ULTRASOUND FUSION OF AORTA

*Exemple: Biopsie d'une lésion hépatique – Fusion US + PET-CT*




Courtesy Dr S.Drisis
Institut Jules Bordet

*Exemple: Biopsie d'une lésion hépatique – Fusion US + PET-CT*




**Anapath: Métastase d'un carcinome peu différencié**

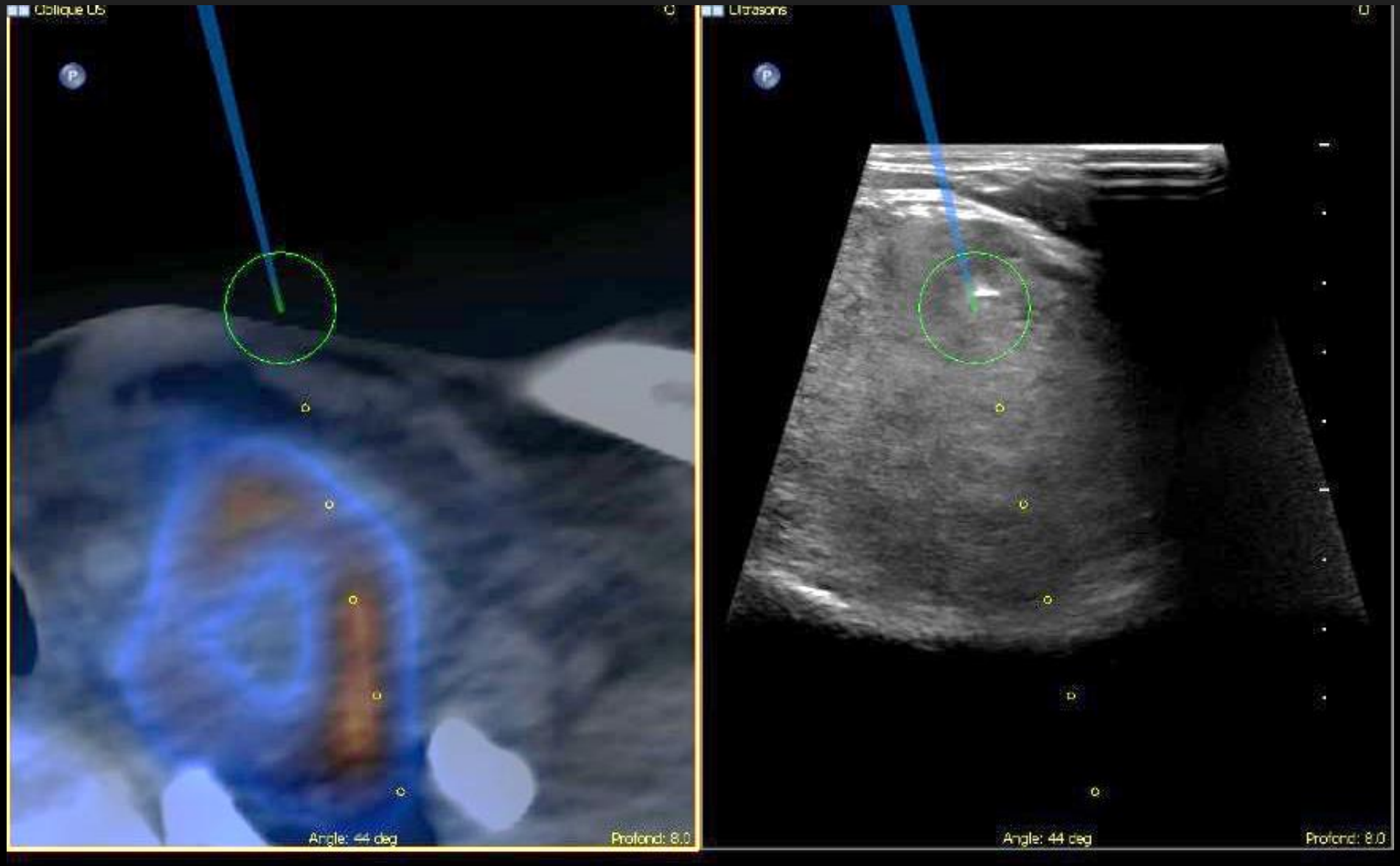
**1. Cible FDG + (IsoUS): Tumeur 50 % / Nécrose : 50 %**

**2. Cible FDG – (HypoUS): Tumeur : 0% / Nécrose : 100 %**

Courtesy Dr S.Drisis
Institut Jules Bordet

*Exemple: Biopsie d'une masse cervicale – Fusion US + PET-CT*

*+ Navigation avec détection de l'aiguille !*




Courtesy Dr S.Drisis
Institut Jules Bordet

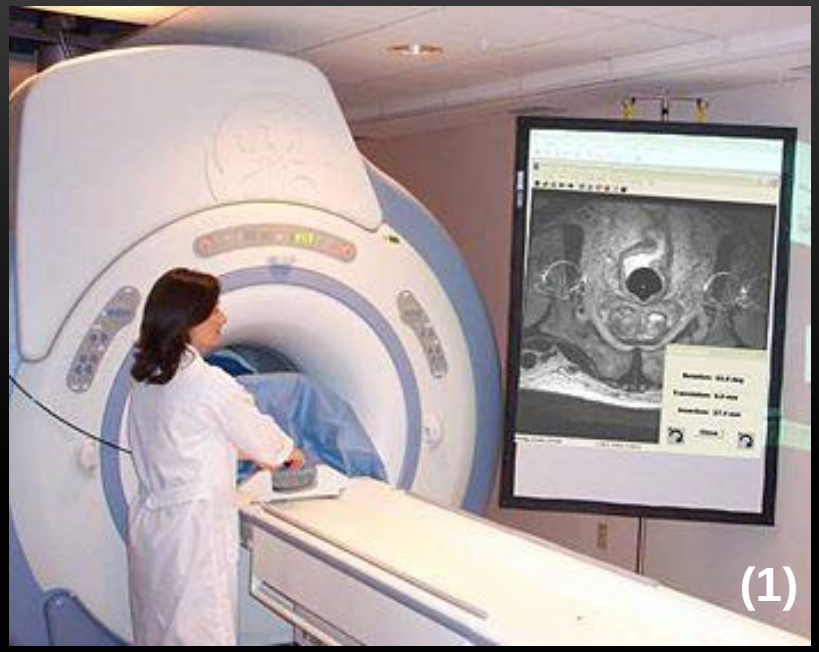
# GUIDAGE: IRM

- Avantages
  - **Résolution en contraste +++** (visibilité lésion + résultat)
  - Non irradiant

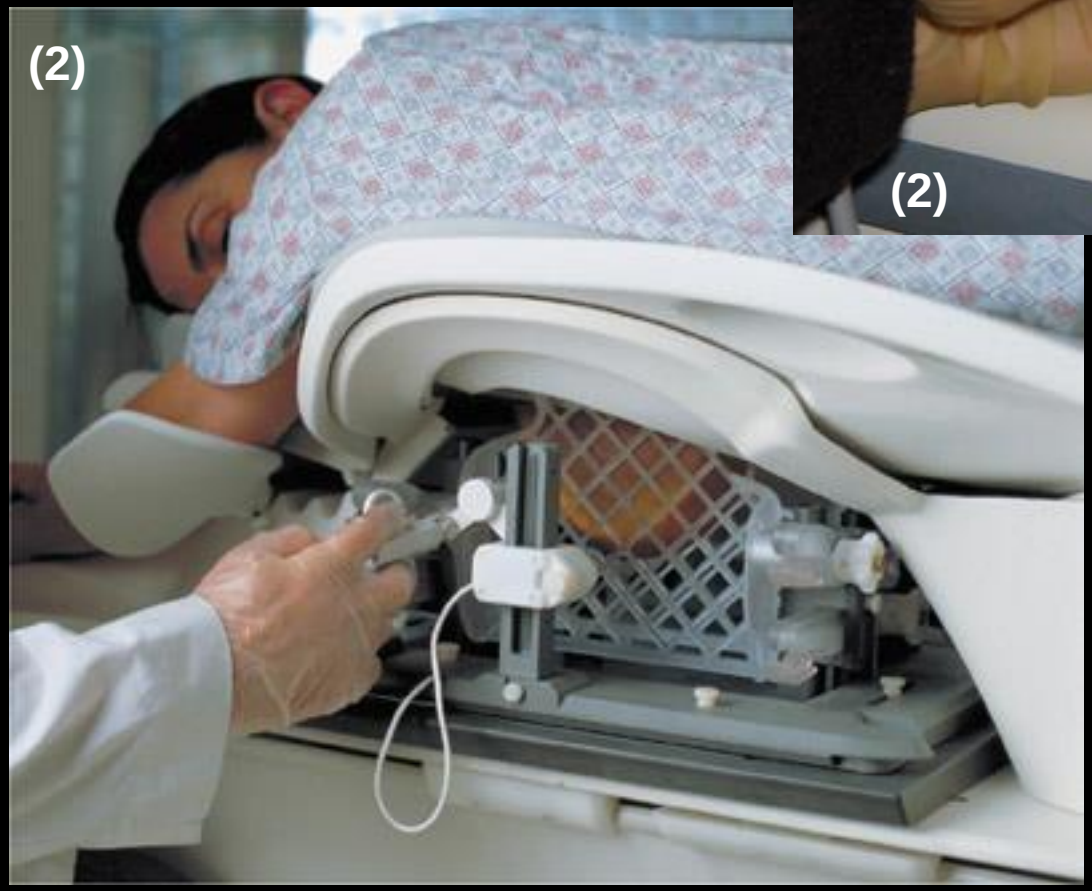
- Inconvénients
  - Matériel compatible IRM
  - Espace de travail
  - Durée des acquisitions
  - Disponibilité ! Rentabilité…

- Indications:

  **Sénologie (biopsies),** Abdomen (ablations tumorales)

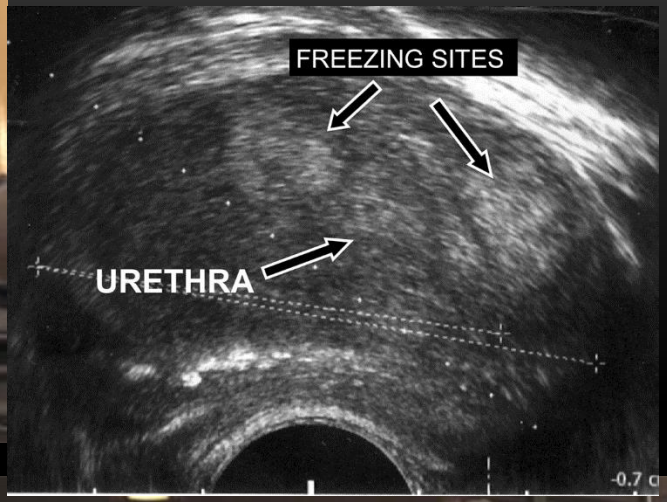







**Prostate (1), Sénologie (2) :**
**→ Biopsies**

EUS




*J Vasc Interv Radiol*. Author manuscript; available in PMC 2012 October 1.

Published in final edited form as:
*J Vasc Interv Radiol*. 2011 October ; 22(10): 1427–1430. doi:10.1016/j.jvir.2011.08.010.

## MRI guided cryoablation for the treatment of benign prostatic hyperplasia

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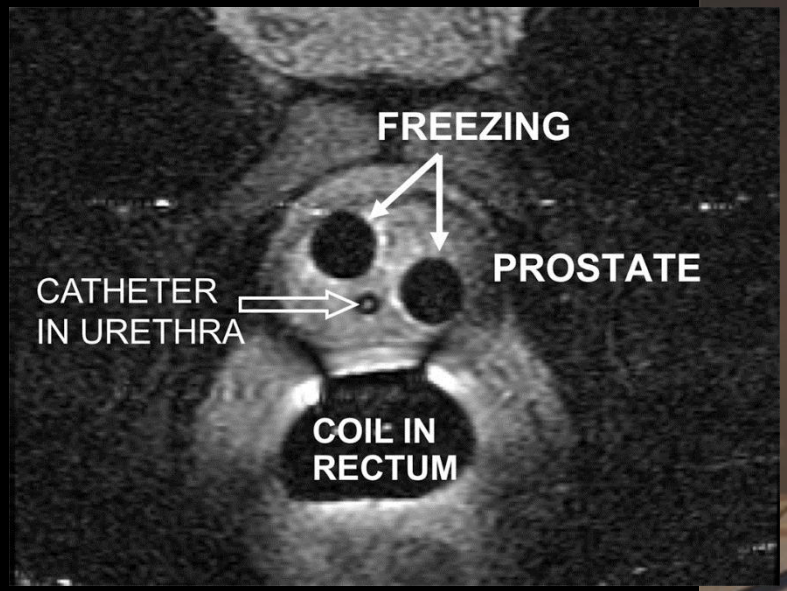
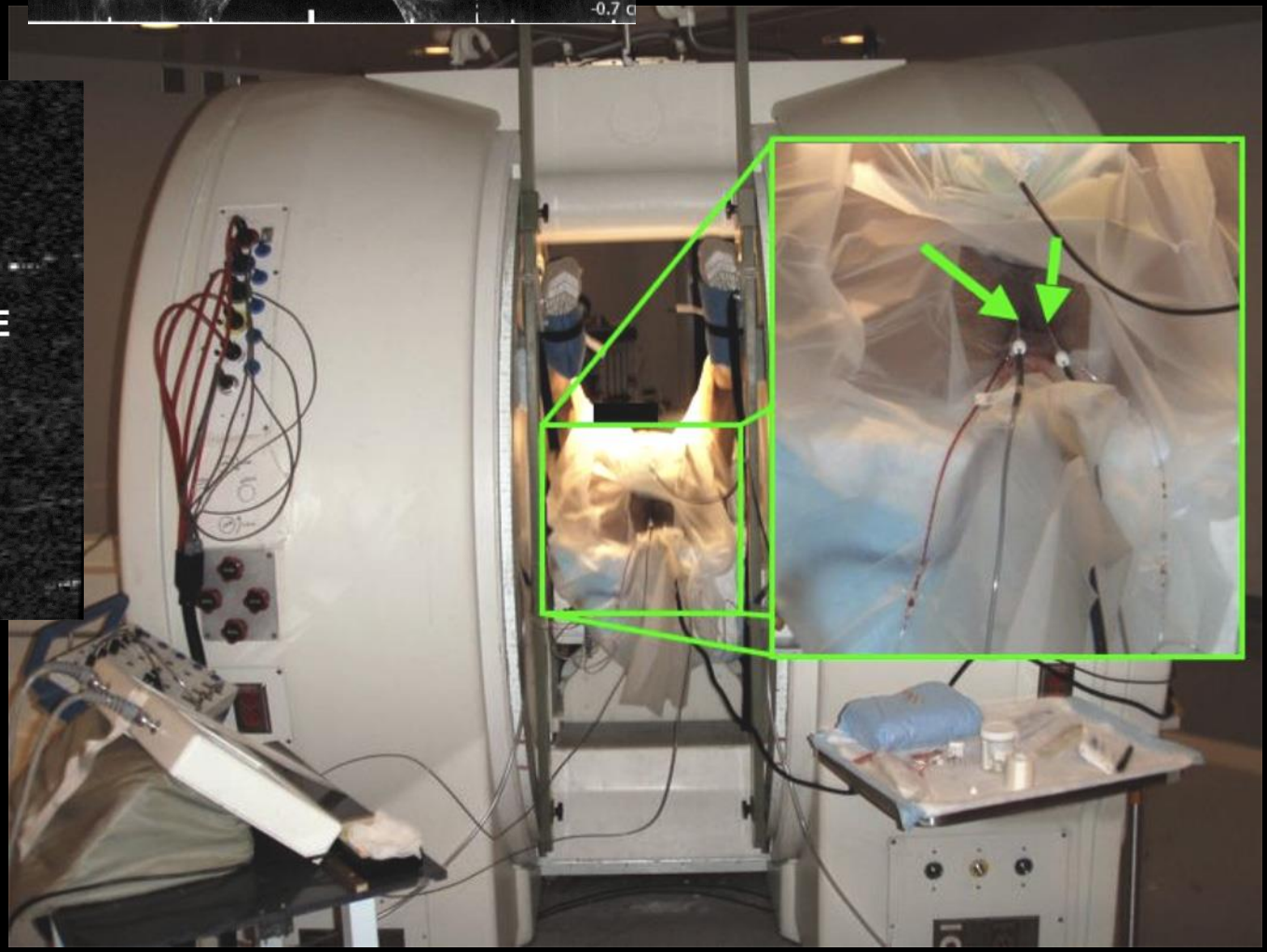
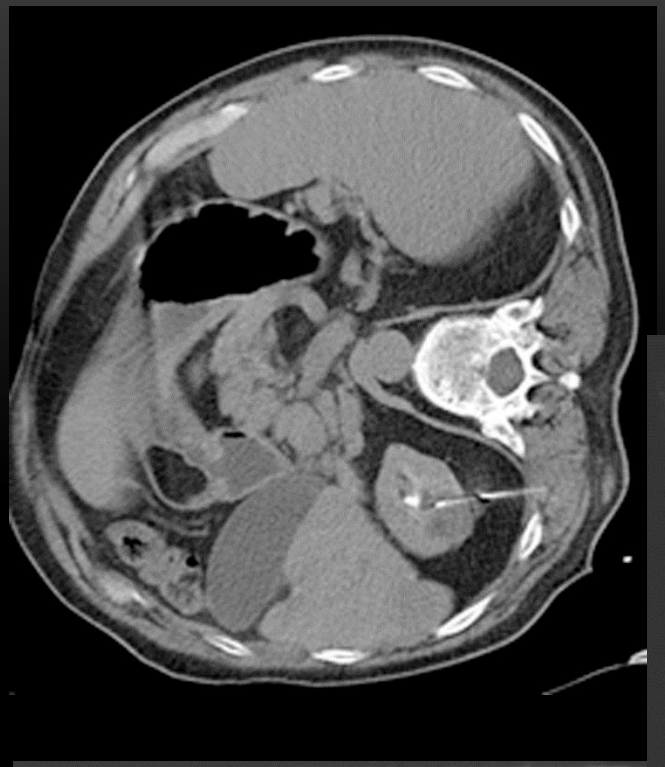
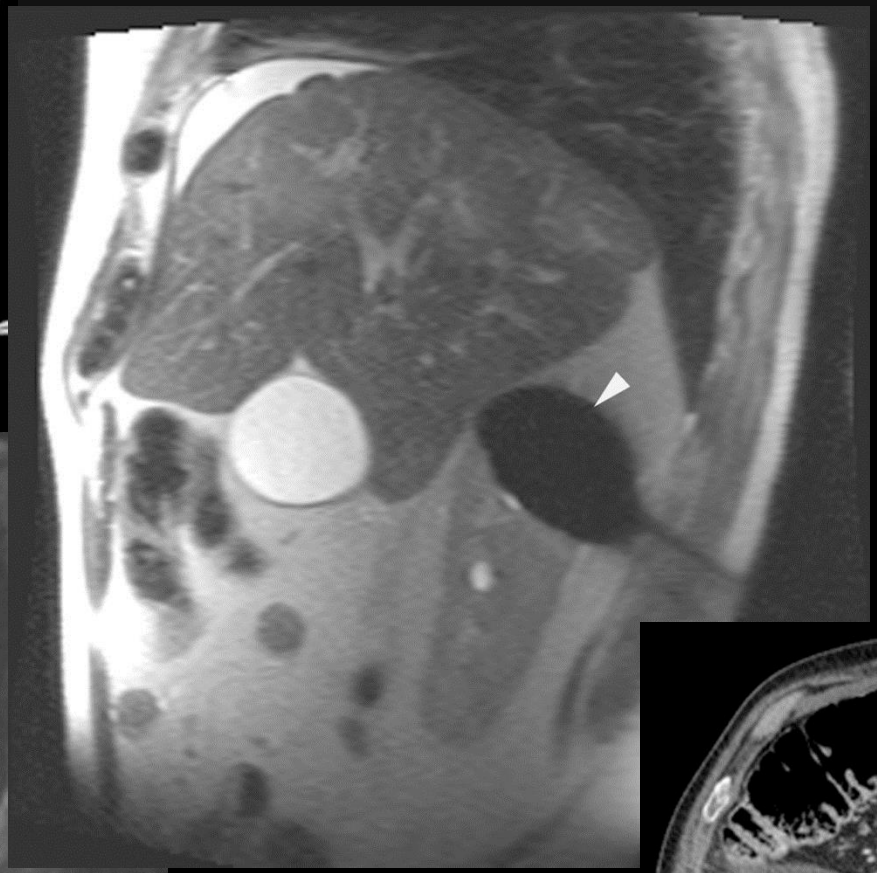
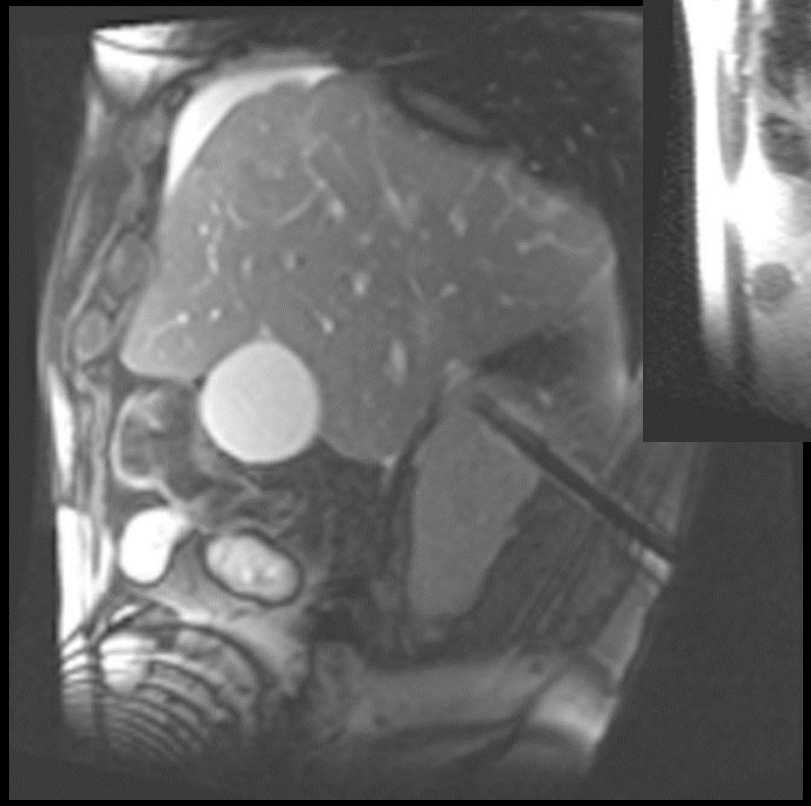



IRM









*Invest Radiol*. Author manuscript; available in PMC 2014 June 01.

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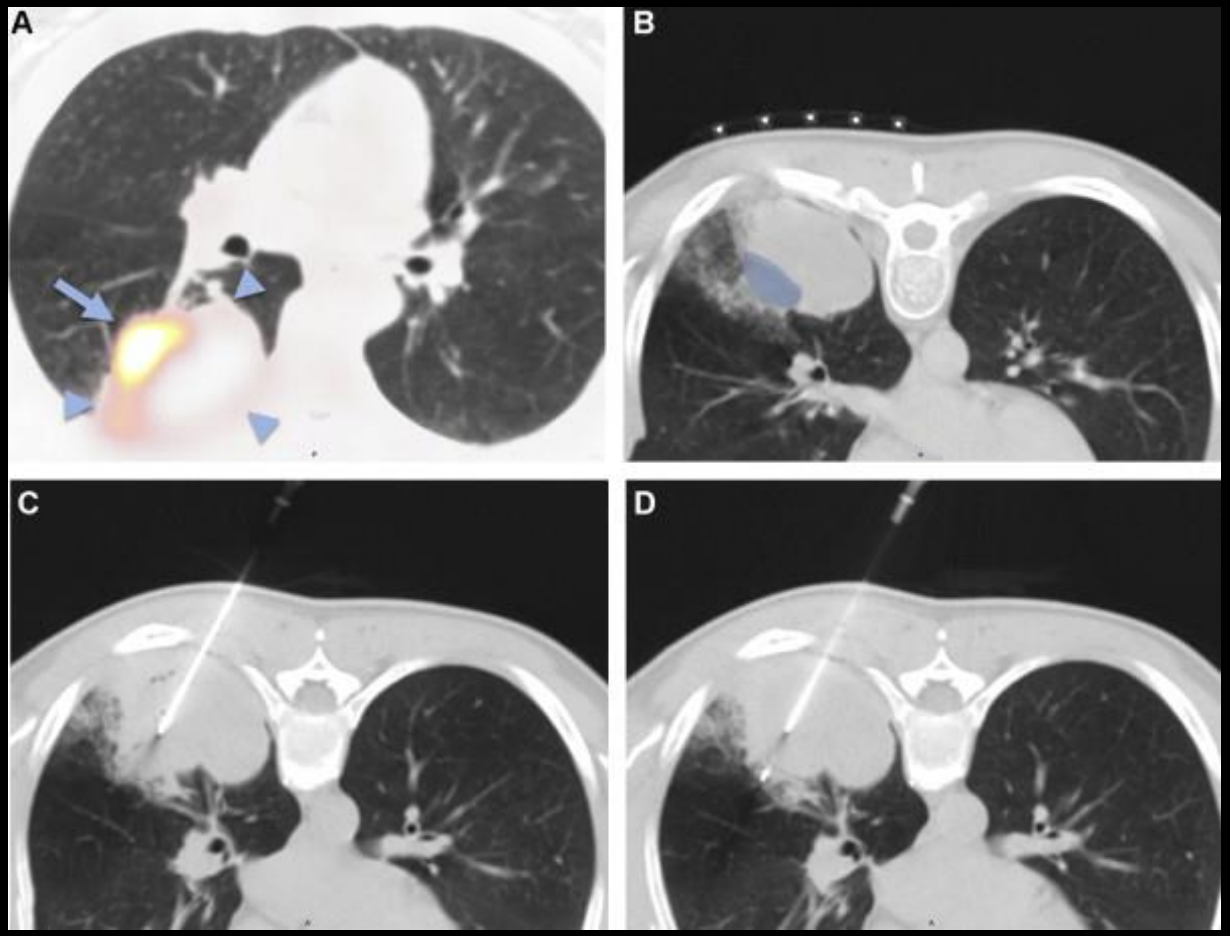
*Invest Radiol*. 2013 June ; 48(6): 437–444. doi:10.1097/RLI.0b013e31828027c2.

# Real-Time MRI-Guided Cryoablation of Small Renal Tumors at 1.5 T

**Kamran Ahrar, MD**[1,*], **Judy U. Ahrar, MD**[1], **Sanaz Javadi, MD**[1], **Li Pan, PhD**[2], **Denái R. Milton, MS**[3], **Christopher G. Wood, MD**[4], **Surena F. Matin, MD**[4], and **R. Jason Stafford, PhD**[5]

# GUIDAGE – IMAGERIE FONCTIONNELLE

| Perfusion | PET/scinti | Elastographie (US) |
|---|---|---|
| Viser les zones les plus perfusées | Viser les zones avec les SUV max. | Viser les zones les plus « dures » (sein) |



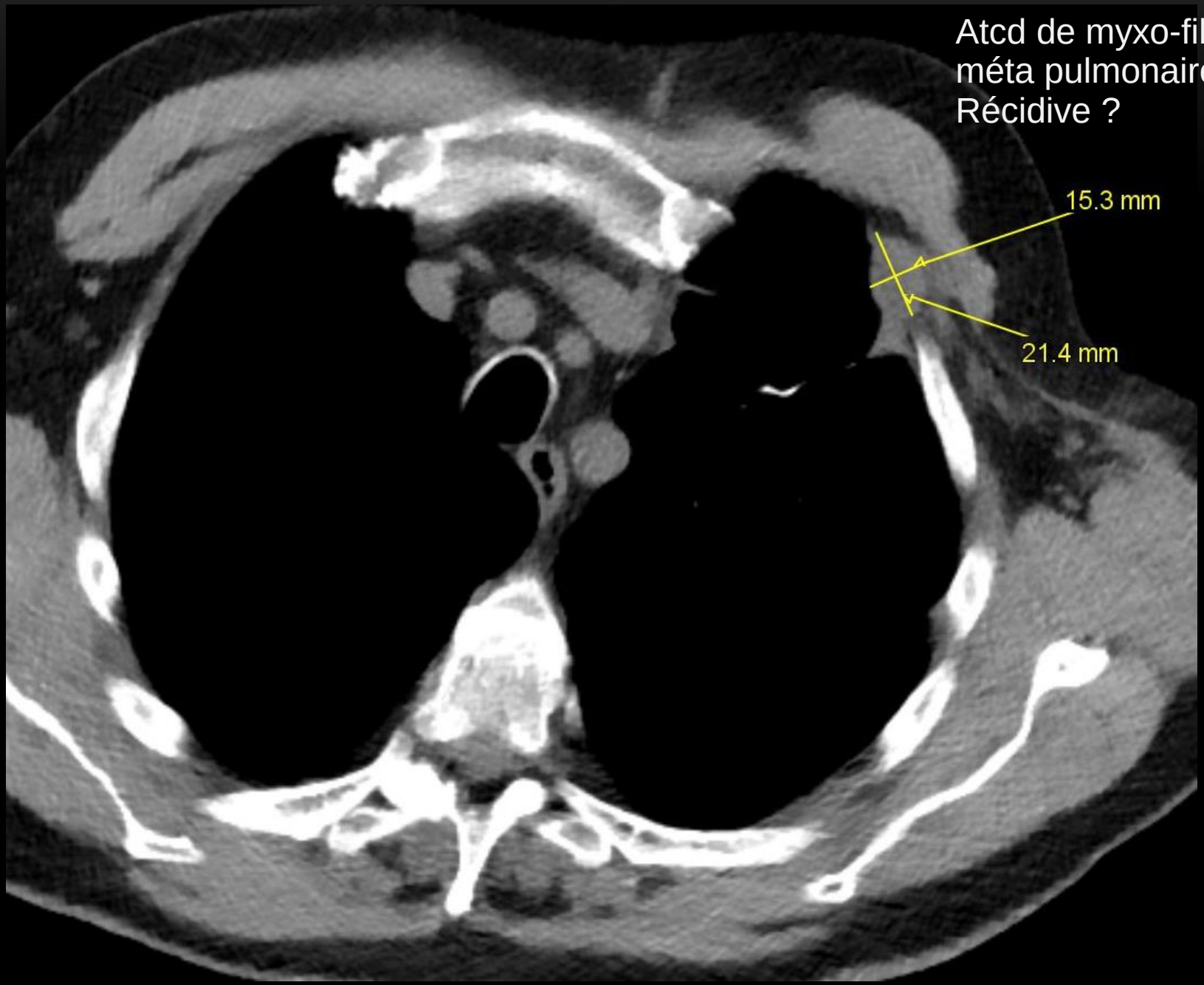

*D'après:* Biopsies en oncologie. de Bazelaire C et al. Journal de Radiologie diagnostique et interventionnelle. Vol 95 - juillet 2014

# GUIDAGE - SYNTHÈSE

- Le + souvent: CT ou US
- Si centre RI: **C-arm CBCT** ! De + en + polyvalent !
- Favoriser la technique dans laquelle on a le plus de compétences... et si possible avoir des compétences dans plusieurs techniques !
- *Conseil:* US à toujours envisager
- *Conseil*: **Coupler les techniques** dans les cas difficiles !
- *Futur:* Fusion d'images (IRM, PetCT…)

  Robotique

# QUELLE MODALITÉ DE GUIDAGE ?

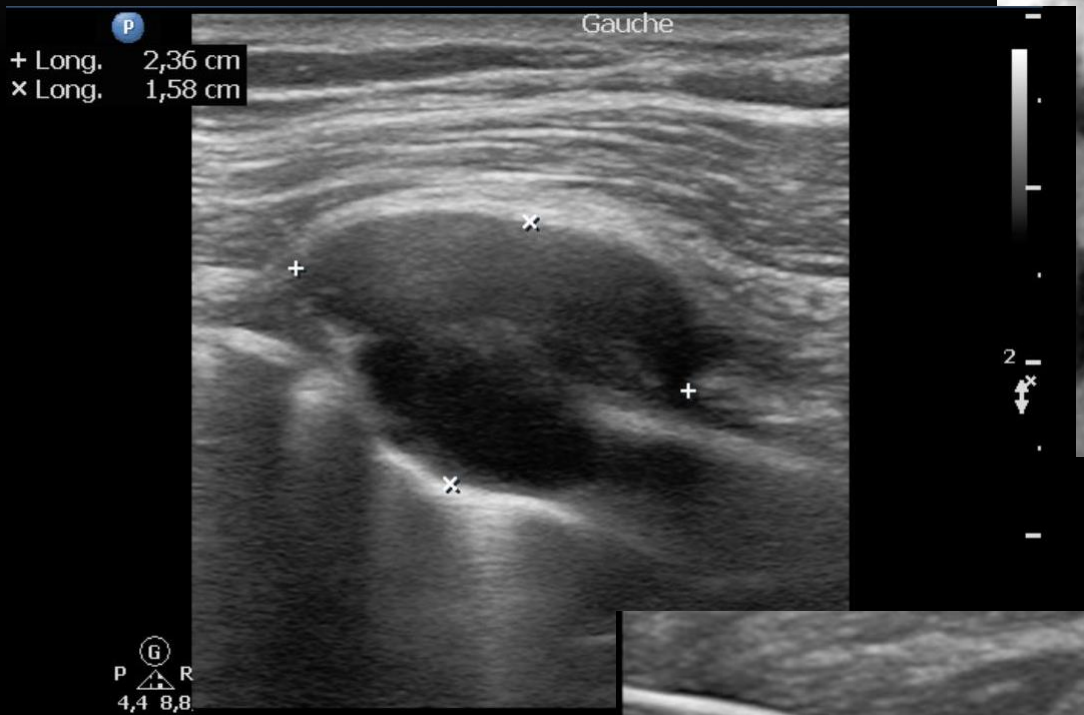


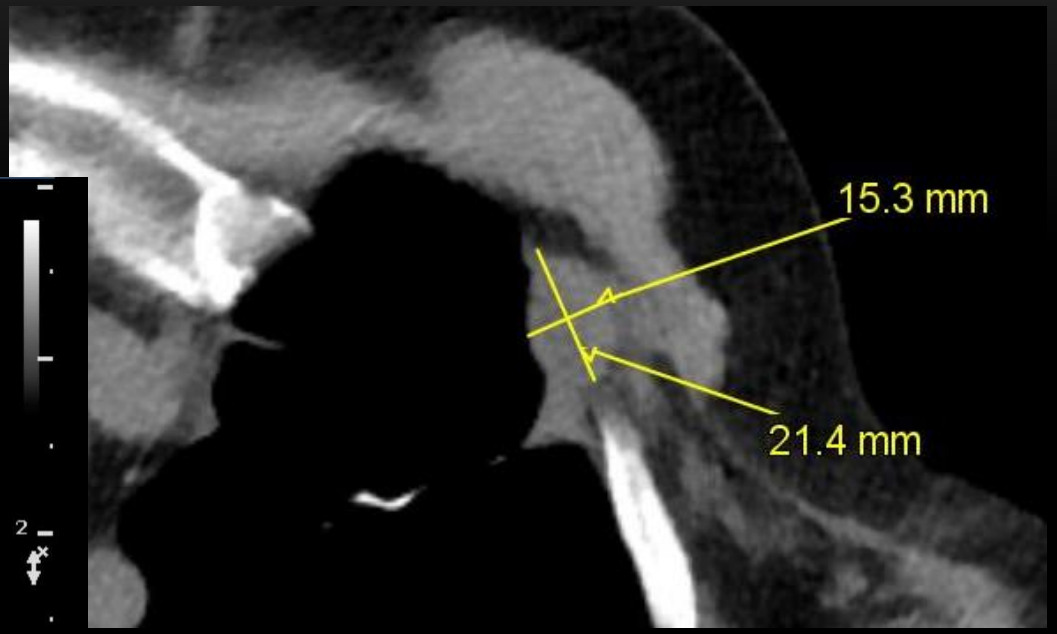

Atcd de myxo-fibrosarcome avec méta pulmonaires opérées
Récidive ?

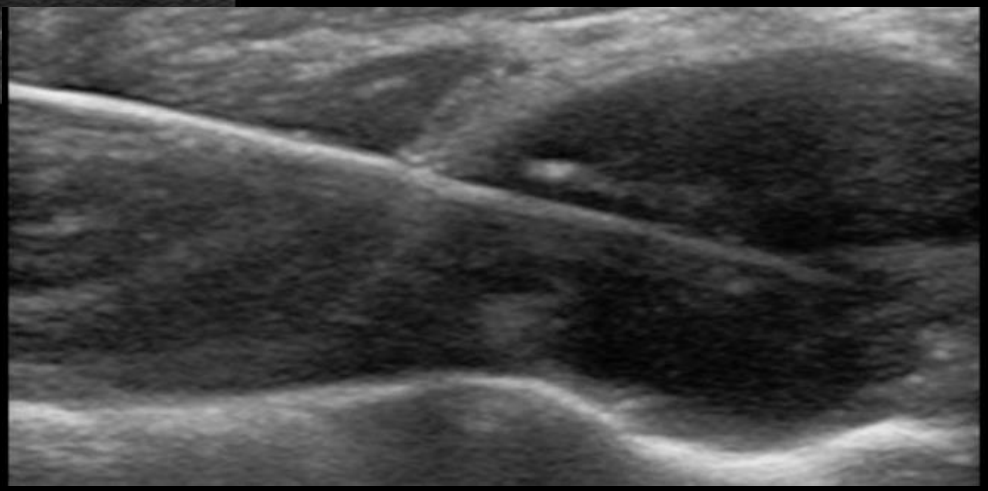
- RX ?
- US ?
- CT ?
- IRM ?
- C-arm CBCT ?

# QUELLE MODALITÉ DE GUIDAGE ?

**→ Privilégier la simplicité ! ☺**



- RX ?
- **US**
- CT ?
- IRM ?
- C-arm CBCT ?

# Thanks for your attention !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