

DES de Radiodiagnostic – Cours de Spé
14/02/2017

Techniques modernes de guidage en RI

Fabrice Deprez

Radiologue interventionnel
CHU UCL Namur, site Godinne

POUR LES NOTIONS DE BASES...

DES de Radiodiagnostic – Cours de base
05/02/2016

Abords percutanés non vasculaires en Radiologie Interventionnelle

Fabrice Deprez

Radiologue interventionnel
CHU Godinne

ABORDS PERCUTANÉS EN RXI

1. Dans quel but ?
2. Avec quelle imagerie de guidage ?
3. Contre-indications et gestion de l'hémostase
4. Anesthésie
5. Matériel
6. Techniques
7. Complications
8. Cas particuliers
 - Néphrostomie
 - Cholecystostomie
 - Gastrostomie



INFOS UTILES



BSR Section Meeting Interventional Radiology

Walking dinner: 19h00-20h00

Scientific program:

- 20h00-20h15: **Results of the survey and discussion “New trends for the IR section”**: Dr. F. Deprez, Dr. T. De Beule

- 20h15-21h00: **Vascular session:**

Chemoembolisation vs radioembolisation: your experience concerning patient selection

- 21h00-22h00: **Non-vascular session:**

Percutaneous punctures: new guidance devices, tools and possibilities

The **next meeting** of the “newly renamed” BSR section “Interventional Radiology” will be held on **Friday, March 24th, 2017** at the **Military Hospital** (Rue Bruyn 1, 1120 Bruxelles).

For this second meeting, we would like to propose you a **vascular AND non-vascular IR** program as discussed in the previous section meeting. During each subpart of the meeting, we would like your participation as in the previous sections to present cases concerning the topic presented, open for everybody.



European Board of Interventional Radiology

[IR Curriculum & Syllabus](#)[European Trainee Forum](#)

EBIR

[General Information](#)[EBIR Examination Council](#)[How to apply - General](#)[How to apply - IRSA](#)[How to prepare for the EBIR](#)[EBIR Australia/New Zealand](#)[Contribute to the EBIR](#)[CVIR](#)[ESIRonline](#)[CIRSE Guidelines](#)[Subspecialty Status for IR](#)[IR Patient Safety Checklist](#)[Job Announcements](#)[Drugs and Doses App](#)[UEMS IR Division](#)

CERTIFIED EXPERTISE - The European Board of Interventional Radiology

The European Board of Interventional Radiology has been running its successful course for 5 years now. To date, over 400 interventional radiologists hold this coveted qualification, and the number is steadily increasing. Examinations are always fully booked long before they take place.

Why take the EBIR?

Built on the pillars of scientifically proven assessment techniques, high-quality material and a dedicated steering committee, the examination has asserted itself as the internationally valued IR qualification that it set out to be.

Career Development

EBIR holders improve their career development, whether they take the examination right at the beginning of their tenure or further down the road. Employers can expect not only firm knowledge of the contents of the **European Curriculum and Syllabus of Interventional Radiology** which serves as the comprehensive guideline for the exam, but also certain skill sets and additional valuable competencies confirmed by trainers or supervisors.

Free movement

Supplemental to any national qualifications, the EBIR also aims to facilitate the free movement of IRs across Europe and even globally.



European Board of Interventional Radiology

IR Curriculum & Syllabus

European Trainee Forum

EBIR

General Information

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How to apply - General

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How to prepare for the EBIR

Recommended reading

Recommended online lectures

Sample questions and cases

EBIR Australia/New Zealand

Contribute to the EBIR

CVIR

ESIRonline

CIRSE Guidelines

How to prepare for the EBIR

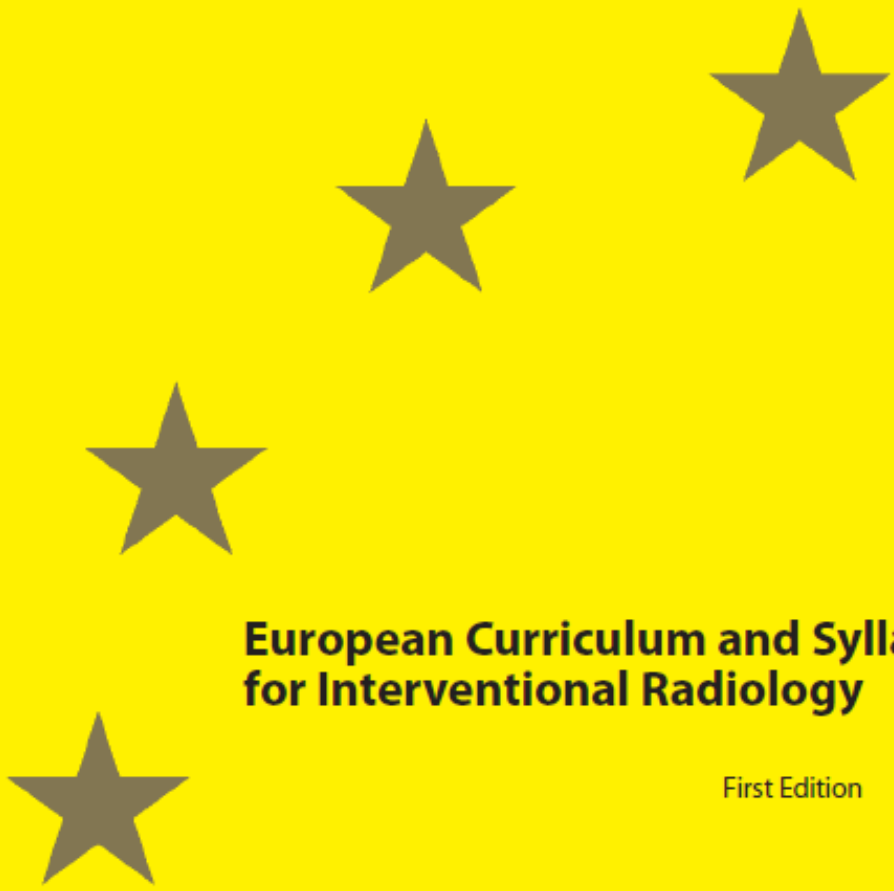
The European Board of Interventional Radiology is based on the **European Curriculum and Syllabus for Interventional Radiology.**



Recommended reading

Recommended lectures from CIRSE events and courses on ESIRonline

Sample questions and cases

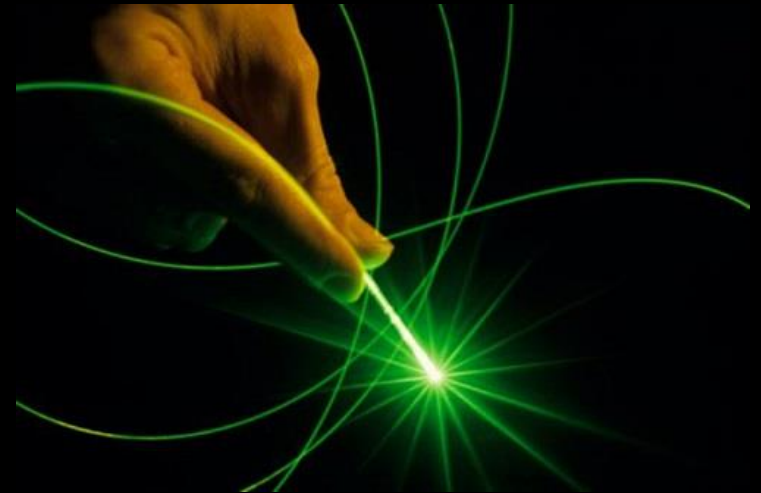
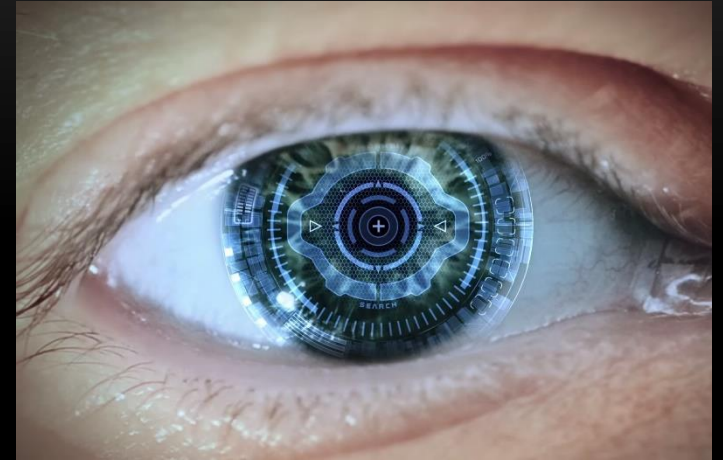


European Curriculum and Syllabus for Interventional Radiology

First Edition

Techniques de guidage modernes en RI ?

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



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 O₂) + O₂
 - 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 »

PHILIPS Patient Programme Acquisition Vue Fin d'examen

3C SINGLE PULMO - MGO

- 1 Surview, Frontale, Topo...
- 2 Chest, Thorax, hélico...
- 3 **CCT Intervention...**
- 4 CCT Intervention...
- 5 CCT Intervention...

3.1 8.33x8.33

4.1 10x10

5.1 1x1

Information de dosage

DLP cumulé : 80.8 mGy*cm

Changer param.

M. en p.

Par défaut

02/15/17 14:21:35

CHU UCL Mont-Godinne
Philips, Ingenuity Core
15 Feb, 2017 14:13:06.28
LC 10.00 mm
Z 1.00

201-5 Fen Pulm, iDose (3)
-88.1 mm
iDose (3)

64.5 mm
91.4 mm

R
A
C -197
L 2015

-88.1 mm
Centre
3 CCT Interventional, Single
Dernière prise

67.0 mm

30 mAs (71 mA), 120 KV
CTDIvol planifié : 2x50 mGy
DLP programmé : 5.1x50 mGy*cm
CTDIvol réel : 2x2 mGy
DLP réel : 10 mGy*cm
Fantôme Corps CTDIvol, 32 cm

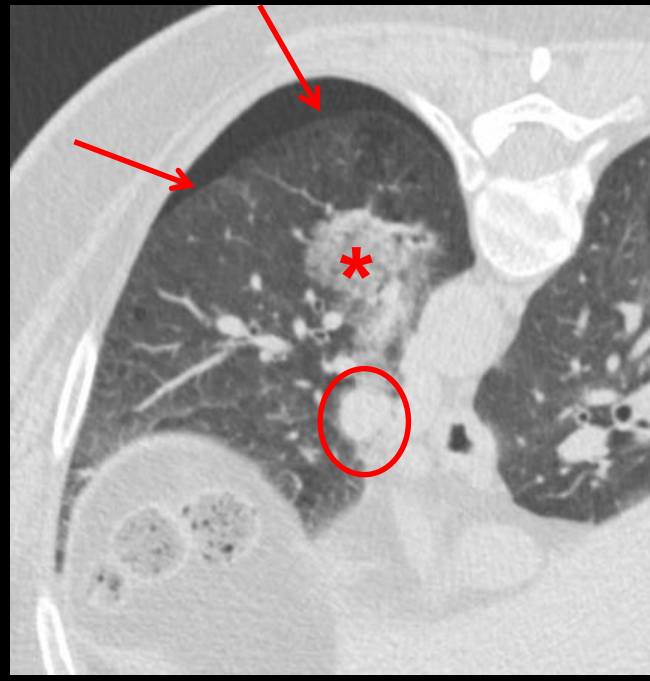
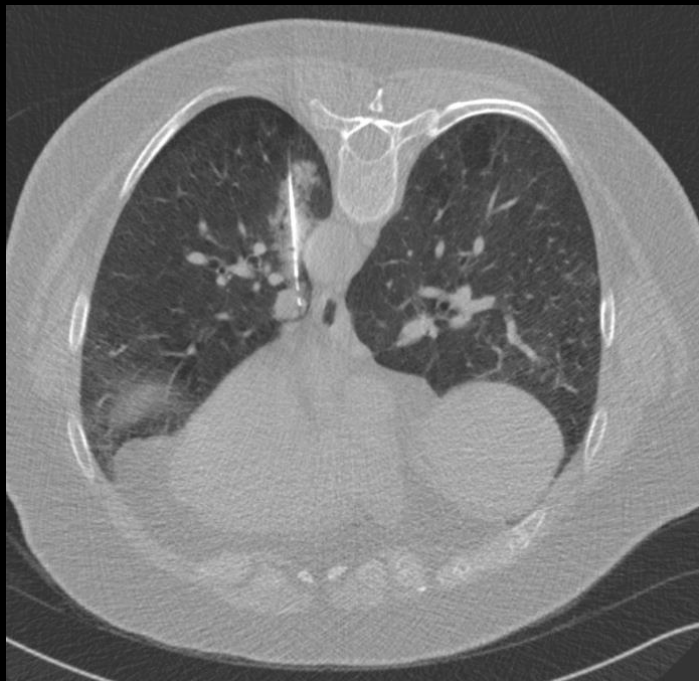
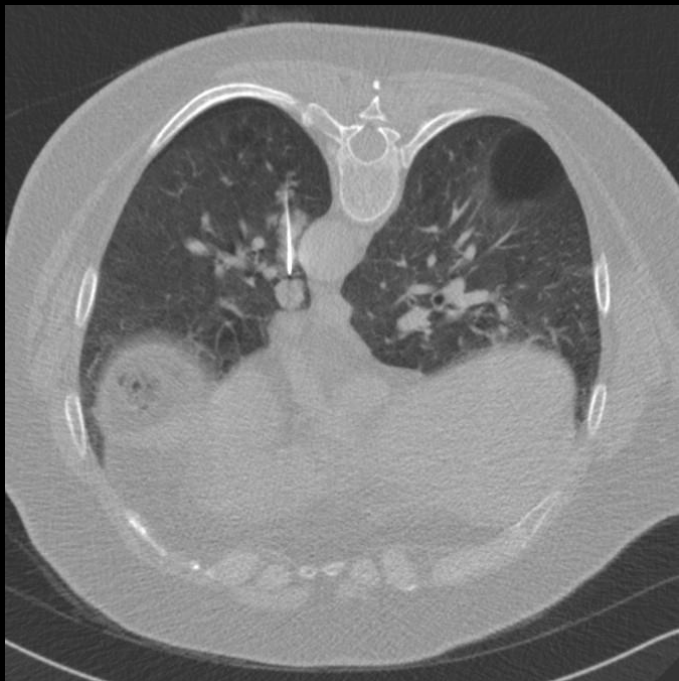
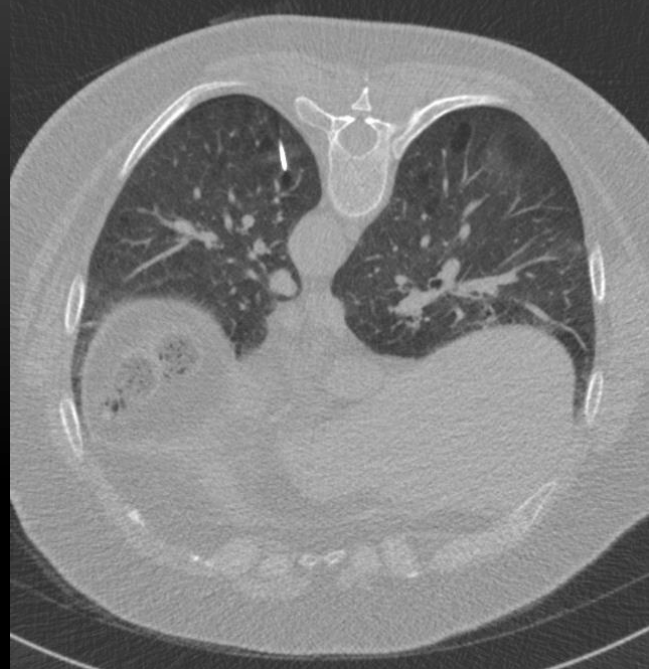
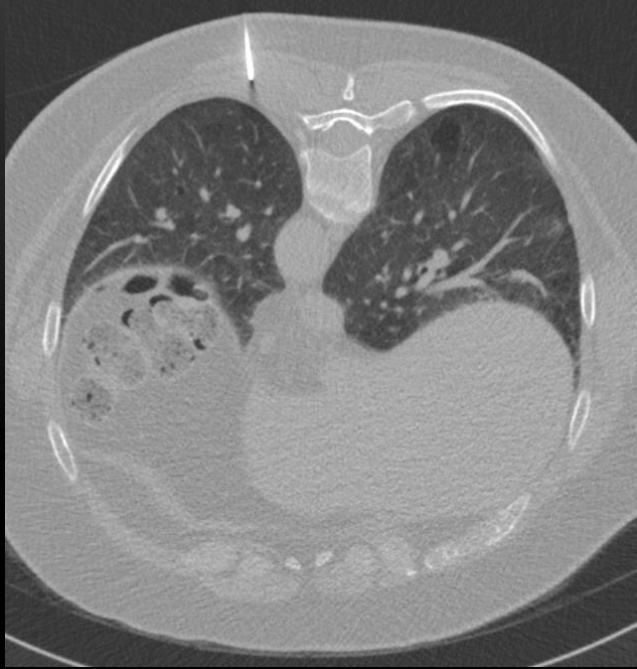
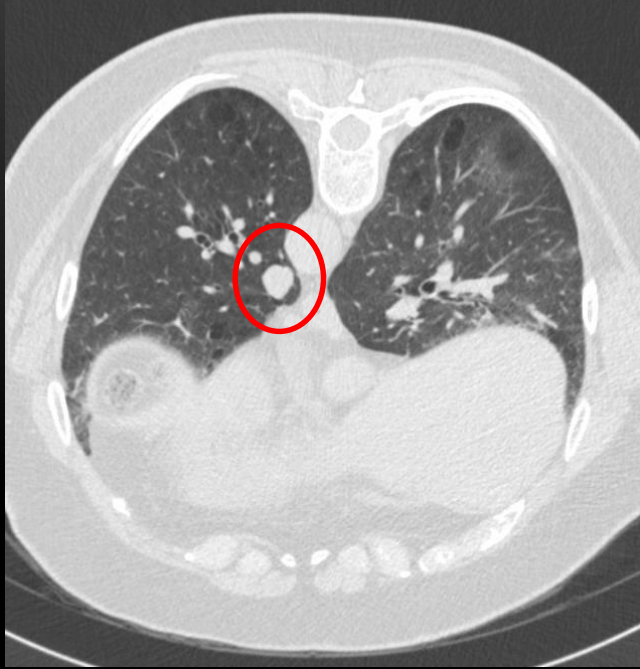
Droite à gauche

-79.8 mm
Tête

-96.4 mm
Pieds

R
A
R
A

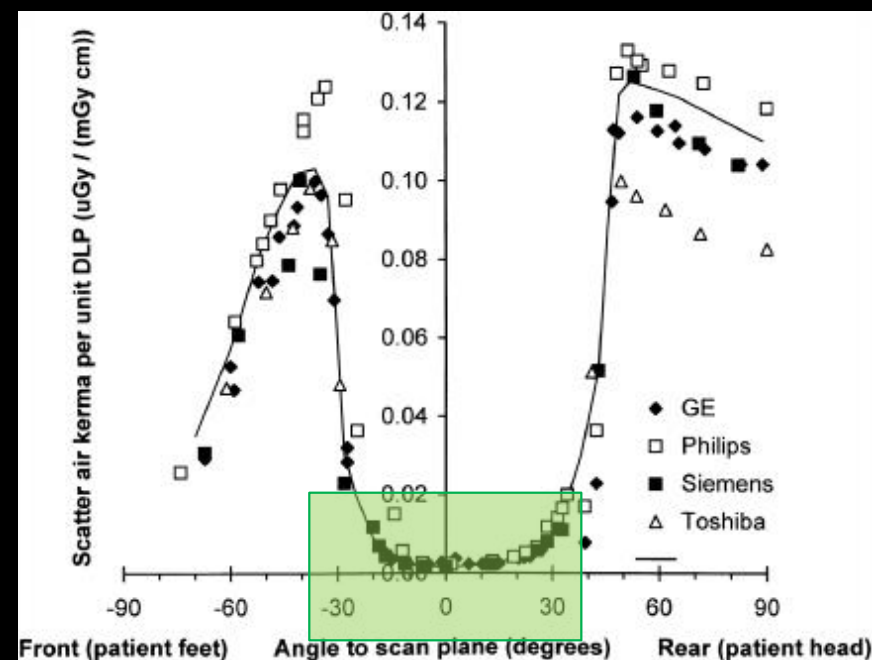
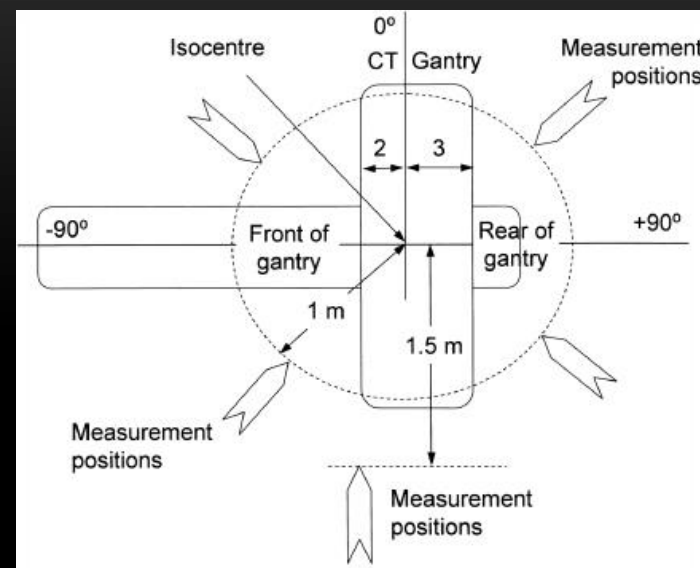
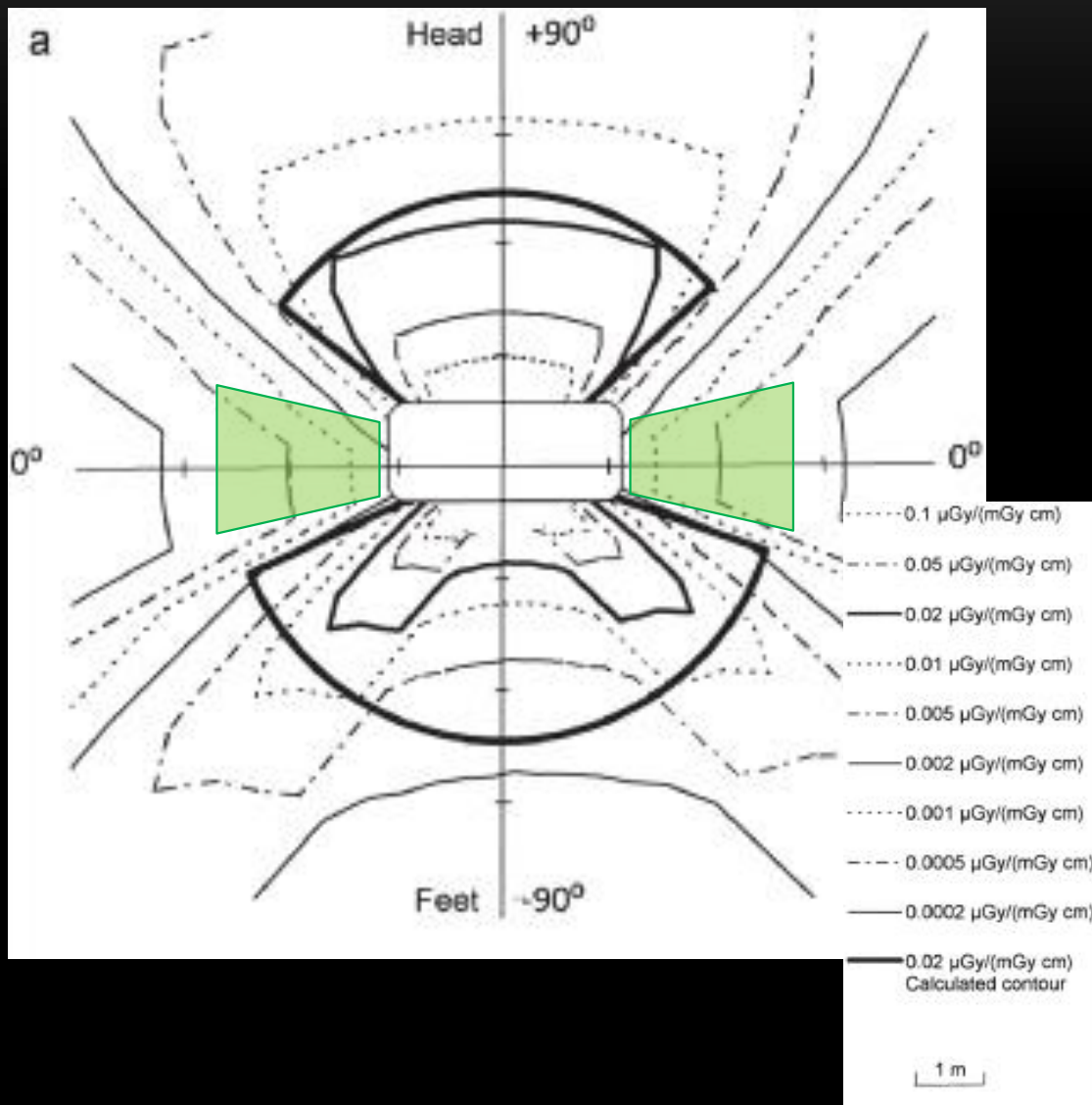
10 cm
10 cm
10 cm



Fluro-CT *! Irradiation +++*



GUIDAGE: CT - RADIOPROTECTION



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

H Wallace¹, C J Martin¹, D G Sutton², D Peet³ and J R Williams⁴

Published 10 February 2012 • IOP Publishing Ltd

Journal of Radiological Protection, Volume 32, Number 1

GUIDAGE: CT + ROBOT ?

100th Anniversary of Radiology
RSNA 2014

Daily Bulletin

Wednesday, December 03, 2014

Sunday
Monday
Tuesday
Wednesday >>
Thursday

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.

ADVERTISEMENT

SIEMENS

Clinical capabilities



European Radiology

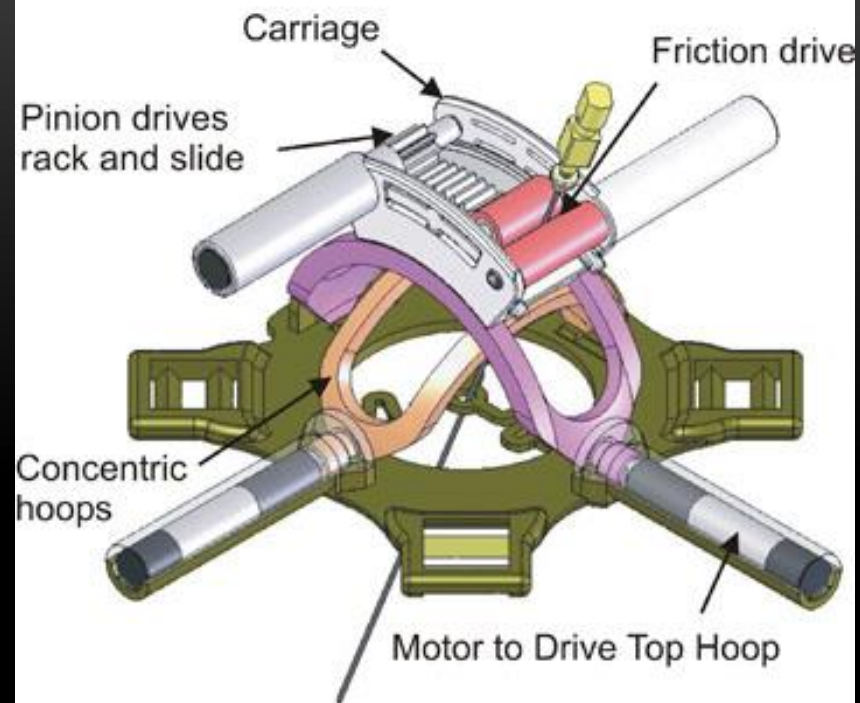
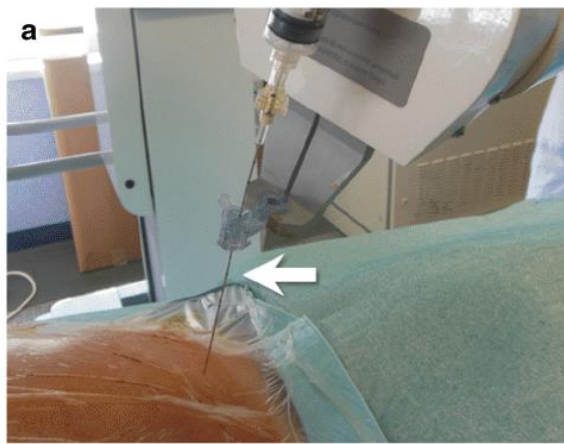
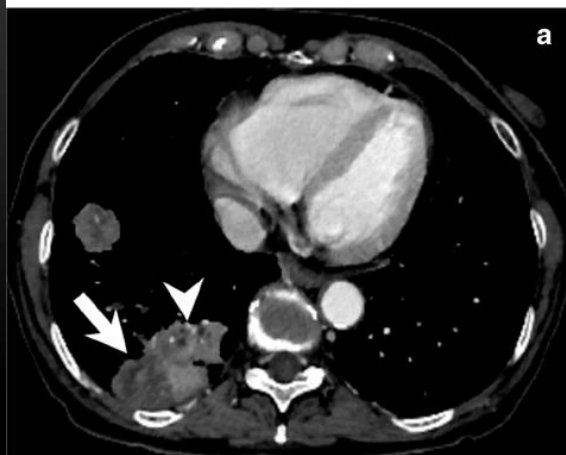
May 2015, Volume 25, [Issue 5](#), pp 1310–1316

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

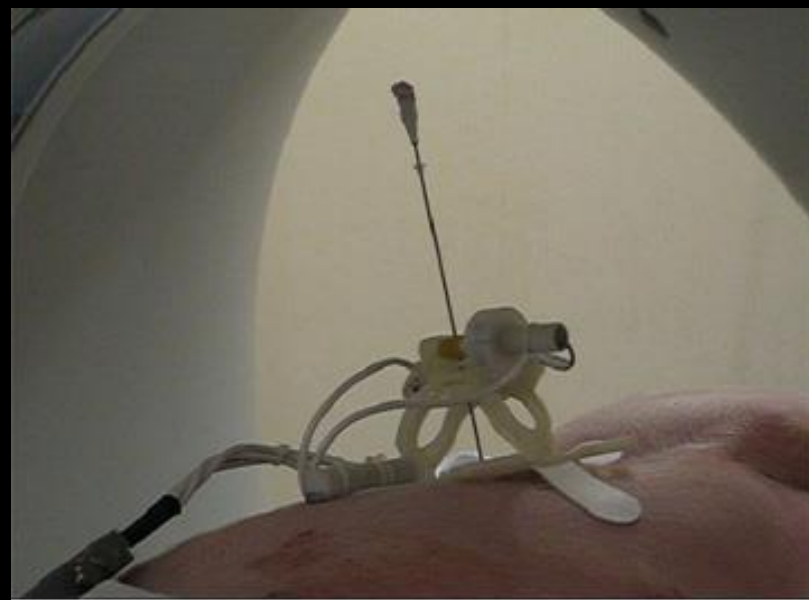
Authors

[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



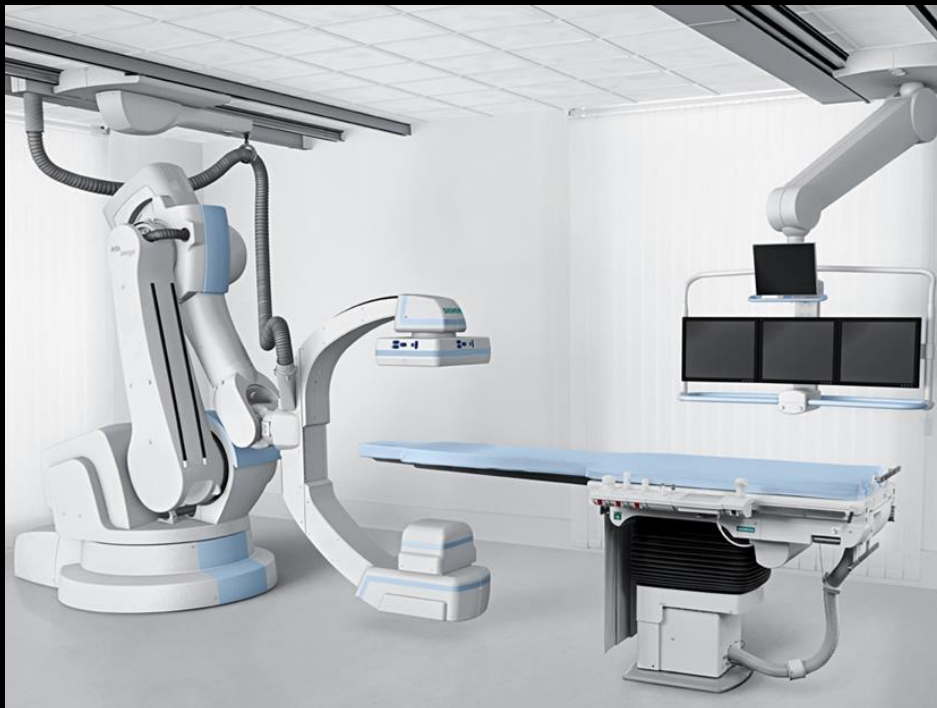
Robopsy robotic biopsy system consists of two hoops (tan and purple) set orthogonal to one another and revolving about their long axes. A carriage that rides atop the hoops encloses the needle (top). A pinion-driven roller (red, left) drives the needle against a passive roller (red, right), which rotates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



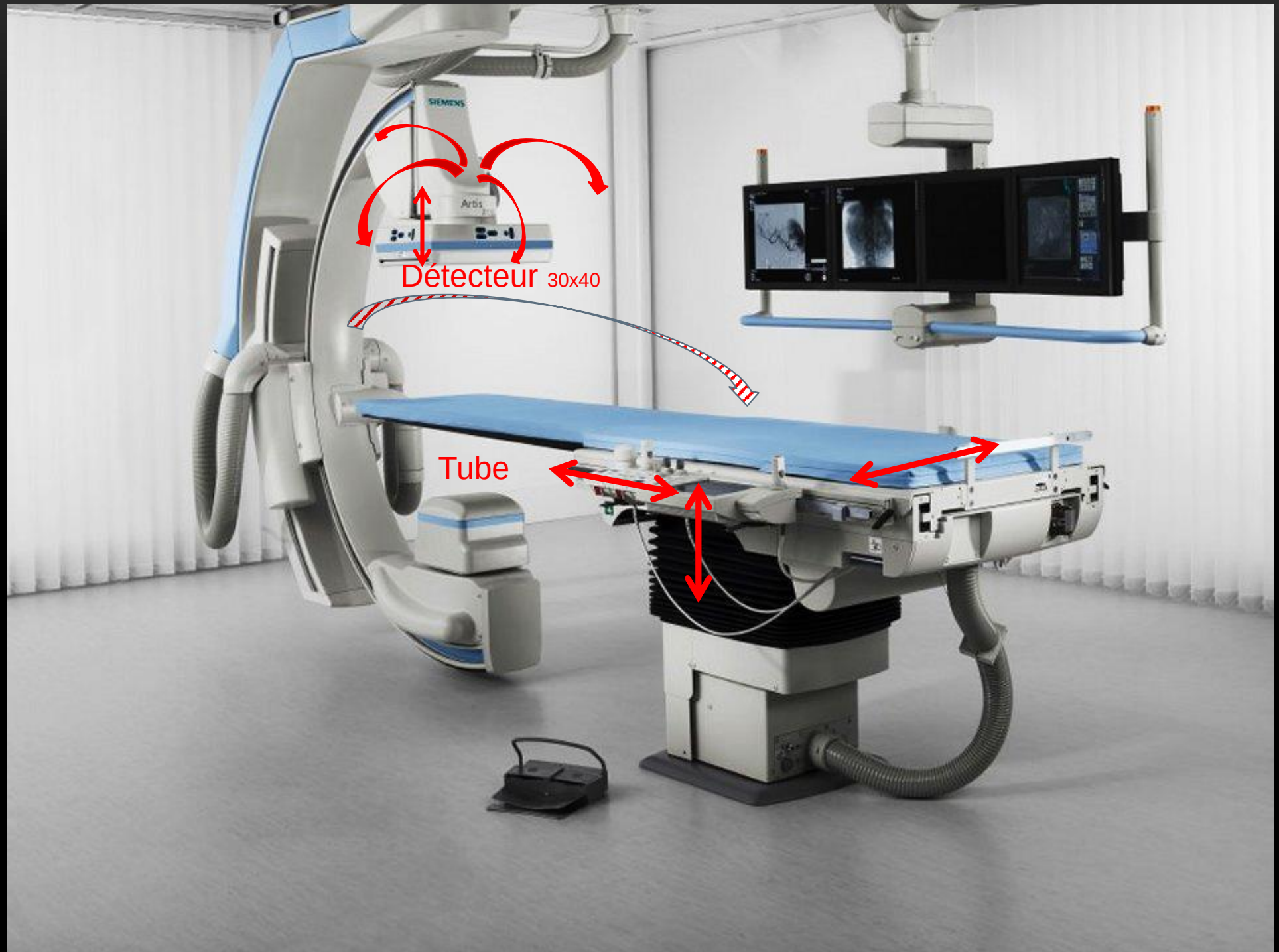
GUIDAGE: C-ARM +/- CONE-BEAM CT

- 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

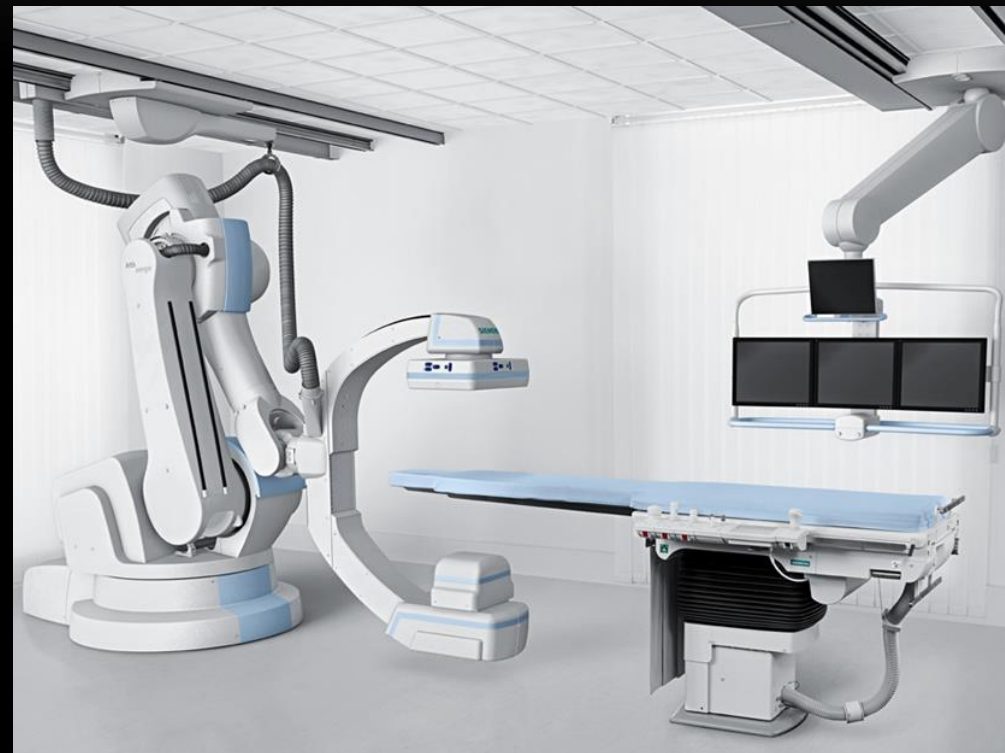


Salle hybride = salle de Rxl au bloc opératoire

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

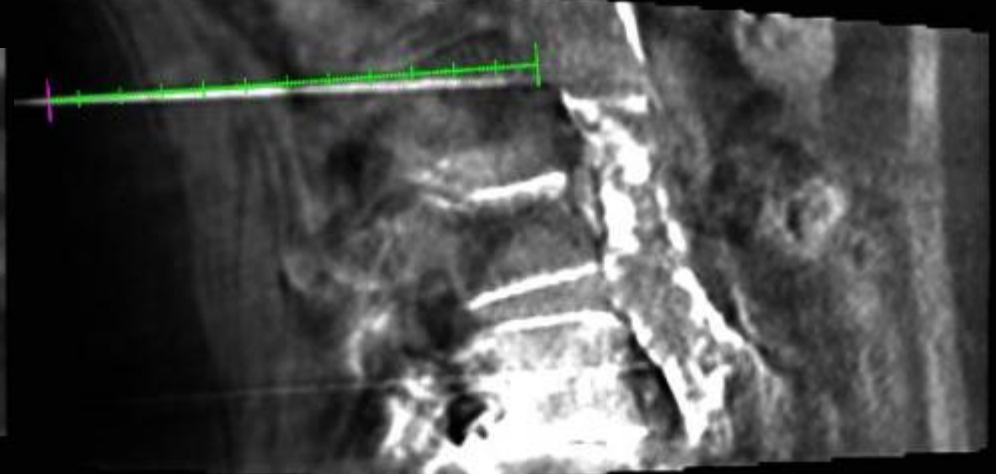
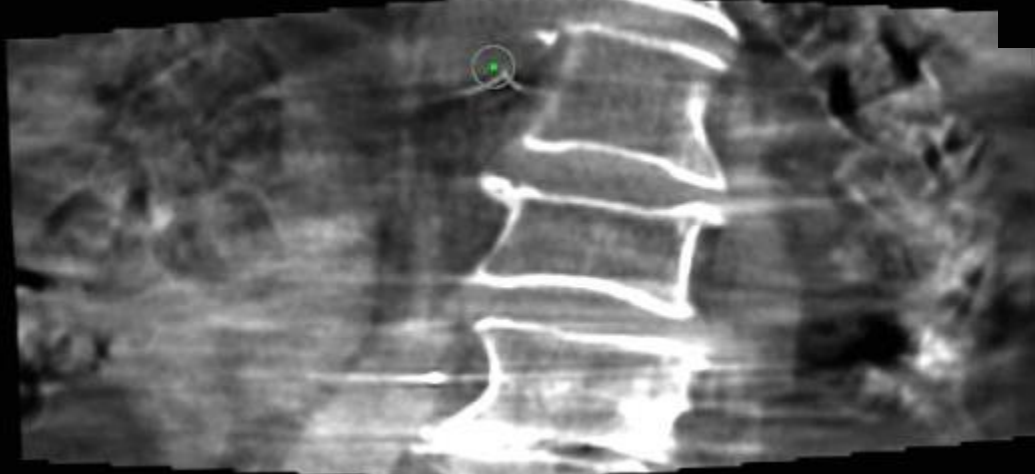
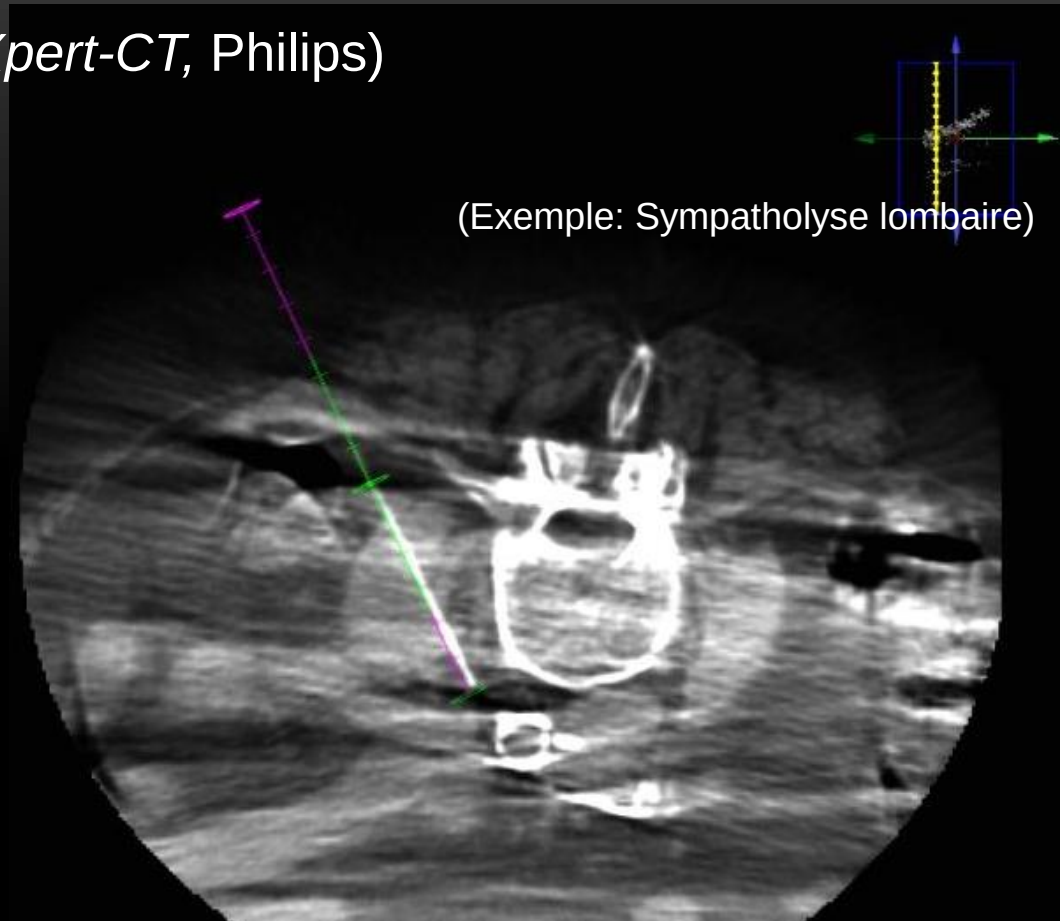
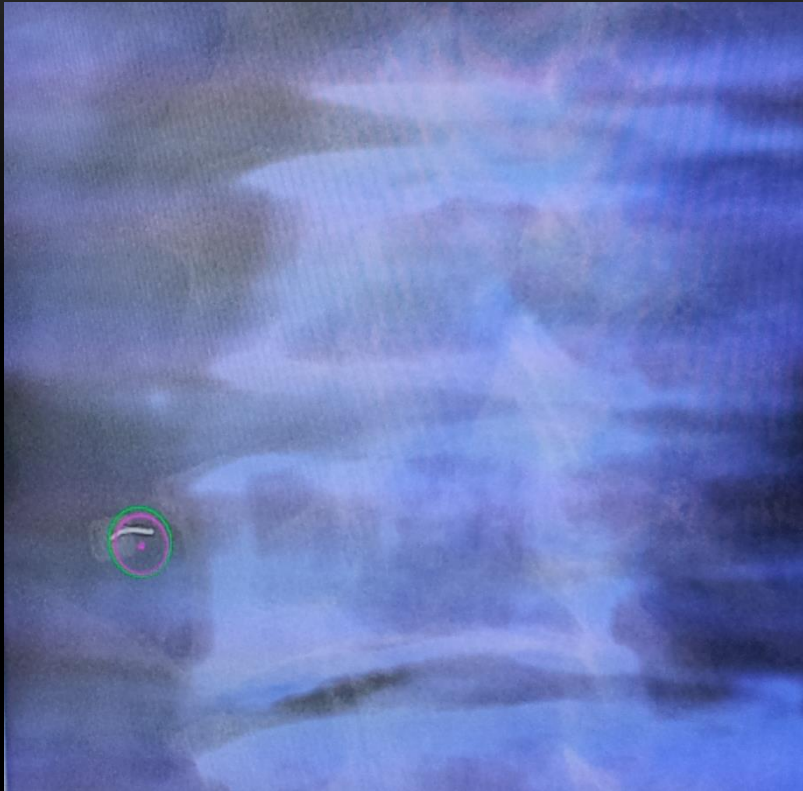


(GE IGS 730)



(Siemens Zeego)

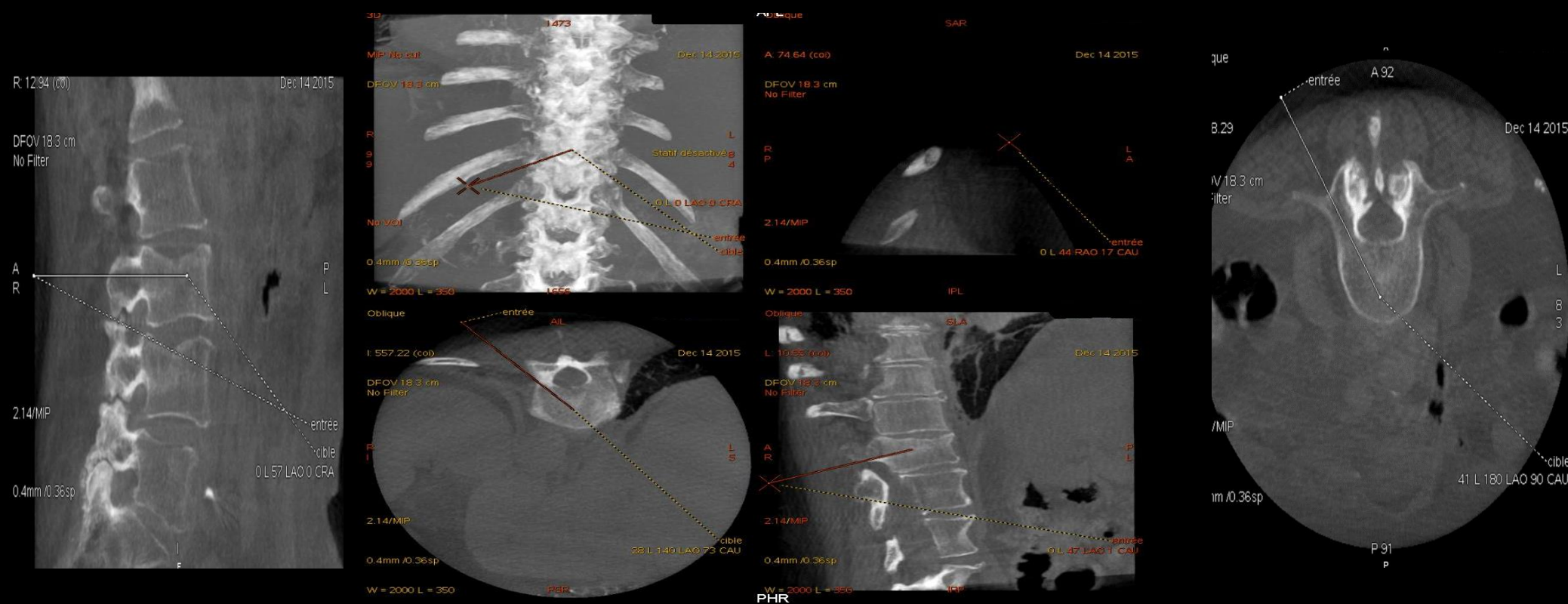
1- Guidage abords percutanés (ex: Xpert-CT, Philips)



PRINCIPE DE GUIDAGE PAR CBCT :

(Exemple: Vertébroplastie)

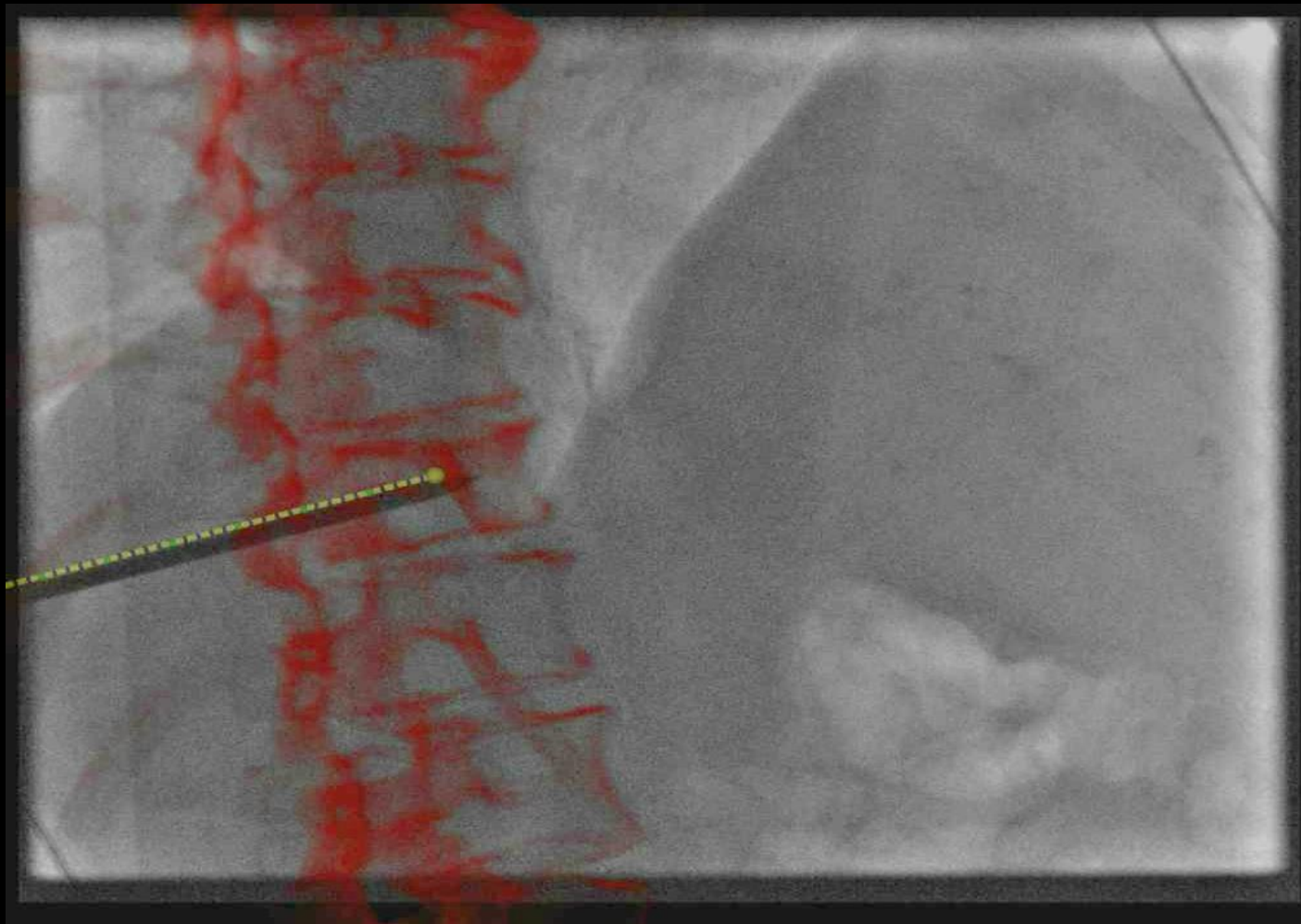
Première acquisition CBCT pour un repérage de la lésion et pour choisir la trajectoire la plus sûre pour l'intervention, dans les 3 plans



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

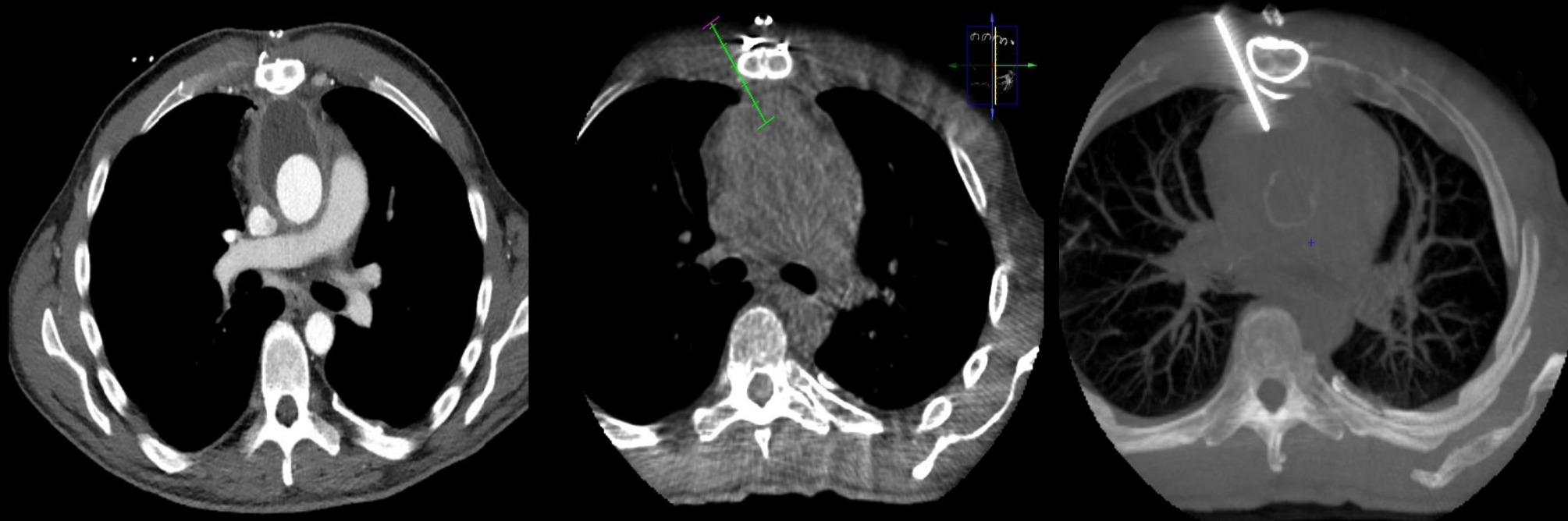


LES AVANTAGES DU CBCT:

→ Couplage CBCT/ Fluoroscopie

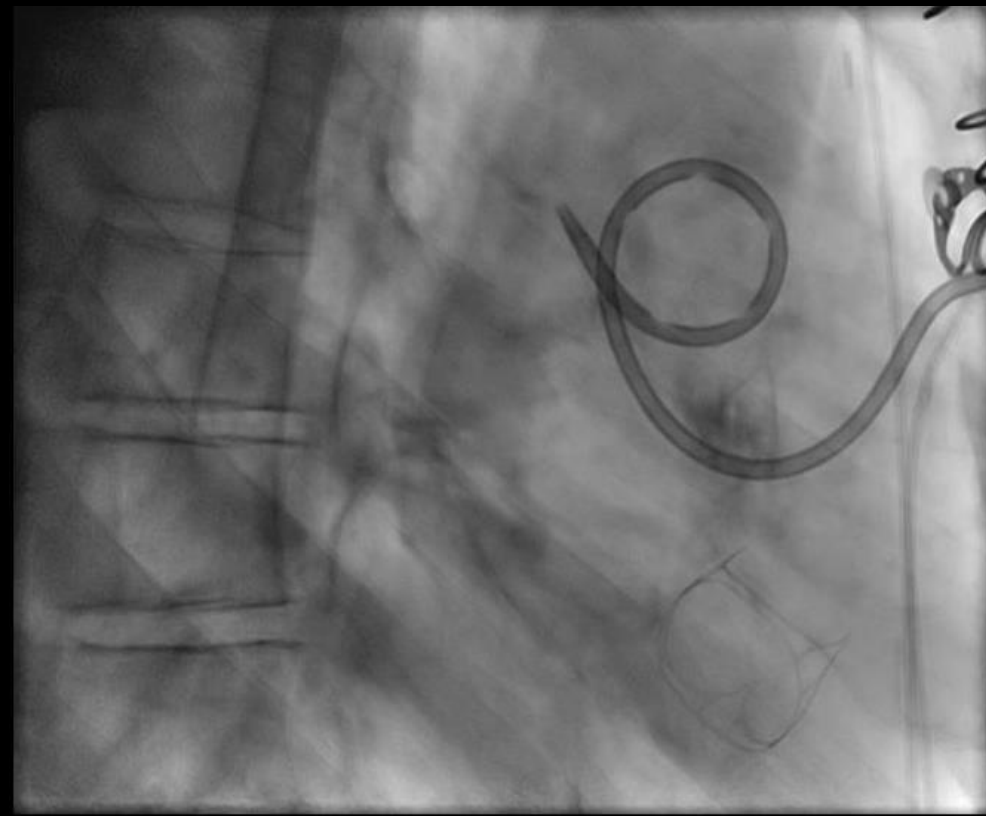
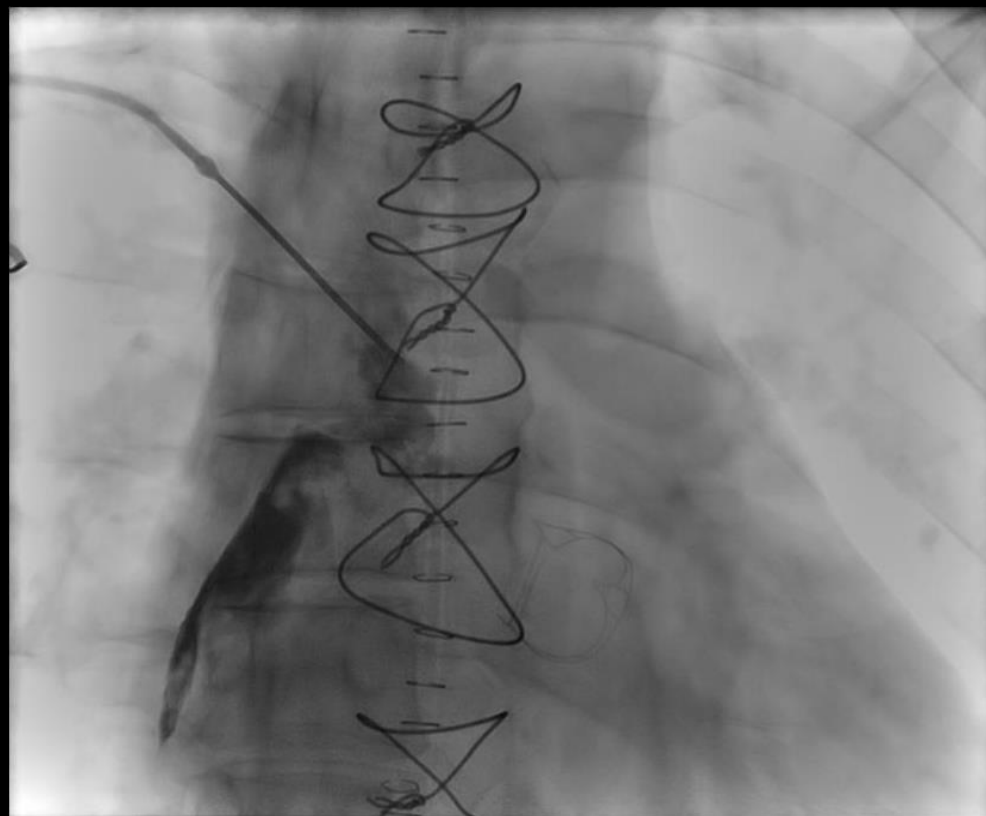
(Exemple: Drainage d'un abcès retro-sternal)

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

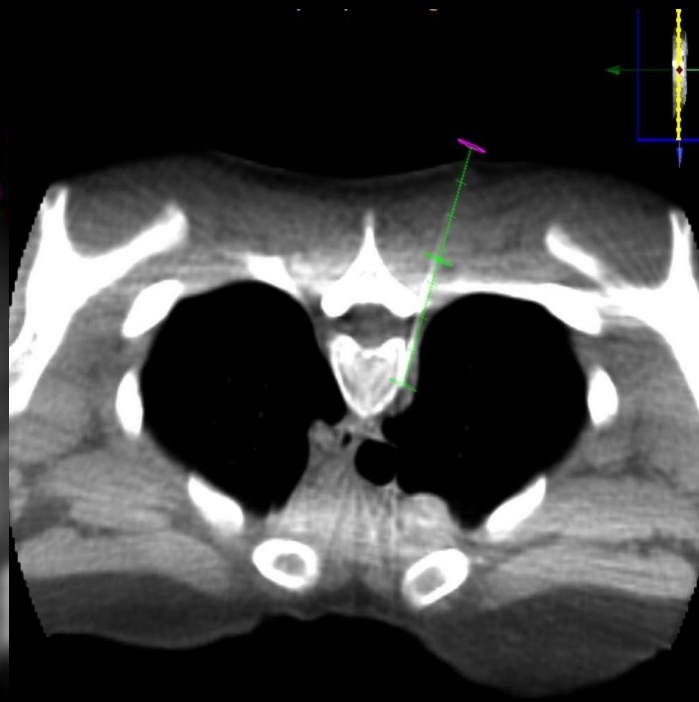
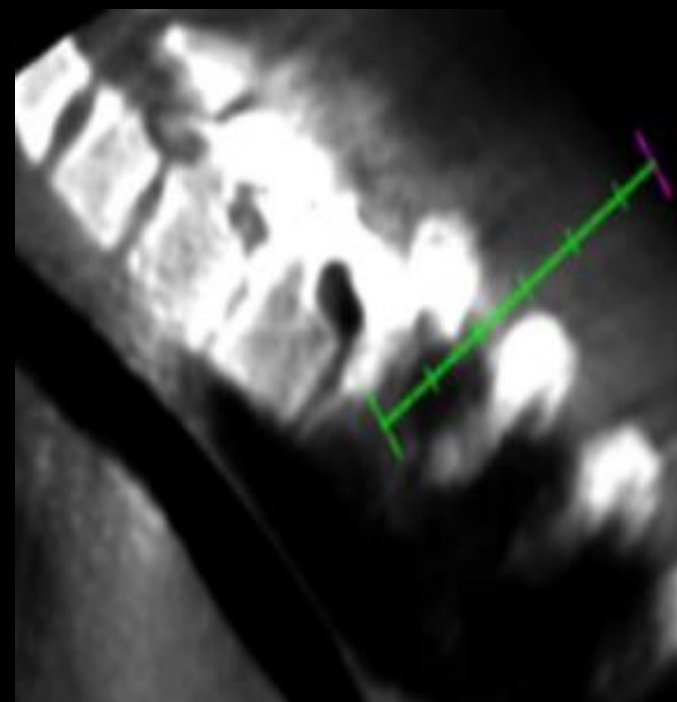
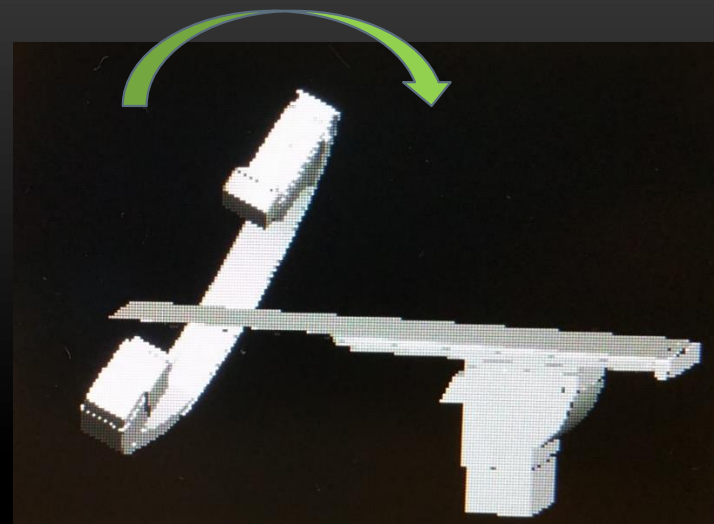


LES AVANTAGES DU CBCT :

→ Trajectoires obliques (cranio-caudale)

! (quasi) impossible en CT !

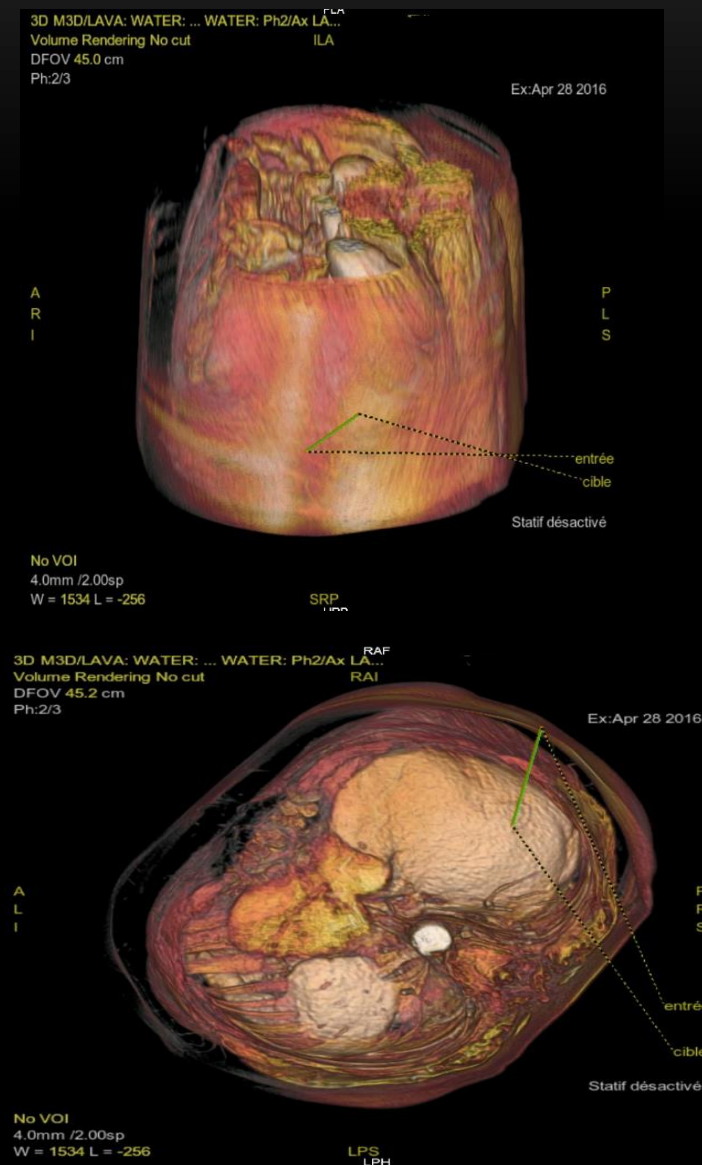
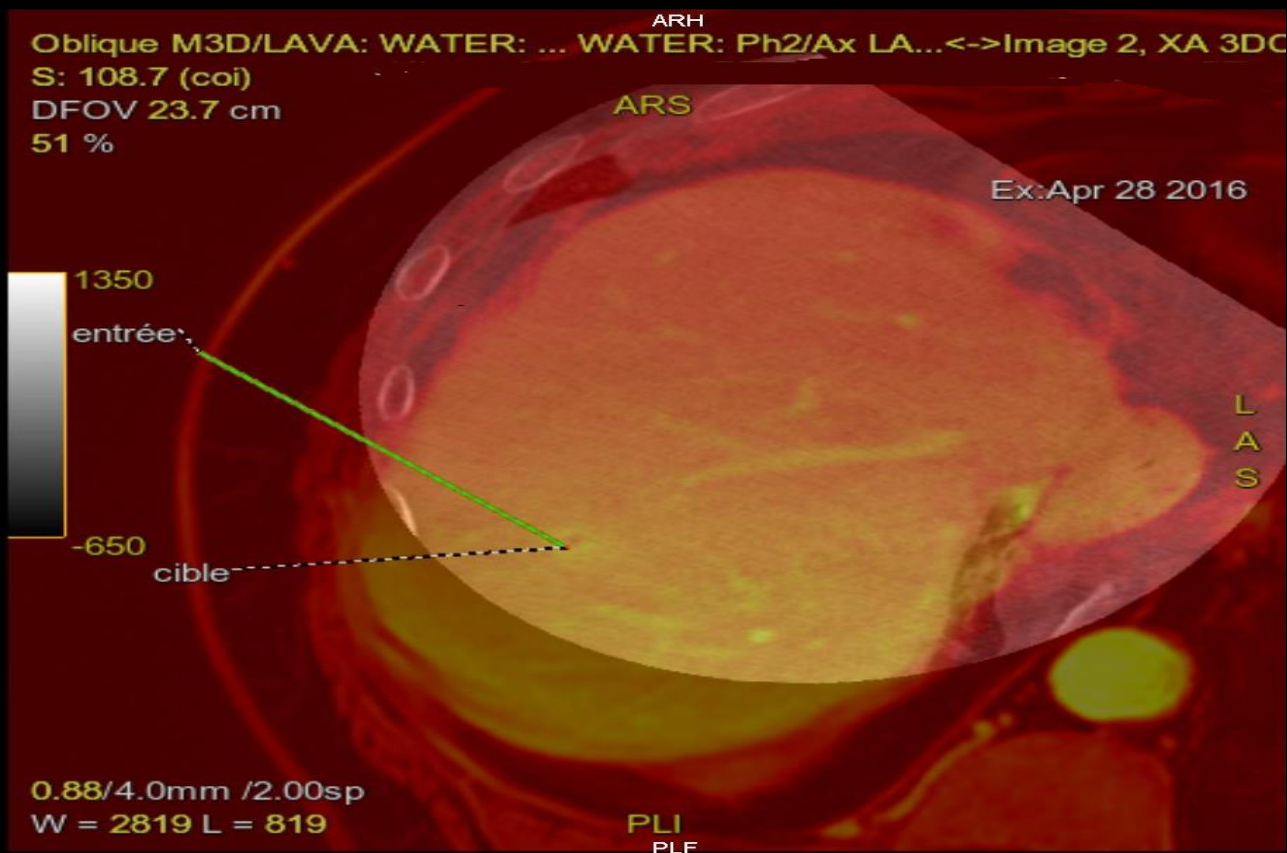
(Exemple: Sympatholyse thoracique percutanée au phénol)



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

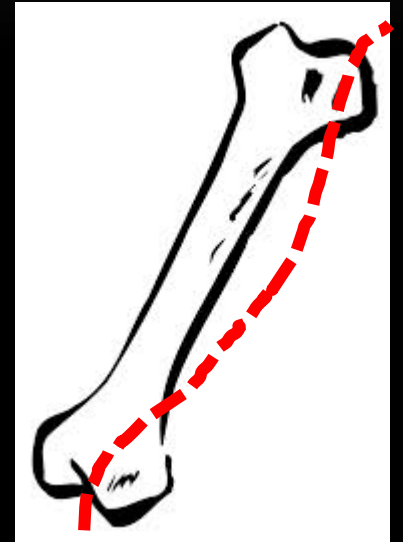
+/- MPR, MIP → mesures auto-calibrées (≠ DSA !)

+/- vues endovasculaires

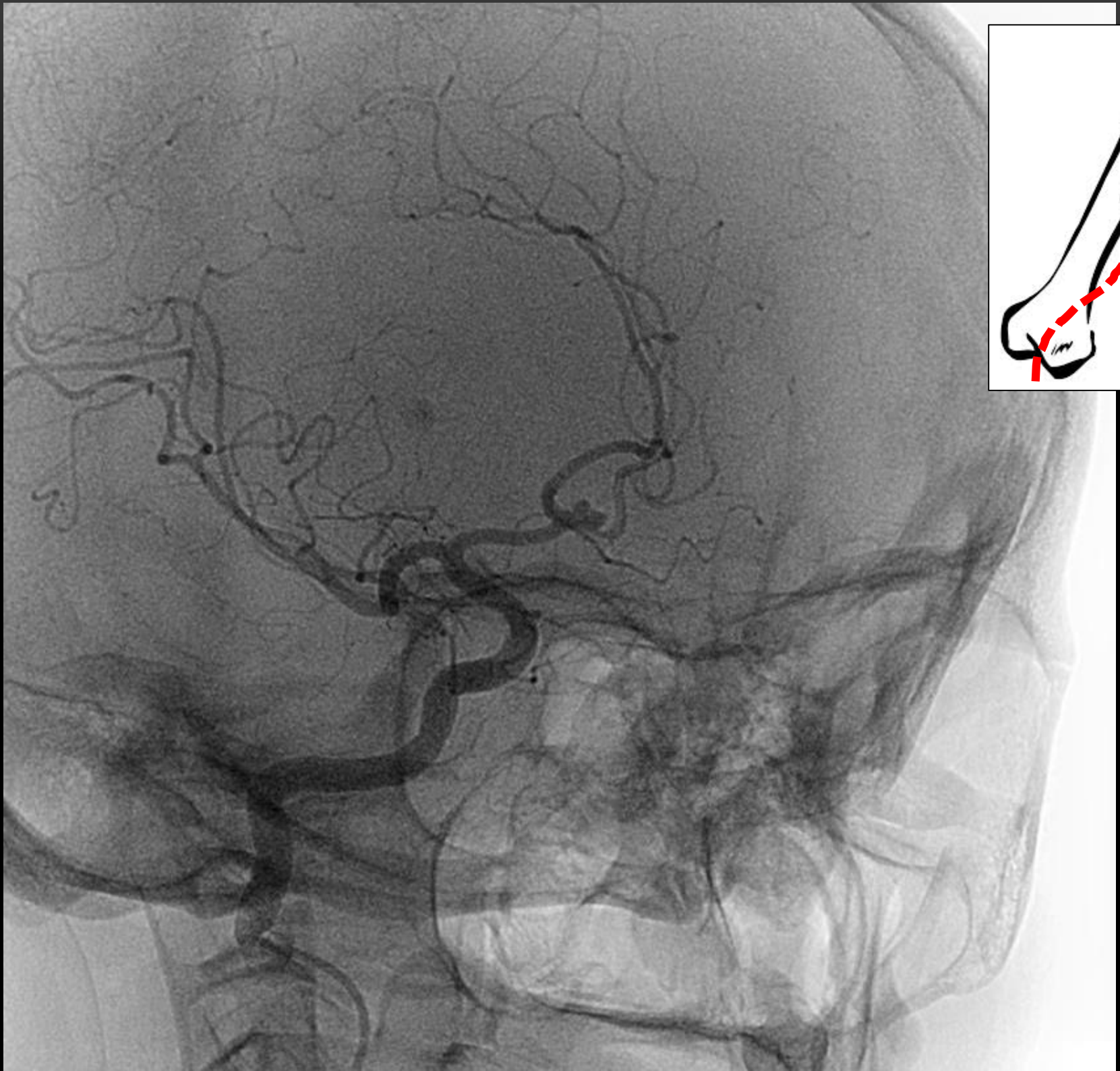
+/- analyse des vaisseaux (diamètre, sténoses, anévrysme)

+/- planification d'endoprothèses

Angiographie sans soustraction numérique



Sans soustraction



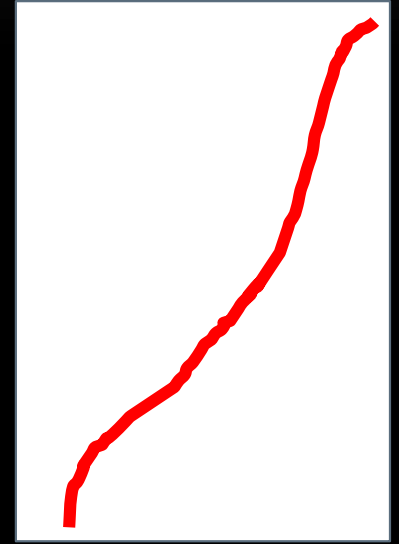
Angiographie avec soustraction numérique



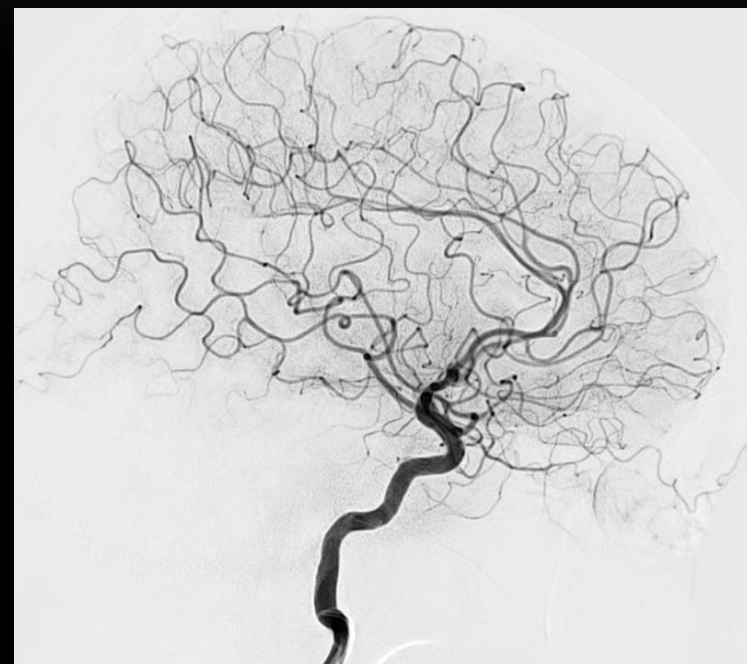
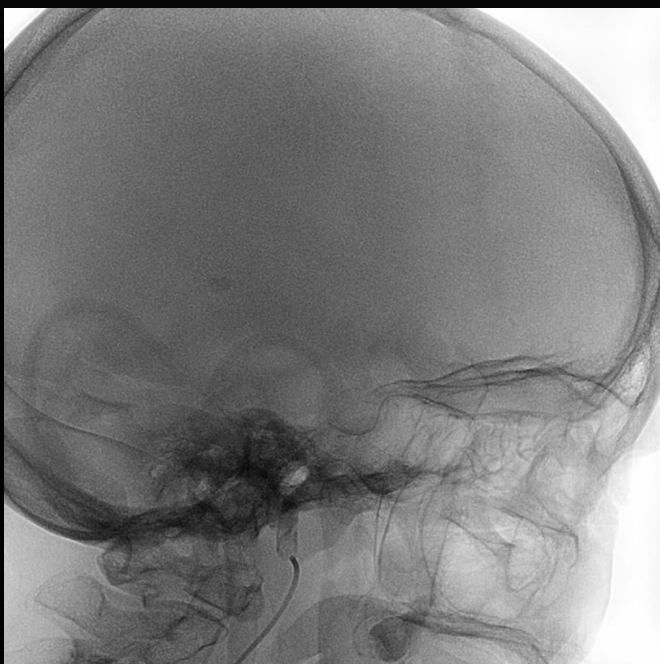
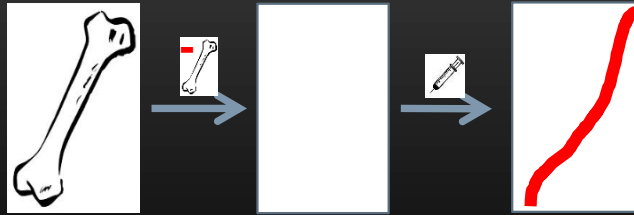
1ere image



Images suivantes...

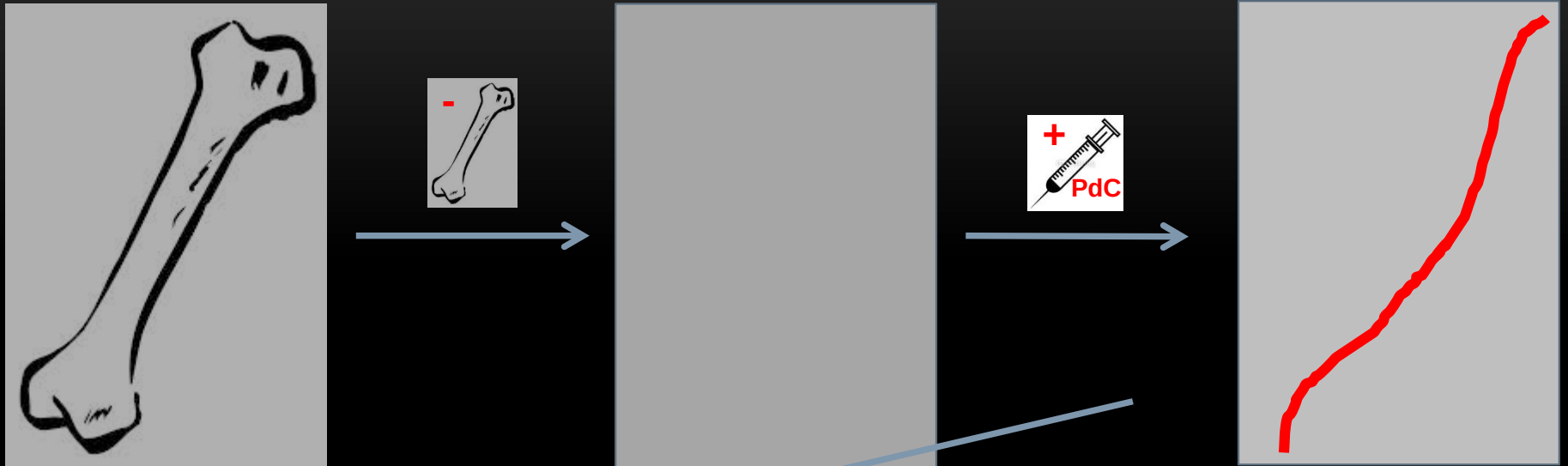


Avec soustraction

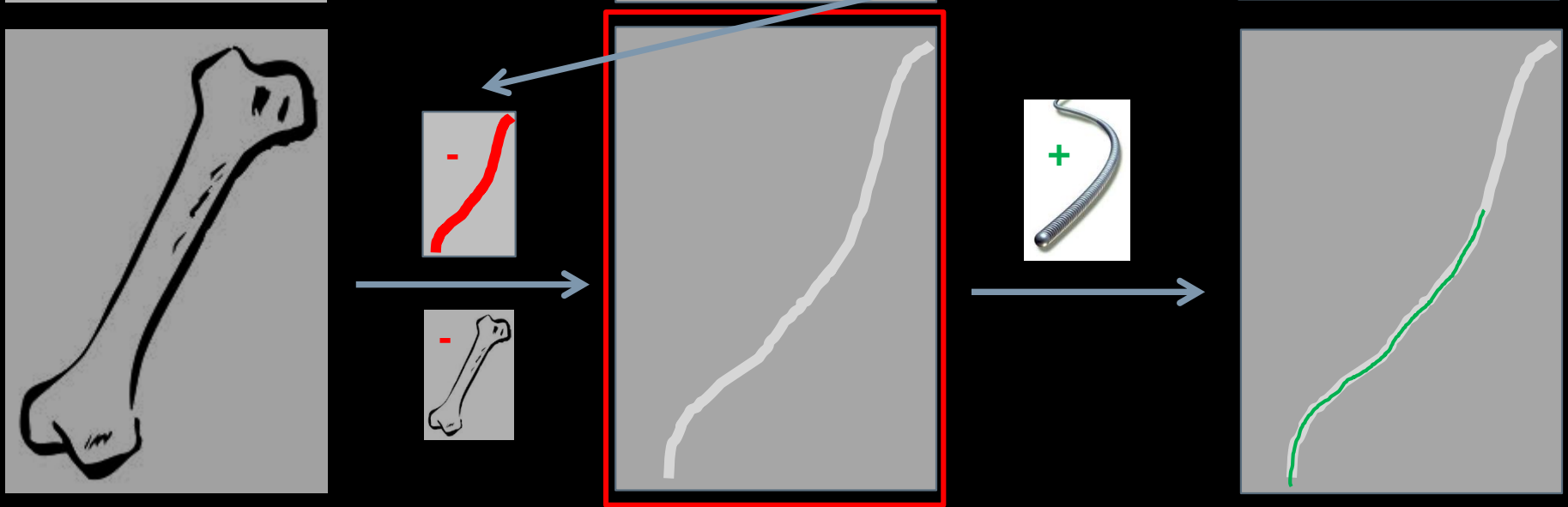


Road-Mapping

1e

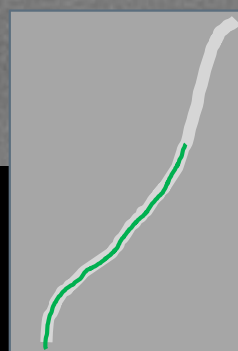
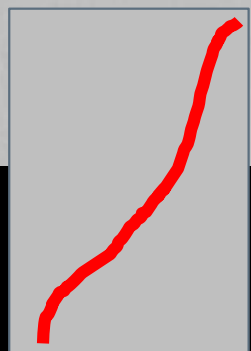


2e

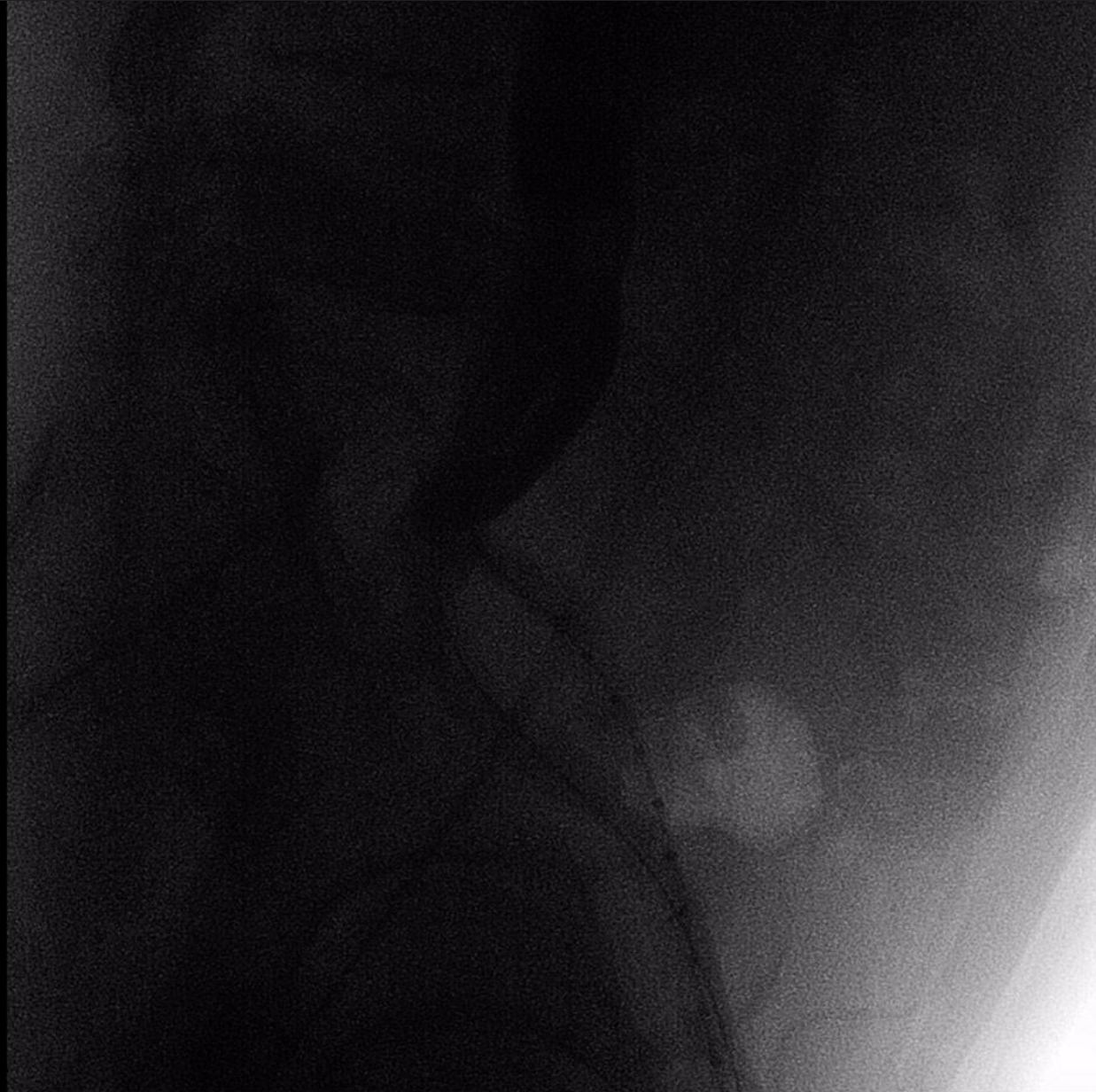


Road-Map





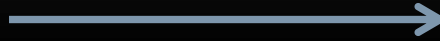
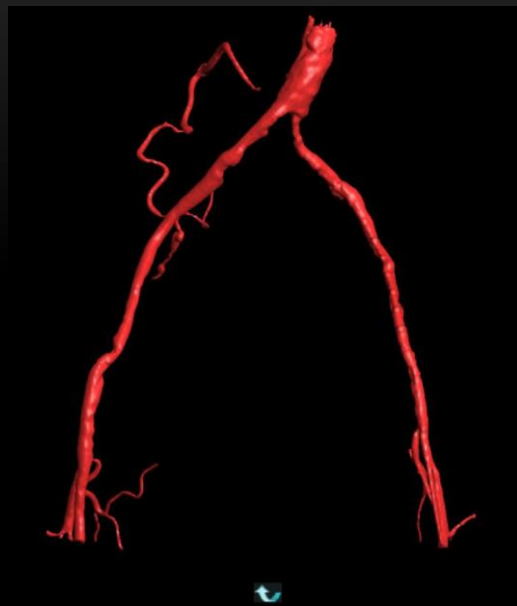
Angio 3D...



Angio 3D...



... et 3D-Road-Mapping



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

(Exemple: Anévrisme intra-crânien et embolisation)

Reconstruction CBCT
Coupes 0,17mm

VR et 3D RoadMap



Analyse MPR

Exam Date: 2017/01/24

Rot: LAO 84°

Ang: Caud 73°

Head Side

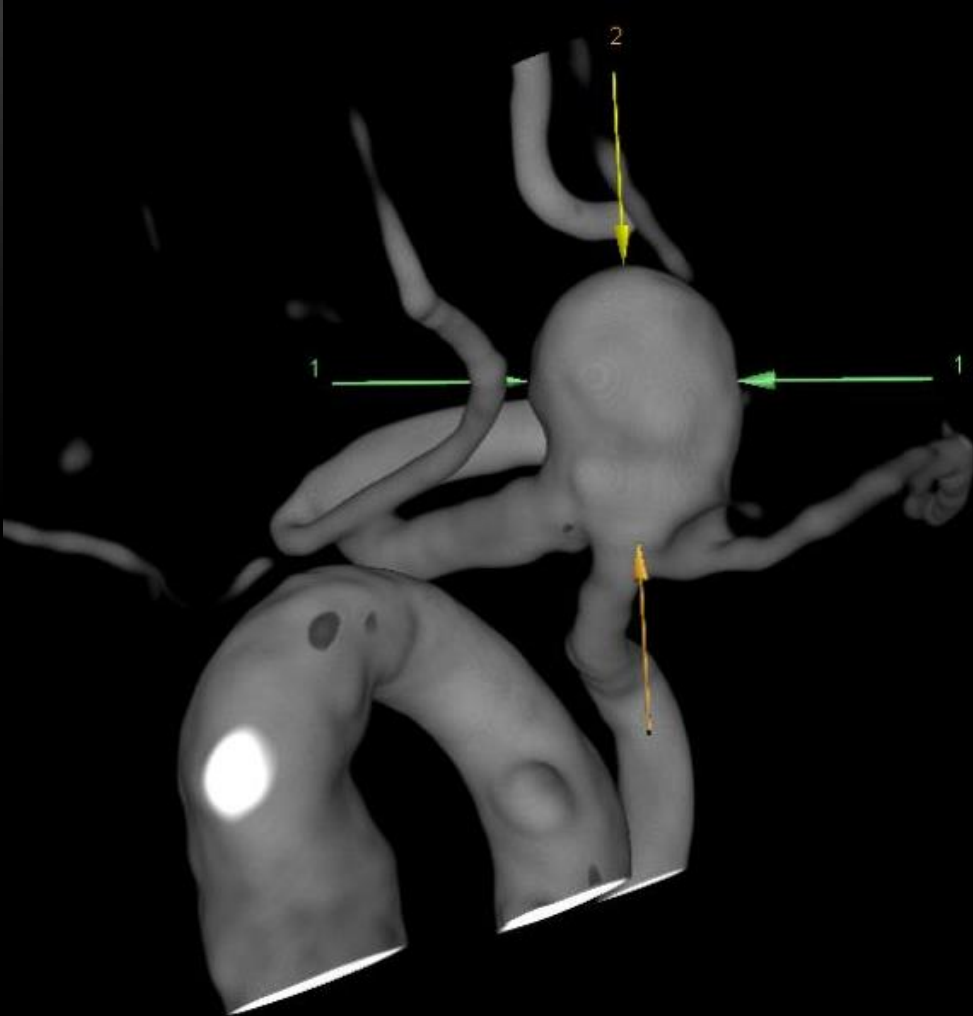
AP

LR

FH

Run Number: 5013
Volume Type: 3DRA
Run Date: 2017/01/24
Run Time: 12:40:39
Cube Size: 21.41 mm

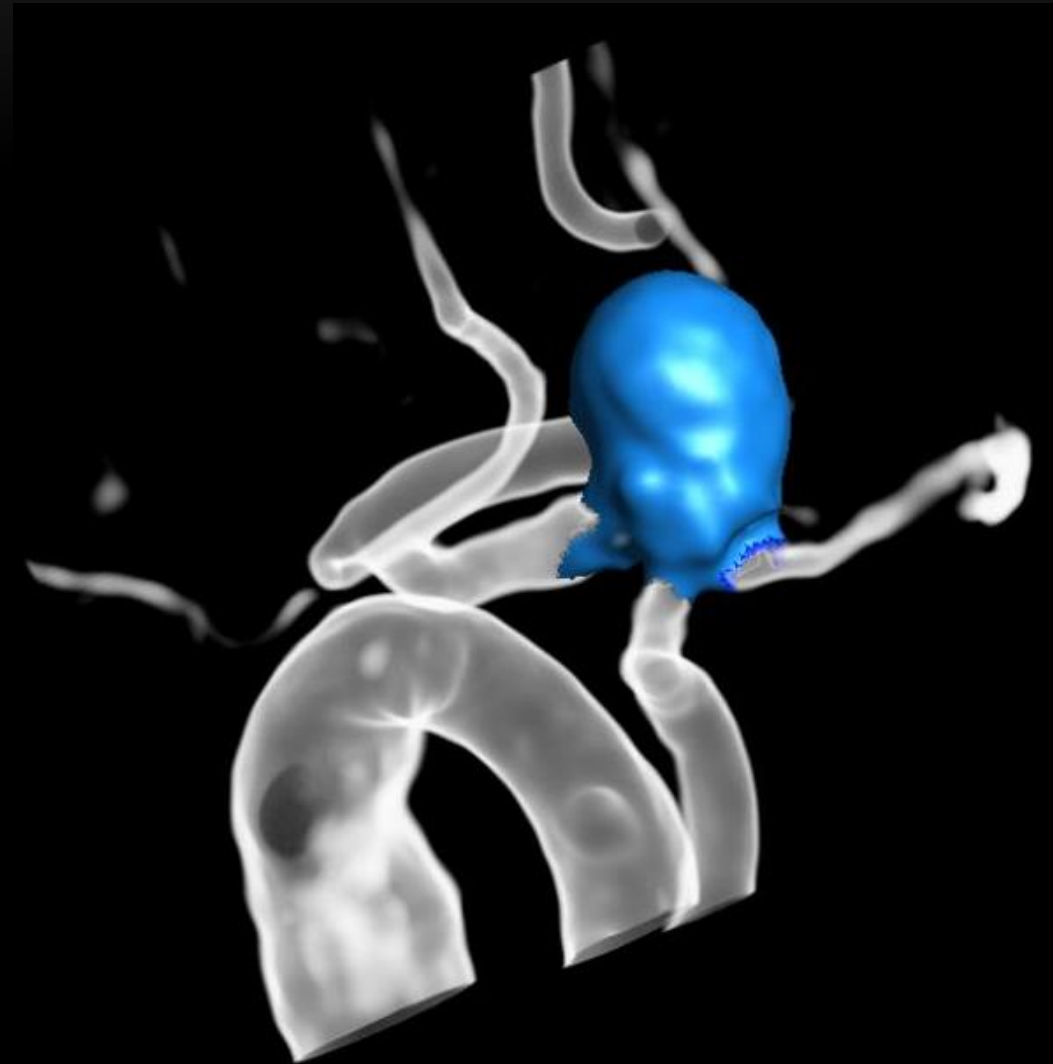
Mesures distances et volume Détection automatique



Distance Measurement 1
Distance Measurement 2

5.58 mm
7.54 mm

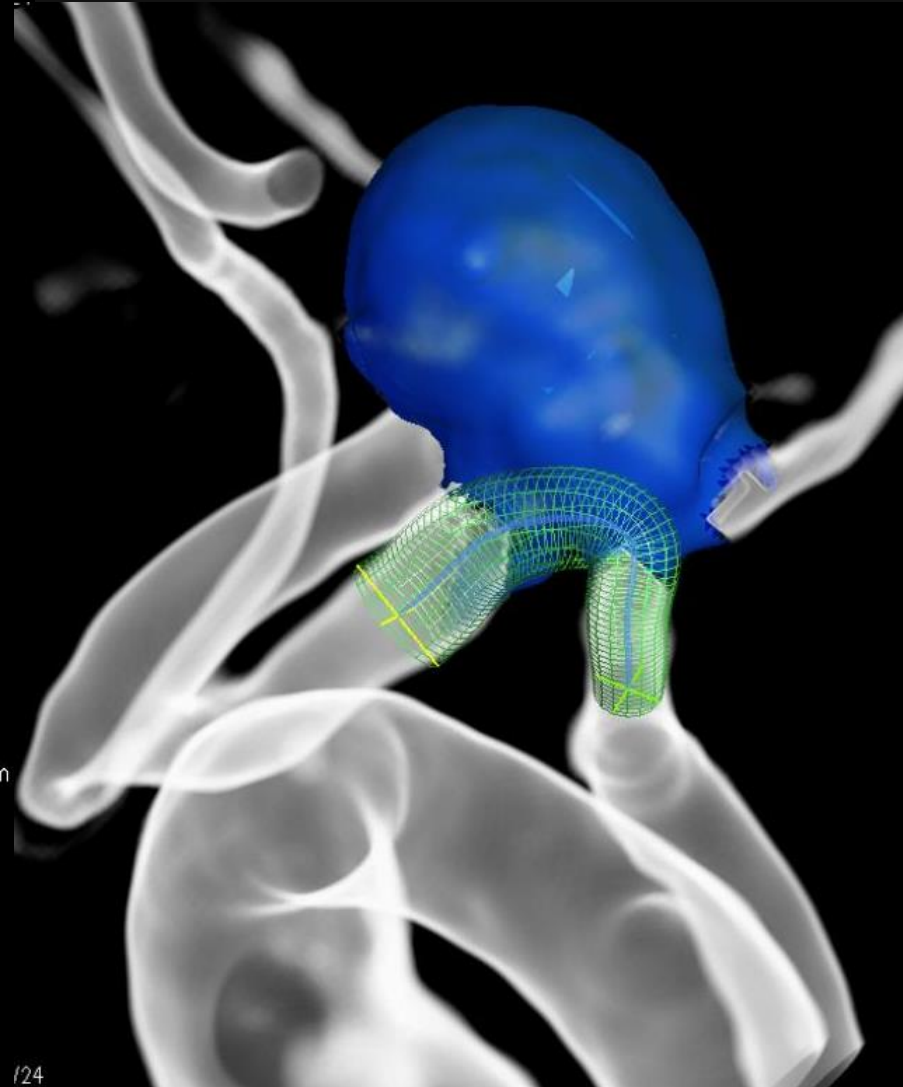
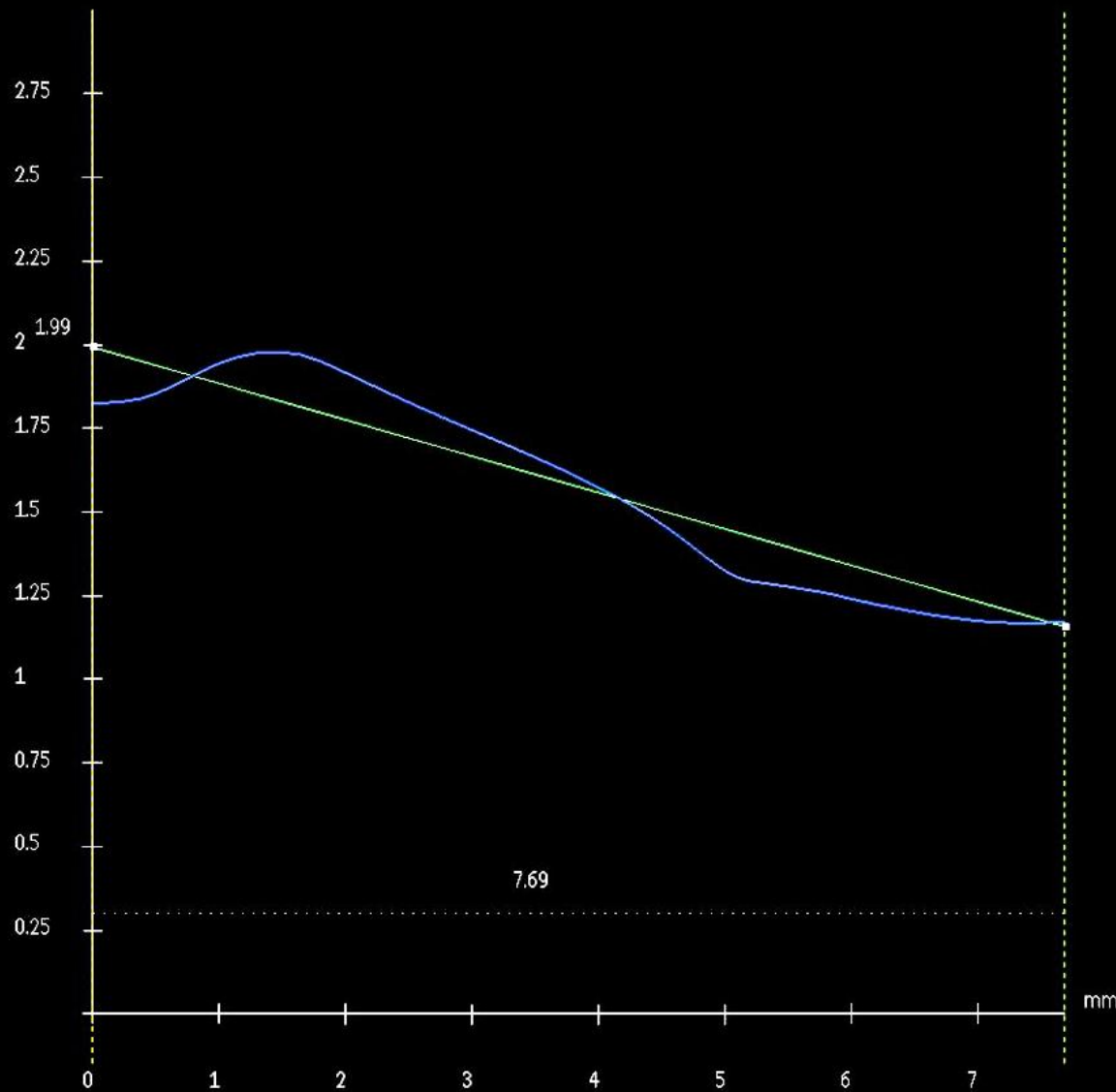
01/24

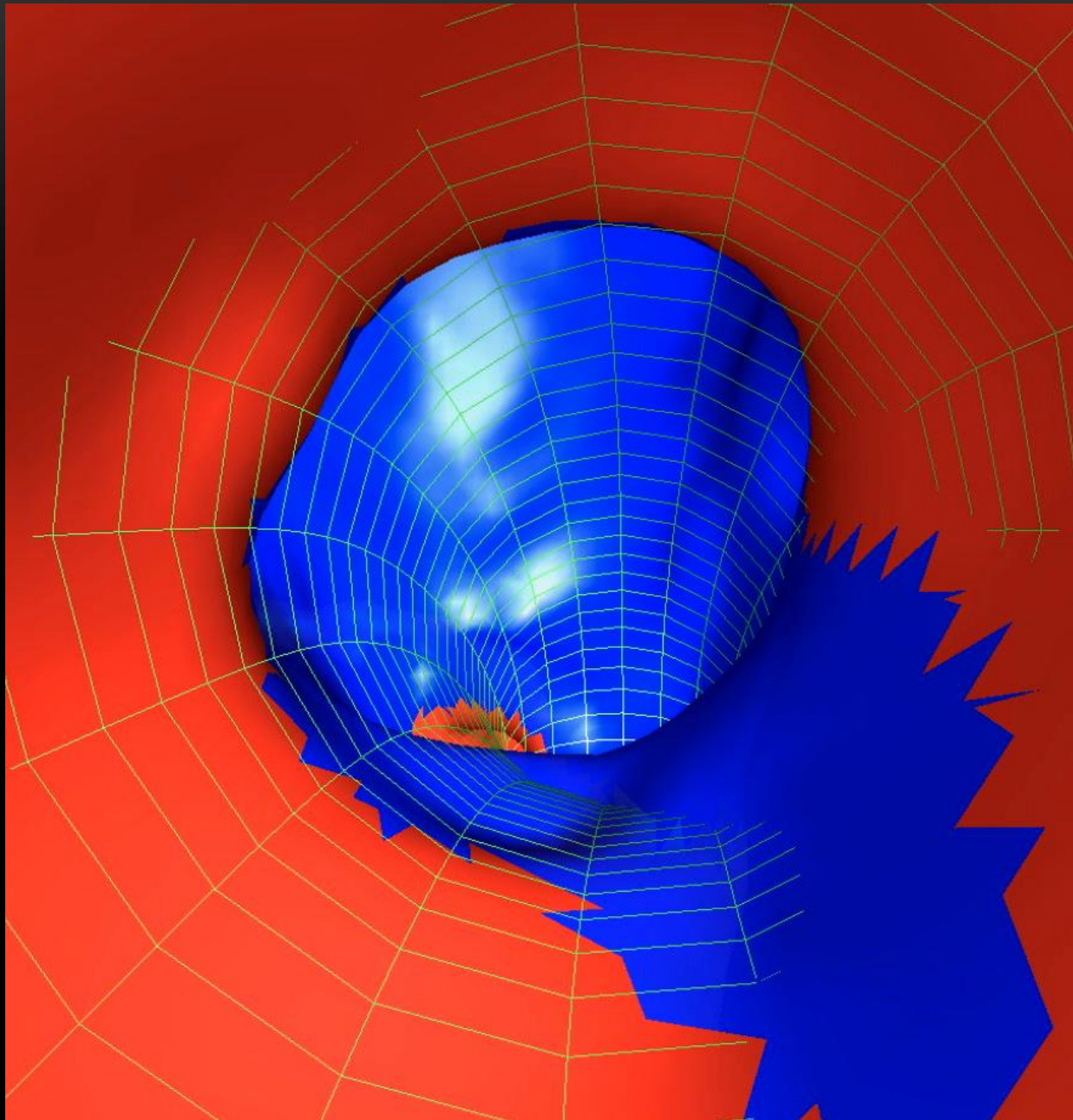


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A
7/01/24

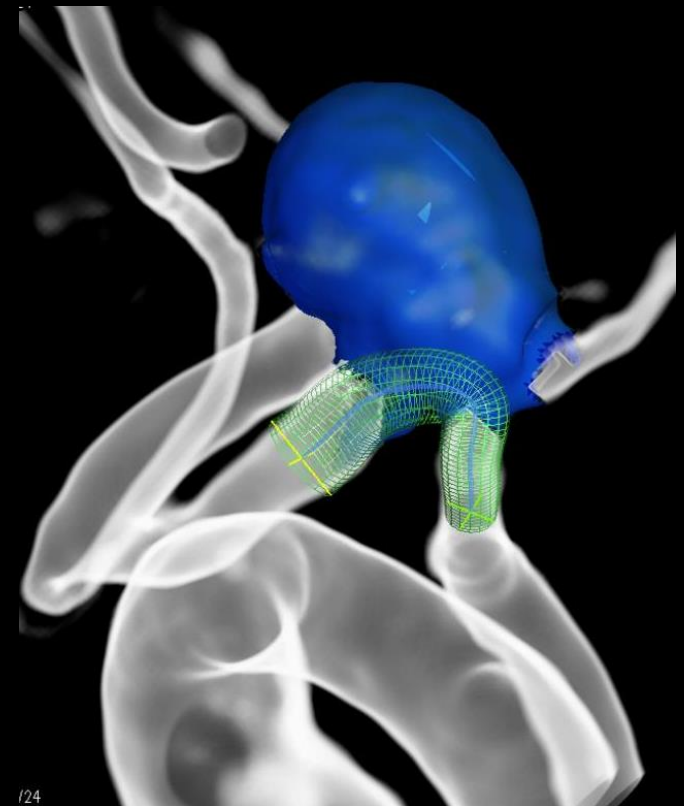
Volume Measurement 0.143 ml

Simulation d'endoprothèse Mesure automatique de la lumière





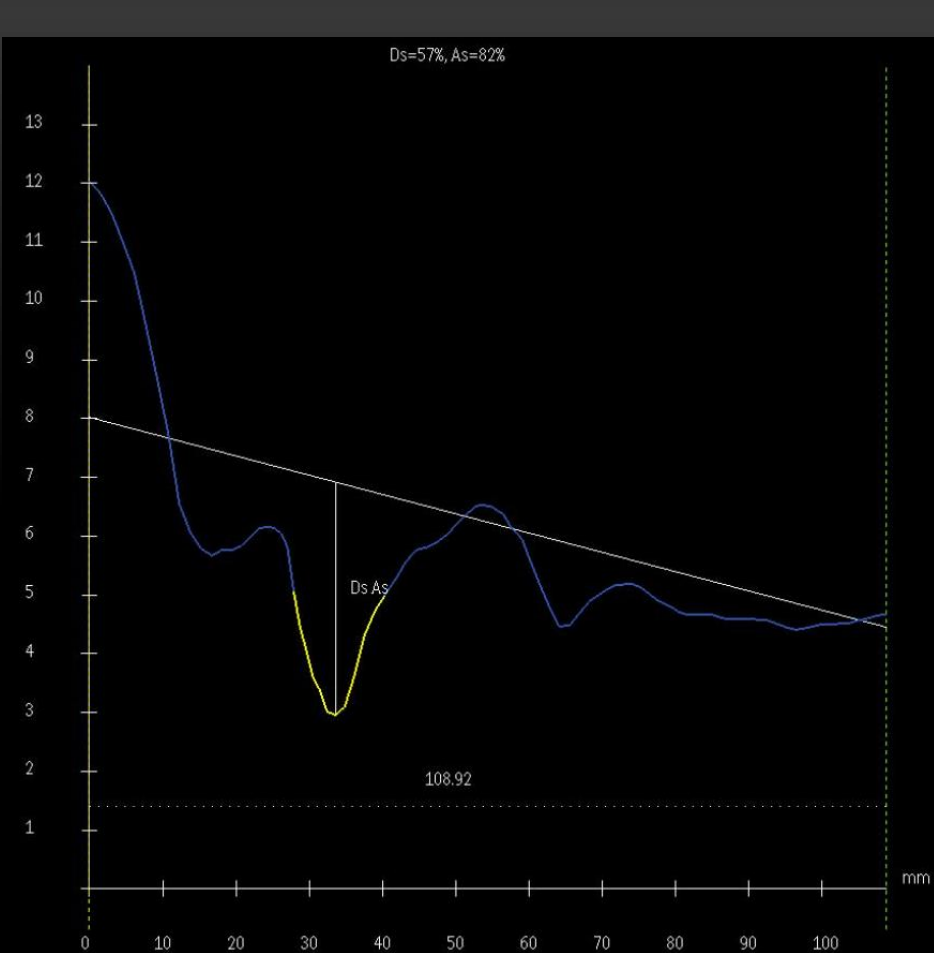
Vue endoluminale



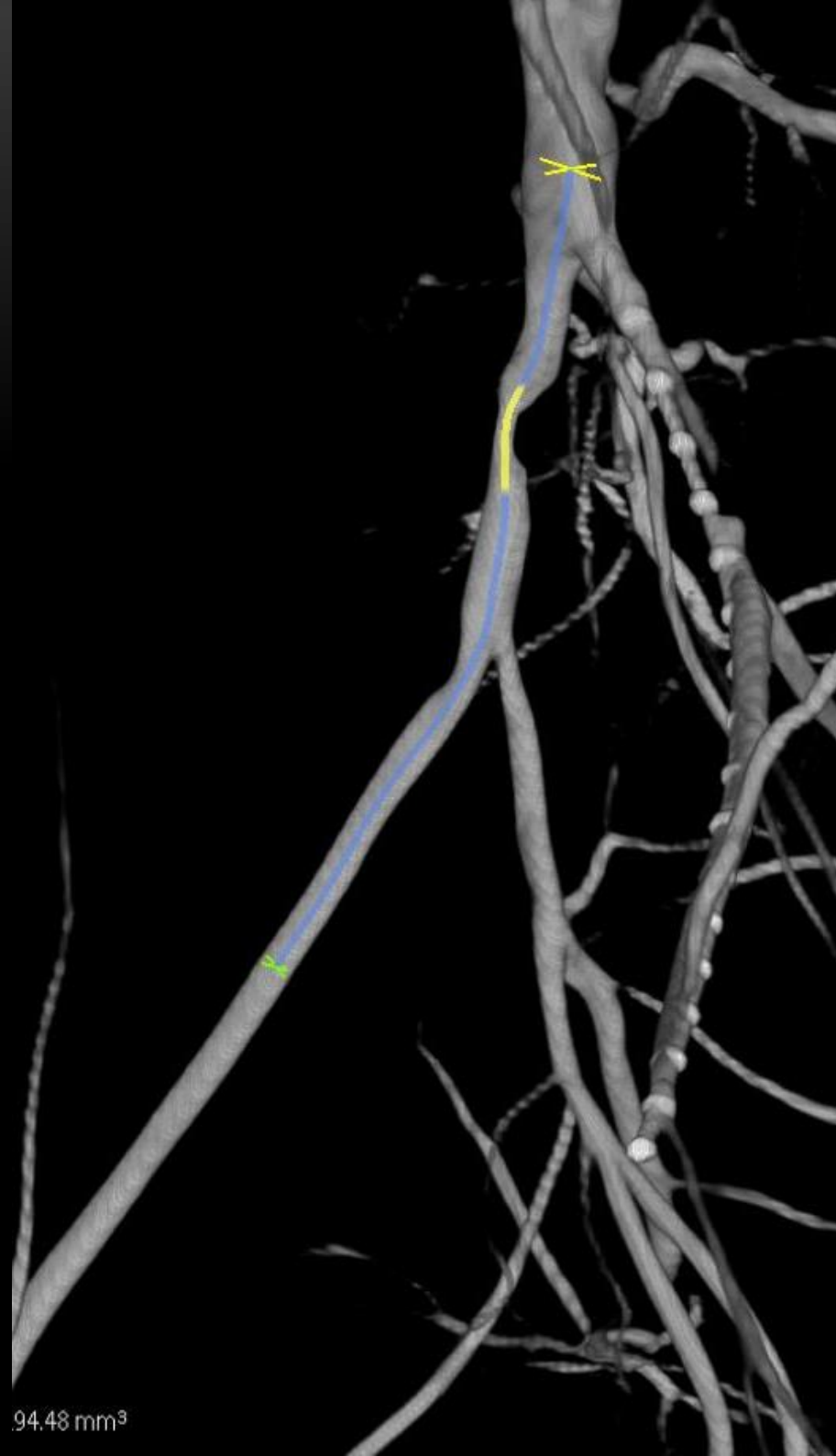
(Exemple: PTA-stenting Aorto-iliaque)

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...

On voit rien là-dessus ?!

Comment ça marche ce truc ?

*Quelqu'un peut-il dessiner un repère
au feutre sur l'écran ?*



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

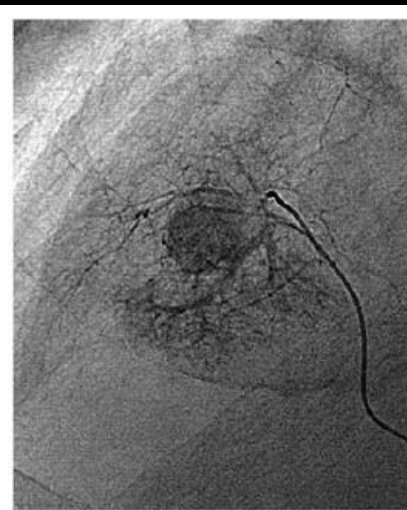
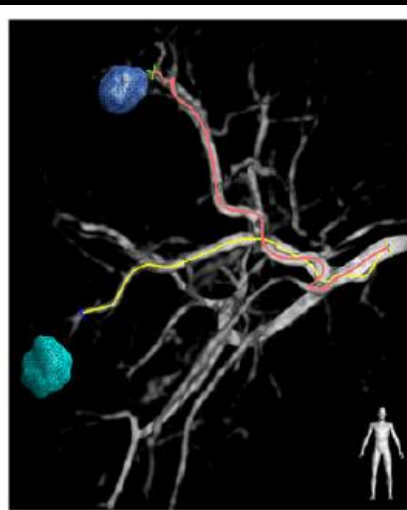
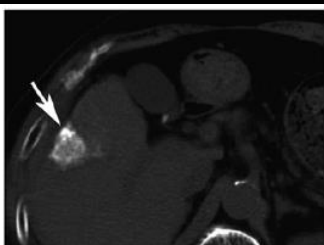
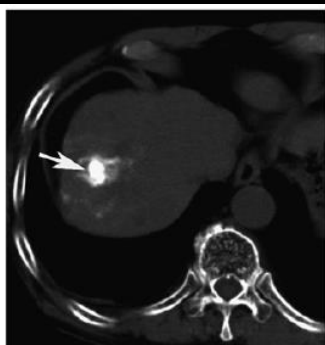
Shiro Miyayama, MD, Masashi Yamashiro, MD, Masahiro Hashimoto, MD, Nanako Hashimoto, MD, Masaya Ikuno, MD, Kenichiro Okumura, MD, Miki Yoshida, MD, and Osamu Matsui, MD

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

Variable	Detected	Not Detected	False Positive
Nonselective DSA	38	62	27
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	—	—

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

Prospective study
Patients n=36
HCC n=66



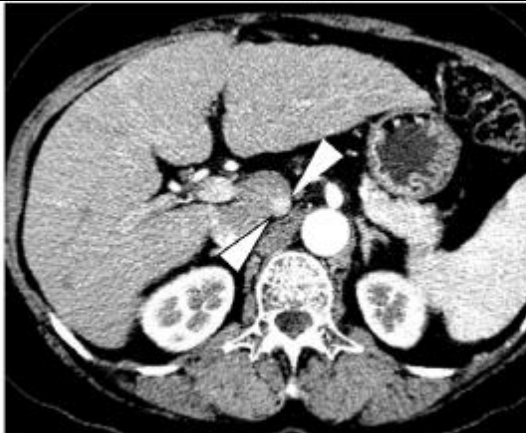
Role of C-Arm CT in Identifying Caudate Arteries Supplying Hepatocellular Carcinoma

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

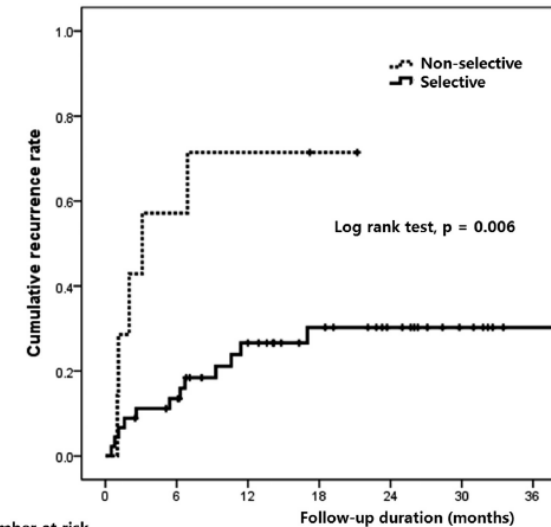
Origin	Number
Right main hepatic artery	23
Right anterior hepatic artery	11
Right posterior hepatic artery	10
S8 hepatic artery	10
S7 hepatic artery	10
Left hepatic artery	7
S4 hepatic artery	7
S2 hepatic artery	2
Proper hepatic artery	2
S6 hepatic artery	1
S3 hepatic artery	1
Right inferior phrenic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



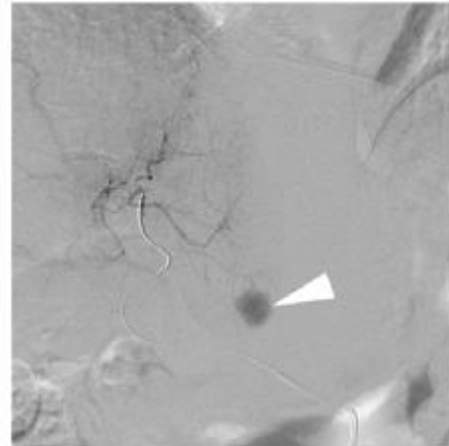
a.



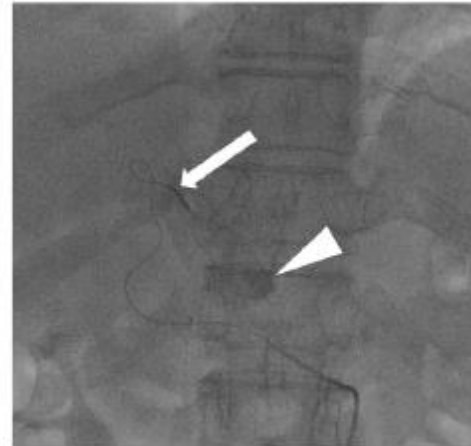
b.



Number at risk		Follow-up duration (months)						
Selective	Non-selective	0	6	12	18	24	30	36
45	7	37	3	27	2	19	13	6
27	2	19	1	13	0	1	0	1



d.



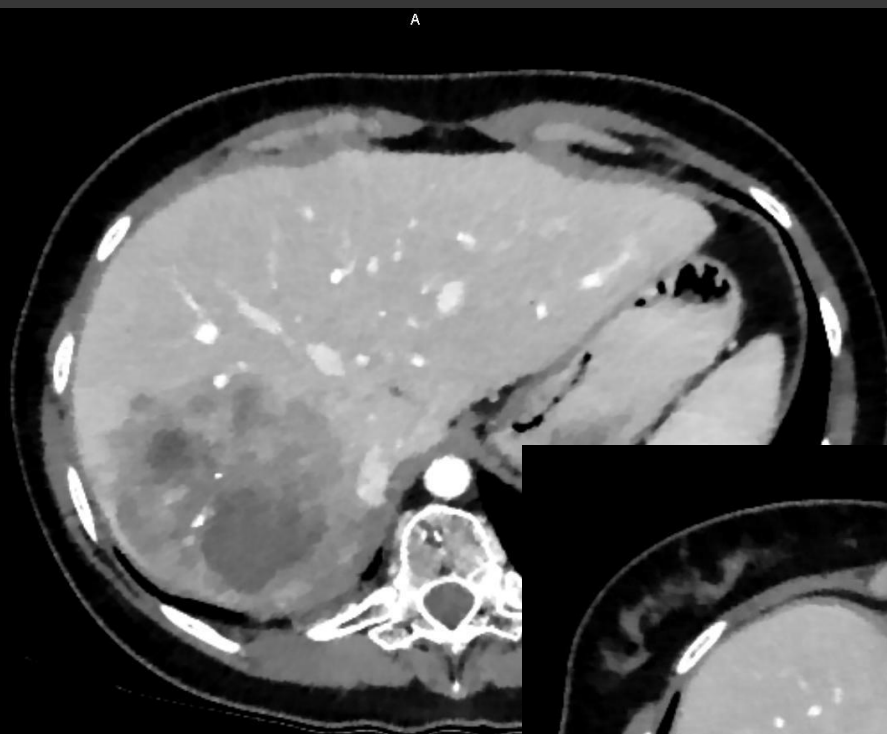
e.

USEFULNESS OF C-ARM CBCT FOR EMBOLIZATION

SOME ILLUSTRATIVE CASES...

Case 1 – Liver: DEBTACE (chemoEmbolization)

- ♀, 30y
- Liver metastases of corticoadrenaloma
- Long medical history, multiple past treatments...
- CMO: _{DEB}TACE under general anesthesia (patient demand), RL then LL





MIP No cut

DFOV 18.2 cm

Jul 27 2015

R
P
I

No VOI

0.4mm / 0.36sp

IPL

FPL

Statif désactivé

OL 4 RAO 4 CA

Jul 27 2015

n

Statif désactivé

OL 3 LAO 28 CA

IPL

FAL

Analyse MPR + MIP

No cut

V 18.2 cm

Jul 27 2015

VOI

im / 0.36sp

LAS

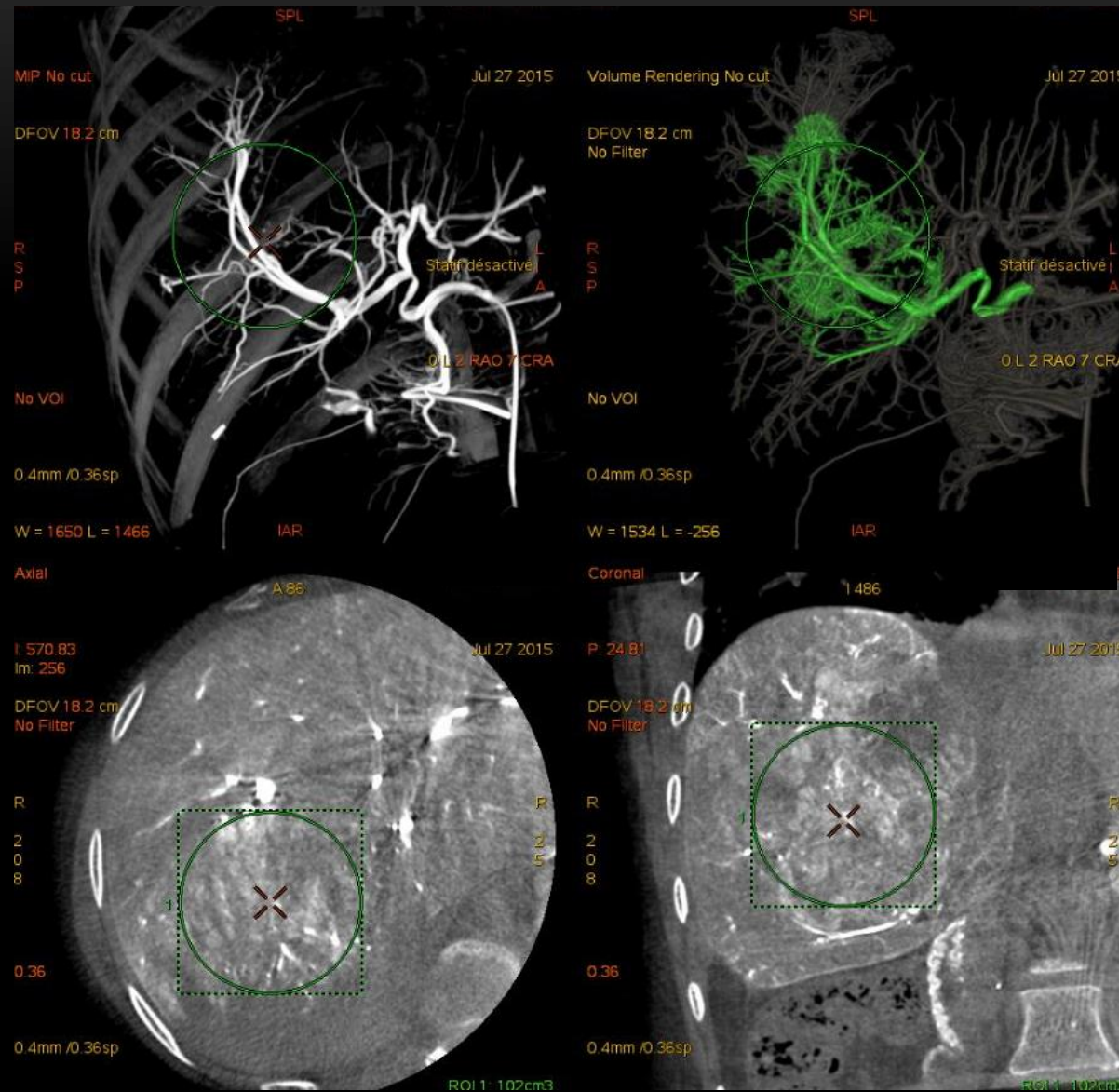
LAH

Statif désactivé

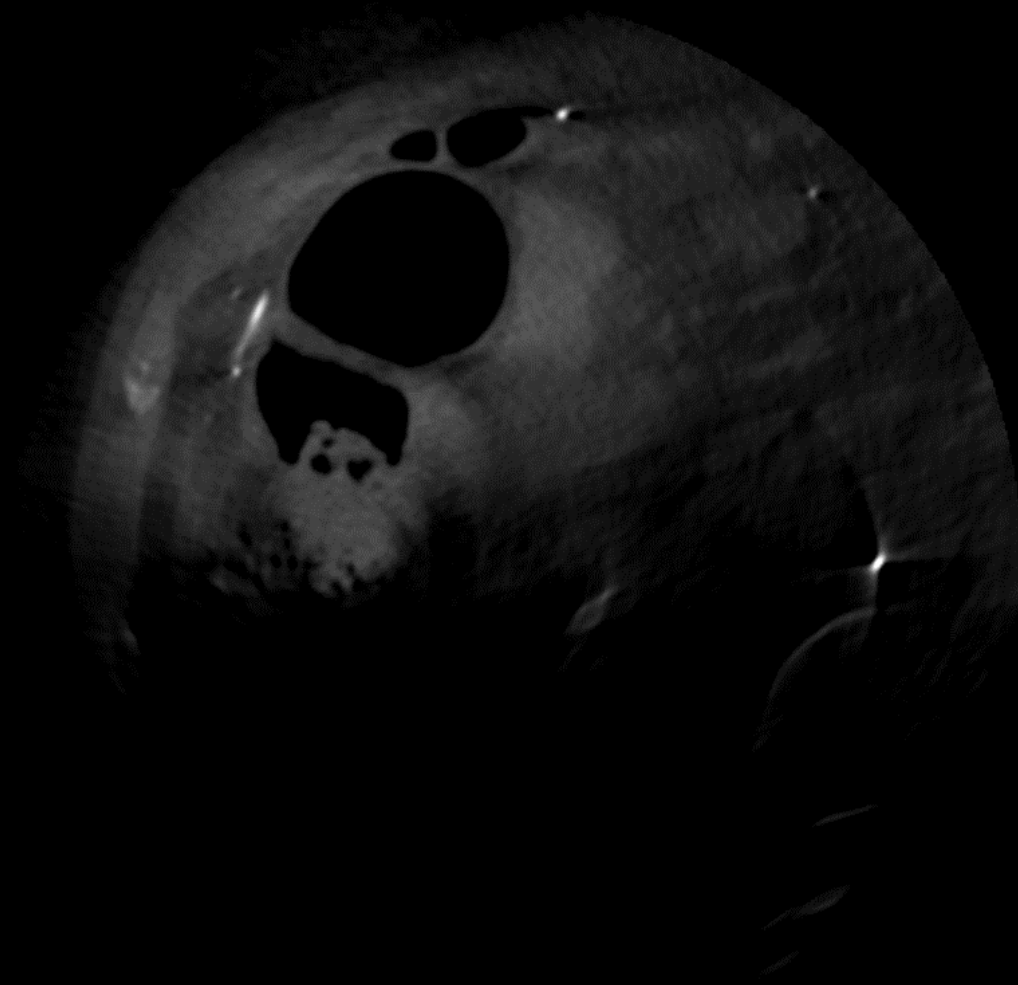
40 L 46 RAO 88 CRA

P
L
S

Tumor vessels automatic detection + 3D RoadMap



KT: TC → Artère hépatique commune





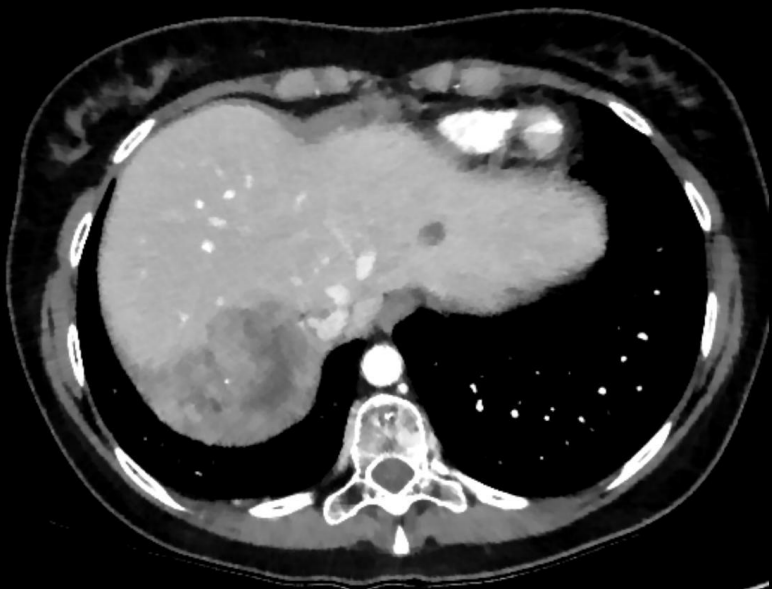
KT: Artère phrénique Dr

A



P

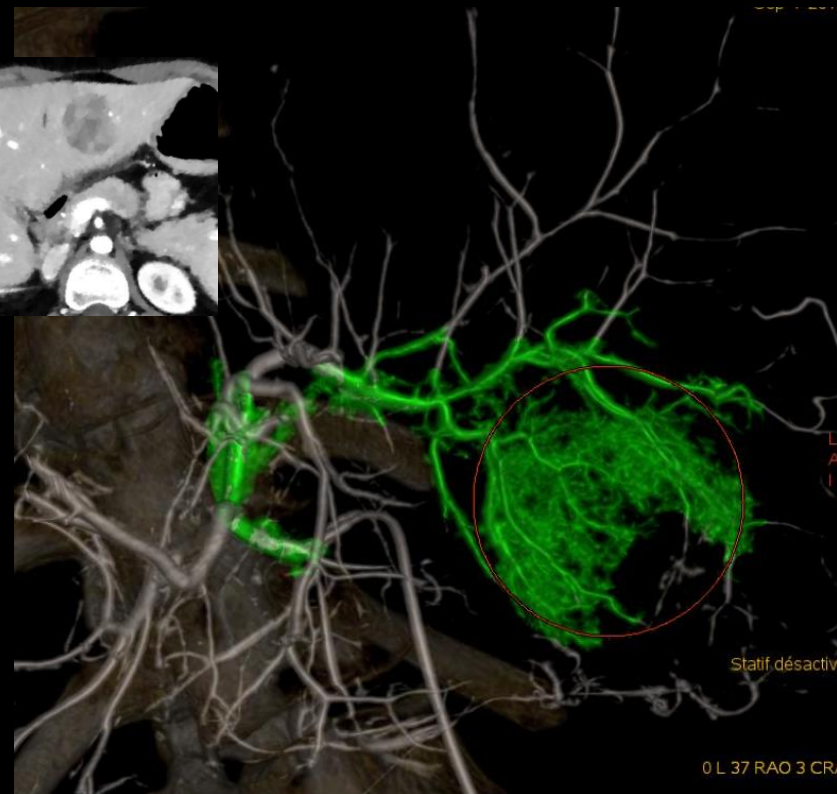
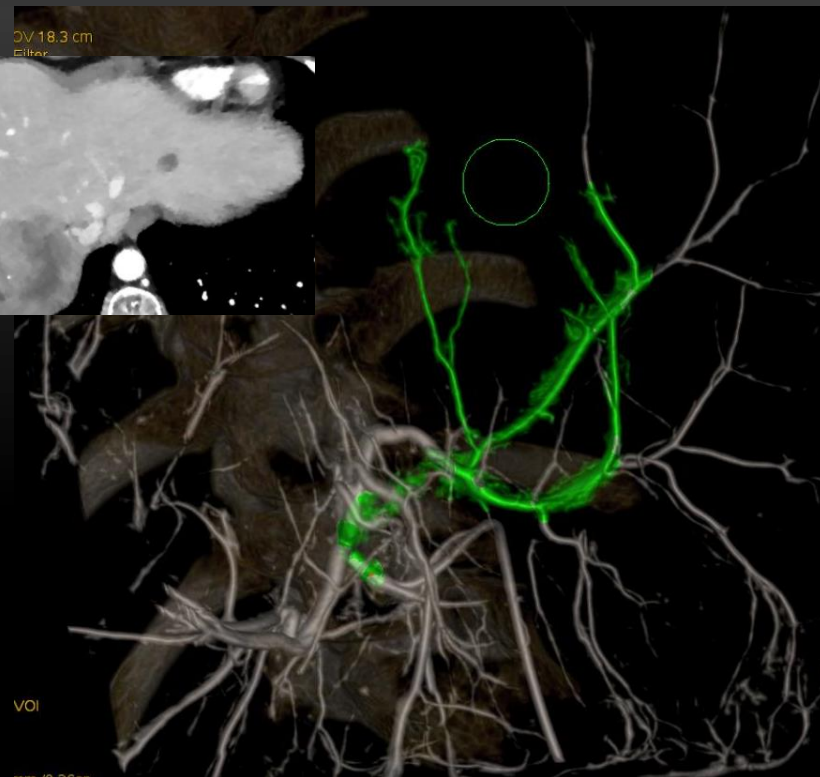
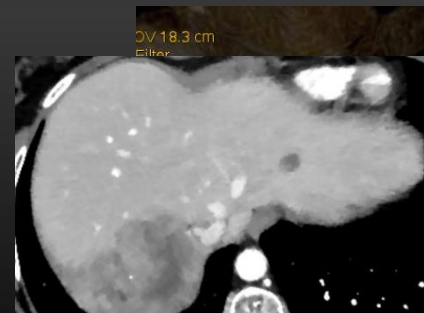
A



P

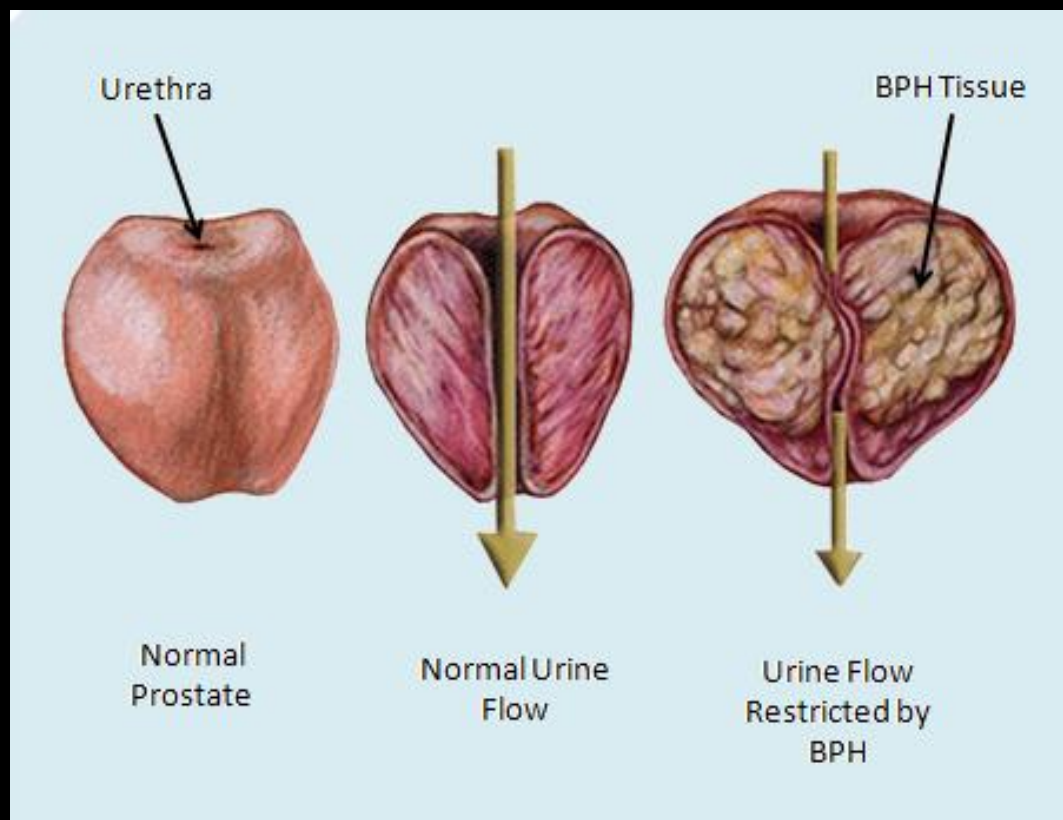


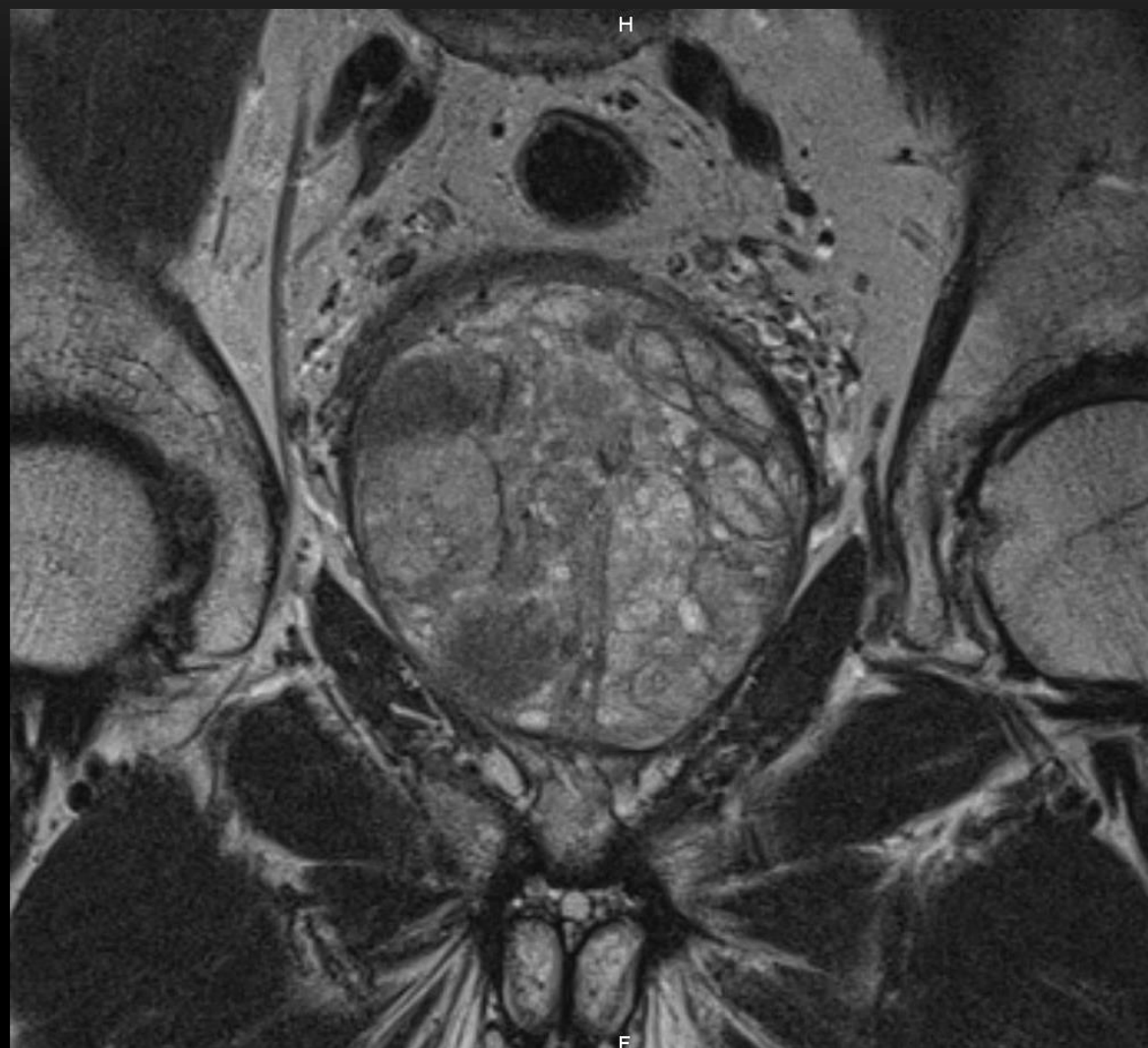
(F)lt



Case 2 – Prostate Embolization

- ♂, 85y
- Very large BPH (140g)





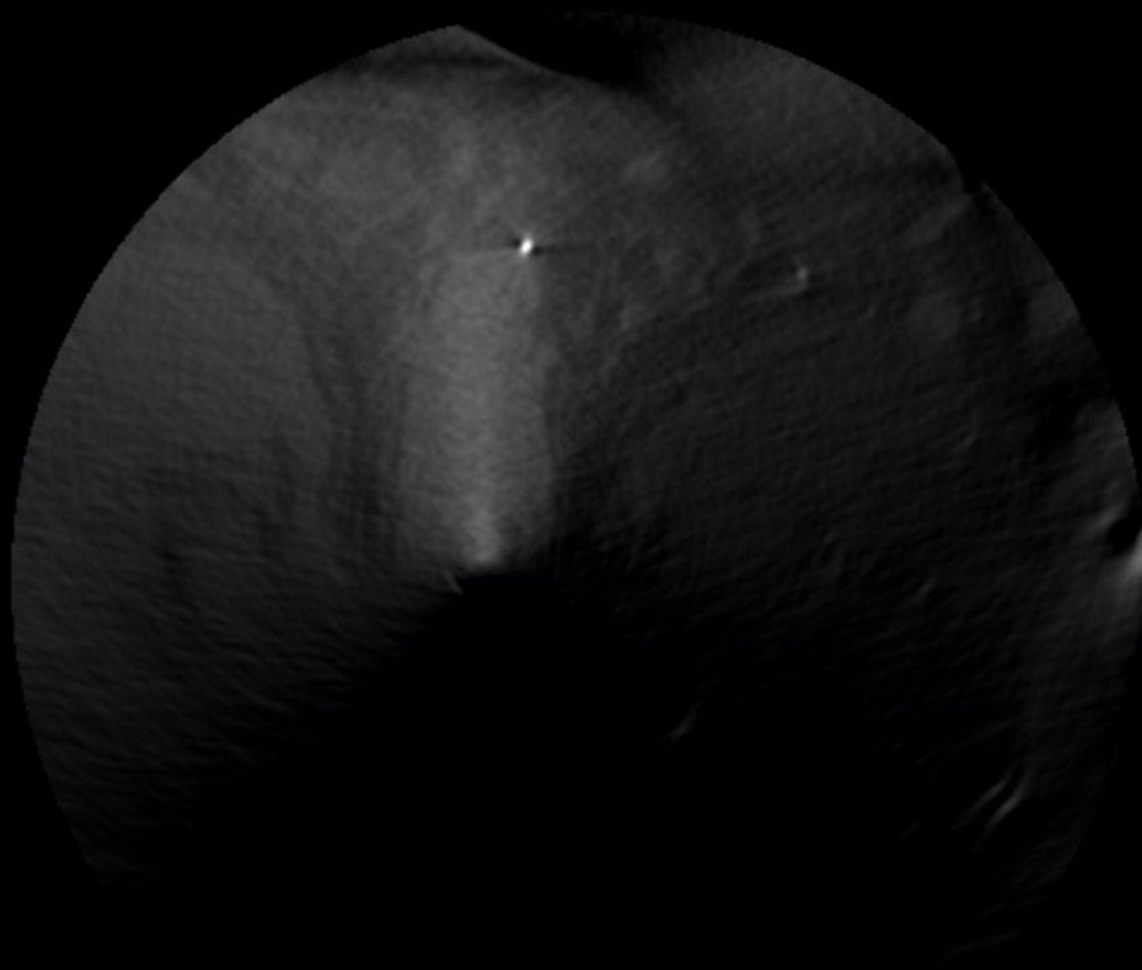
Prostatic artery ??



(Filt. 3)

?





Flight Plan (GE)

MIP No cut

DFOV 18.3 cm

A
I
L

Sep 28 2015

Statif désactivé

0 L 106 LAO 8 CAU

No VOI

IPR

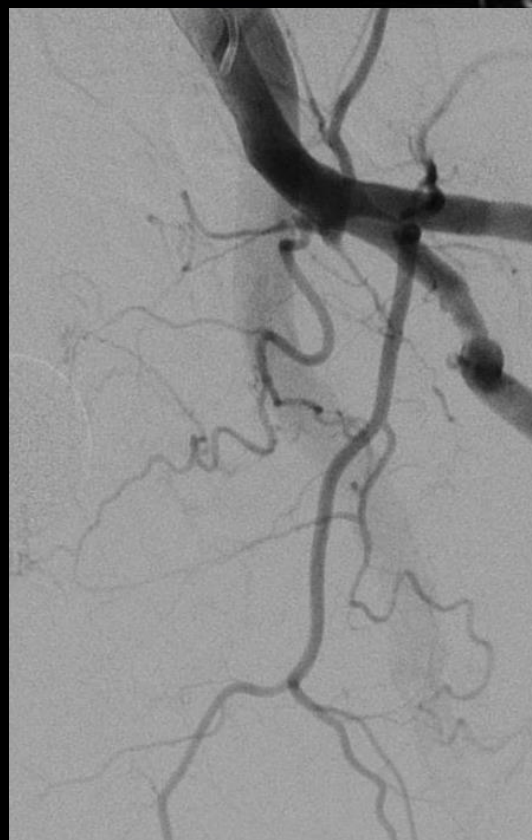
Volume Rendering No cut

DFOV 18.3 cm
No FilterA
I
L

Sep 28 2015

Statif désactivé

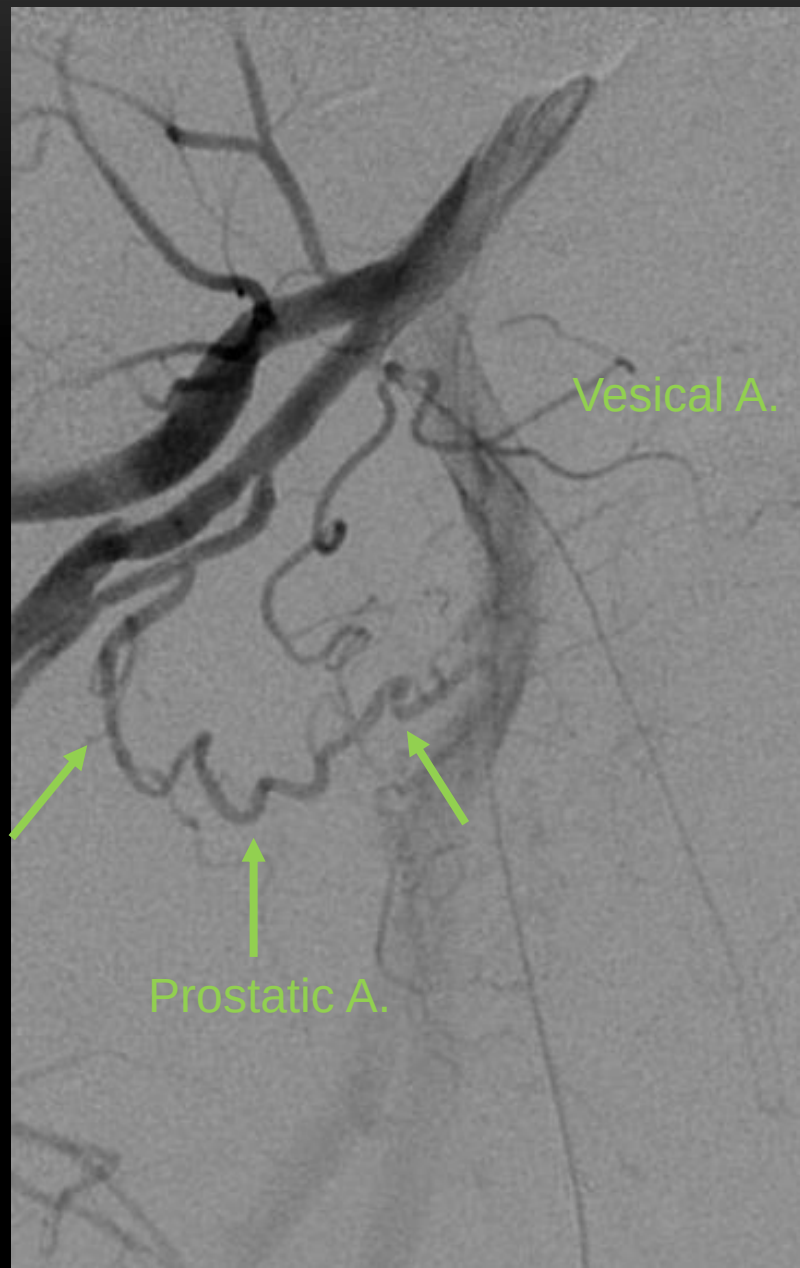
0 L 106 LAO 8 CAU

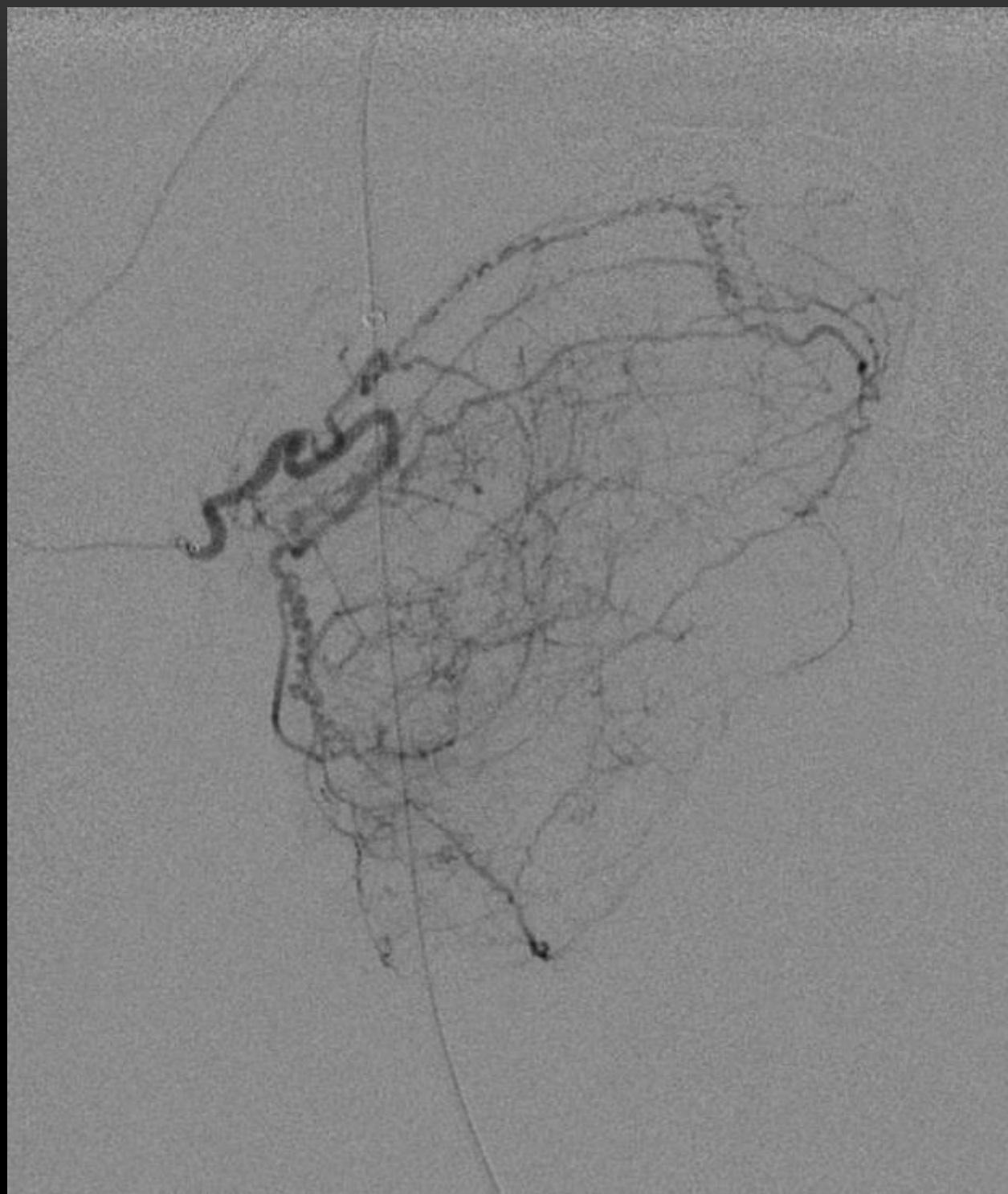
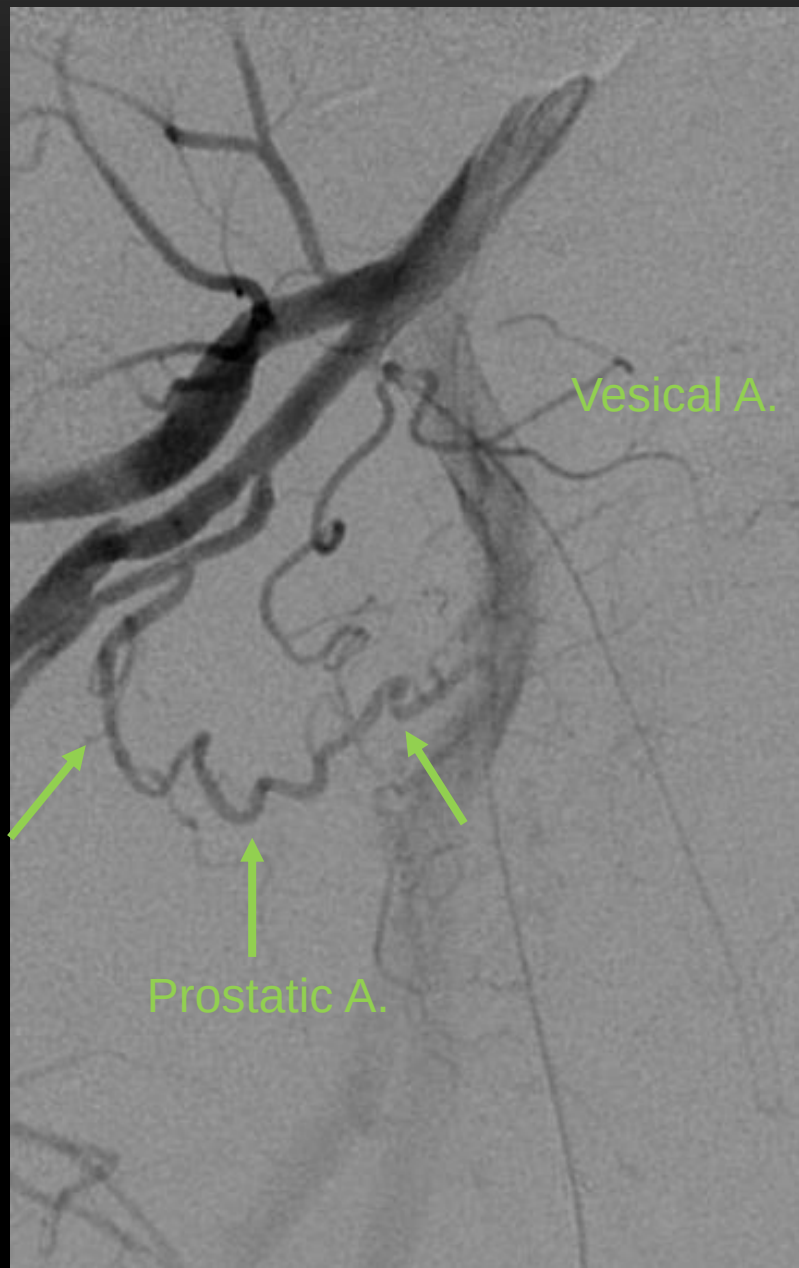


3D RoadMap



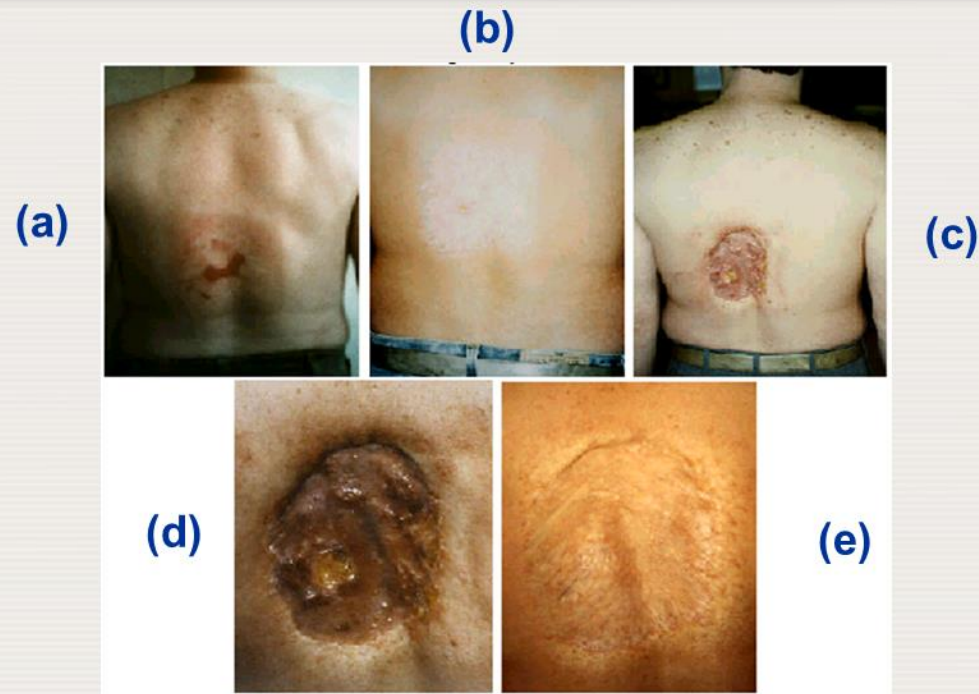
RAO 35°
Caud 10°



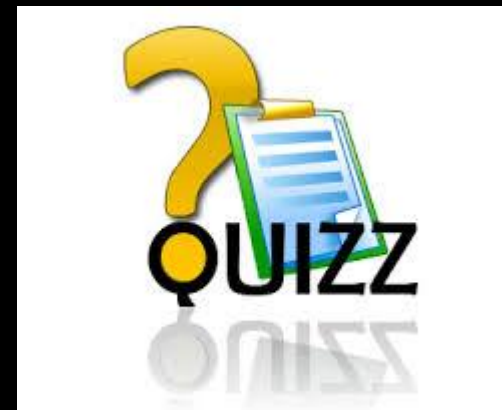


! RADIOPROTECTION EN RxI

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).



Comment optimiser la radioprotection en RxI ?



Protection du personnel:

- 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 !)

$$\downarrow \text{dose} \approx \uparrow (\text{distance})^2$$

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 !)



Position tube-détecteur:

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

Acquisition des images:

- 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)

Réglages machine (scopie / graphie):

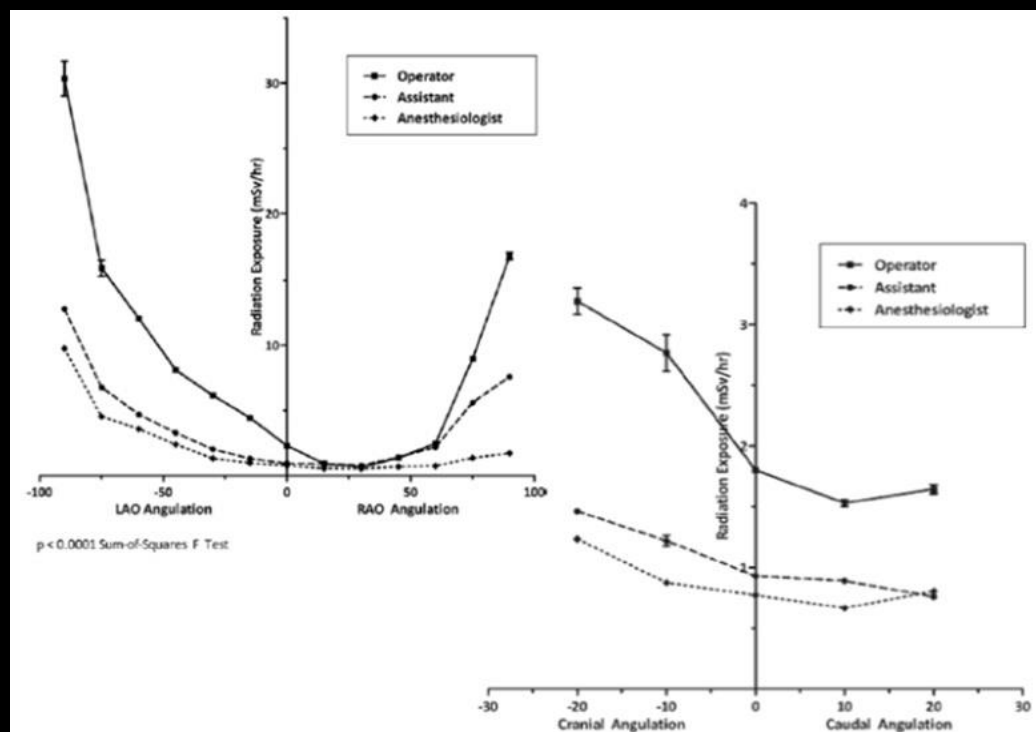
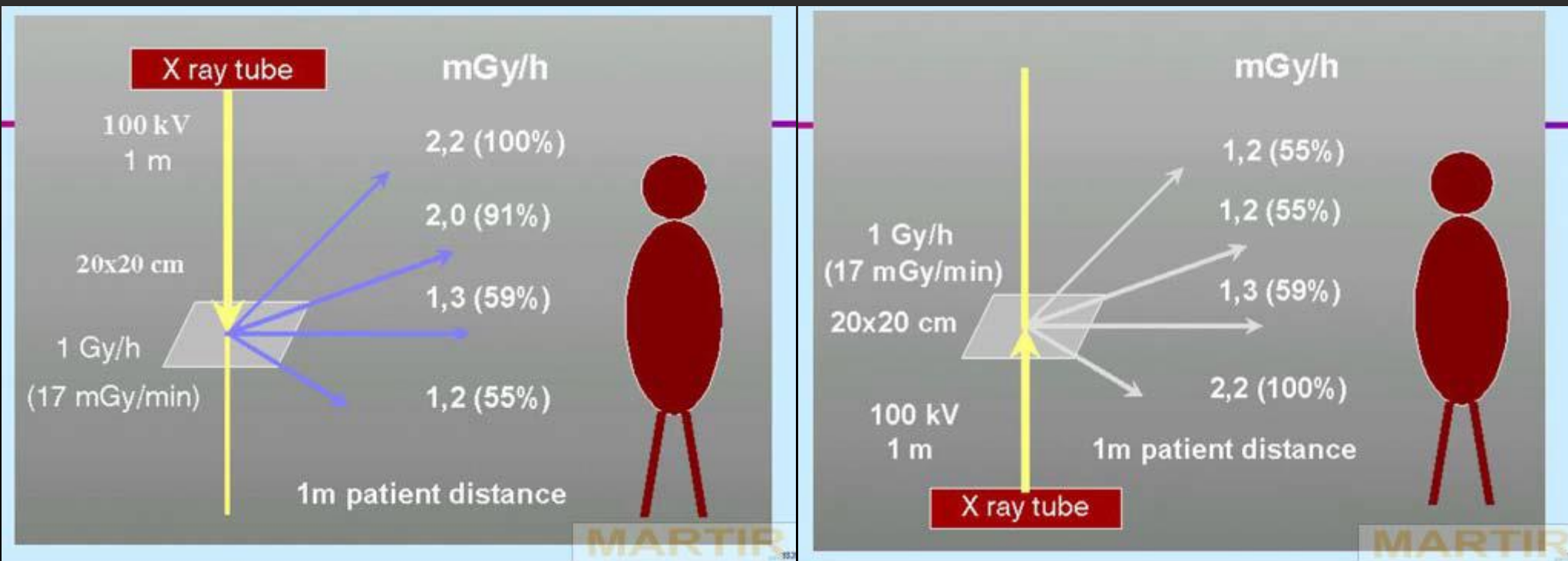
kV, mAs, limites de doses...

dose ~ mAs

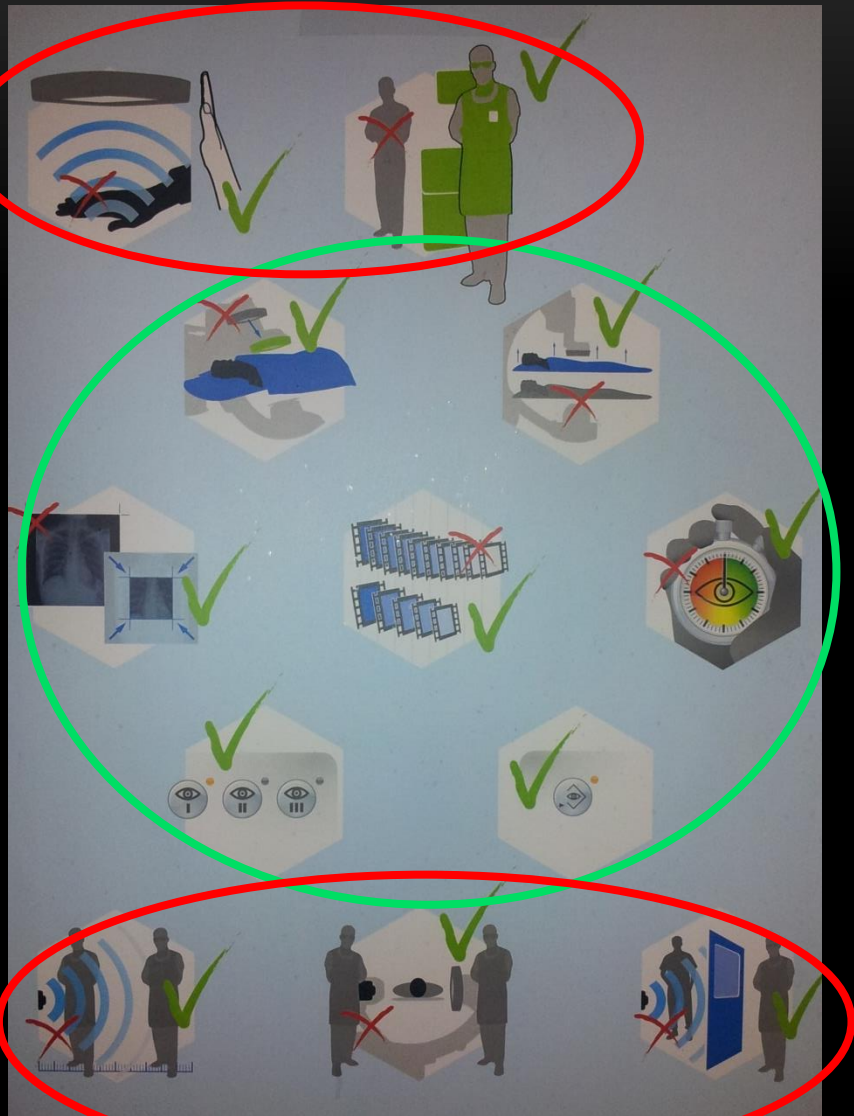
dose ~ kV² à 3

+ Filtres Cu (automatique)

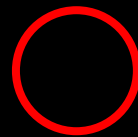
A propos du rayonnement diffusé et de la position tube / détecteur...



... radioprotection du patient ou du personnel ?



Radioprotection **PATIENT** = **Personnel** !
car ↓↓ Rx diffusés



Radioprotection **PERSONNEL**
sans effet sur la protection du patient

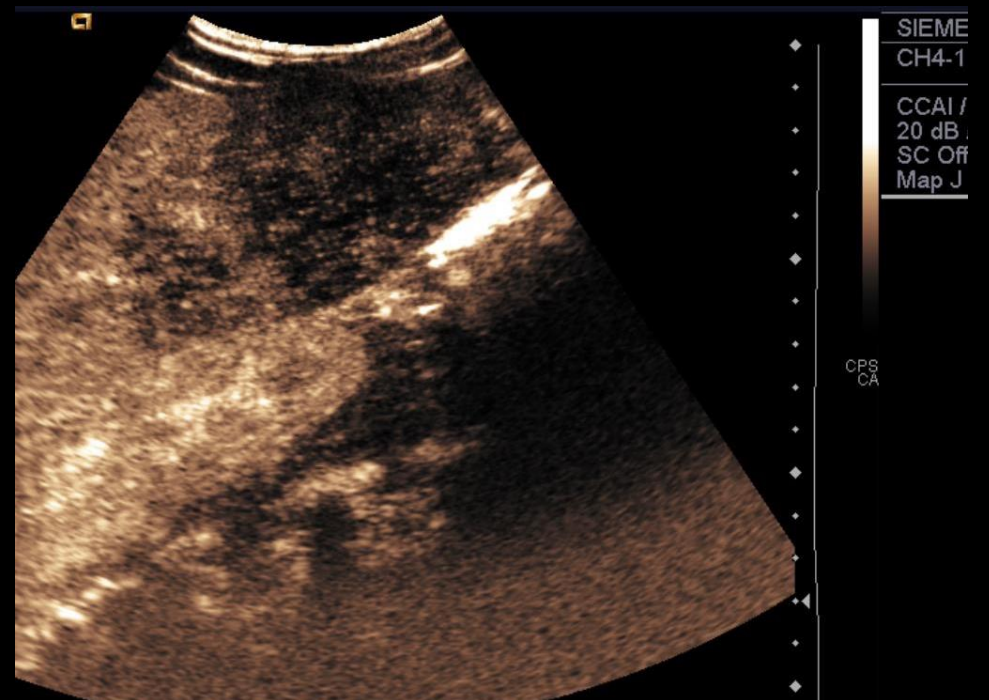
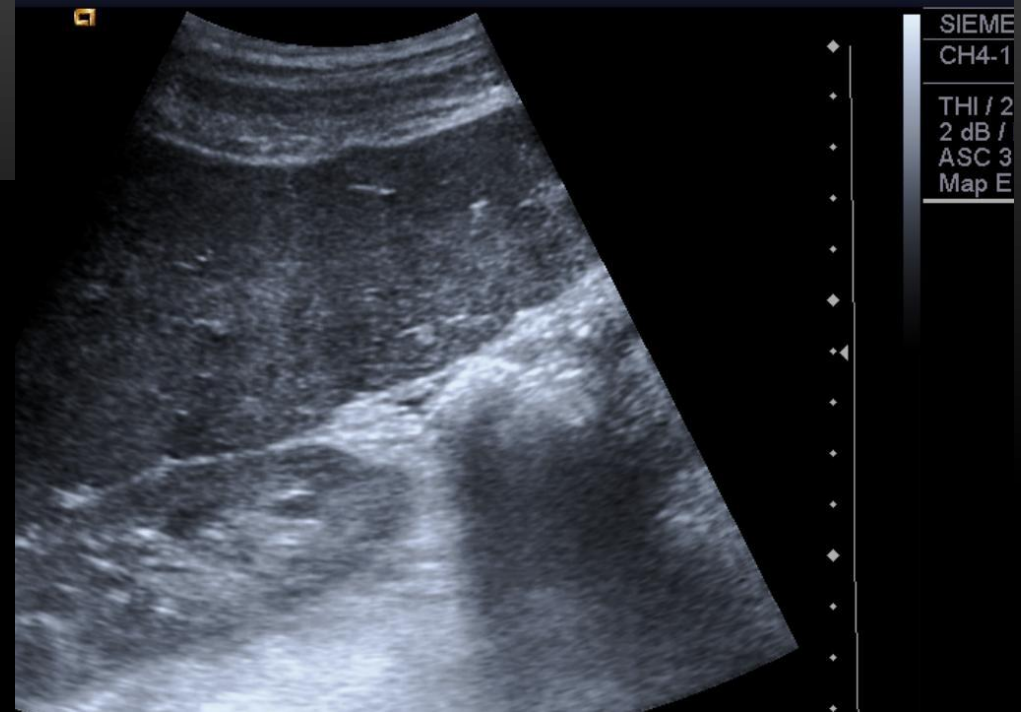
GUIDAGE: US

- 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



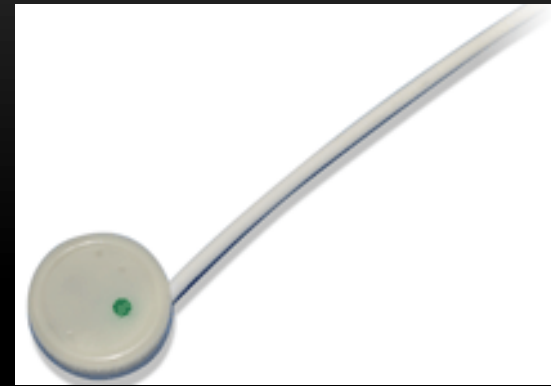
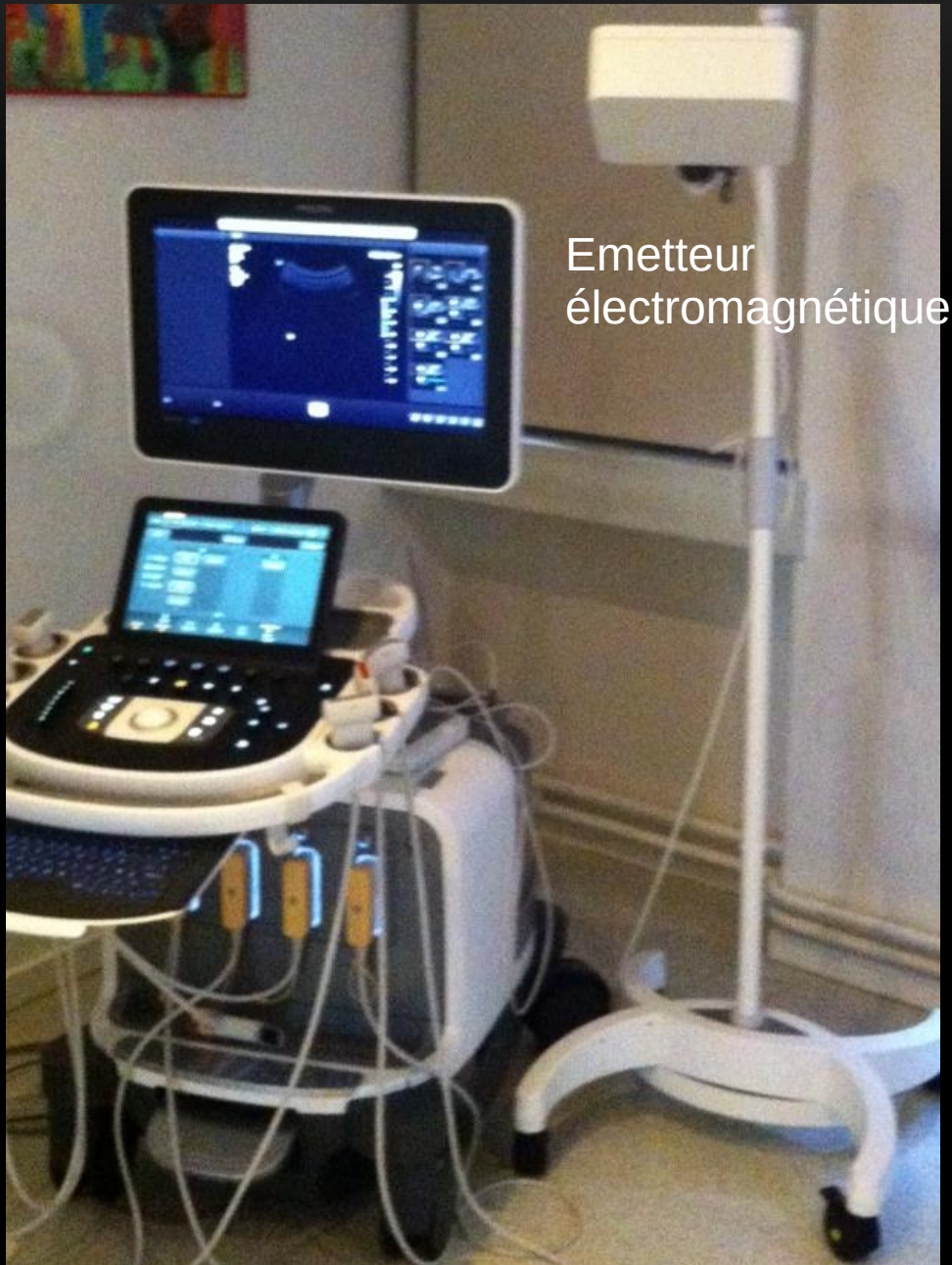


→ Contraste échographique (Sonovue)



Courtesy Dr S.Drisis
Institut Jules Bordet

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

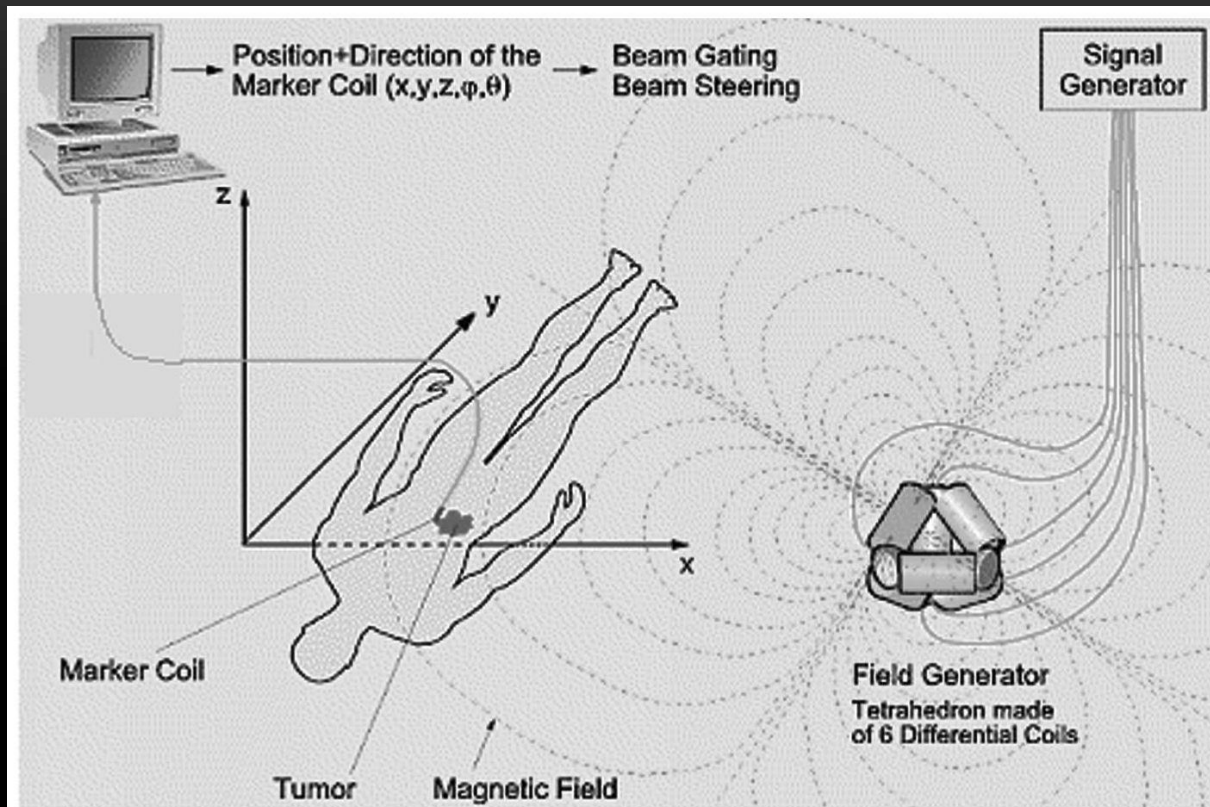


Capteurs électromagnétiques
(patient et sonde +/- aiguille)



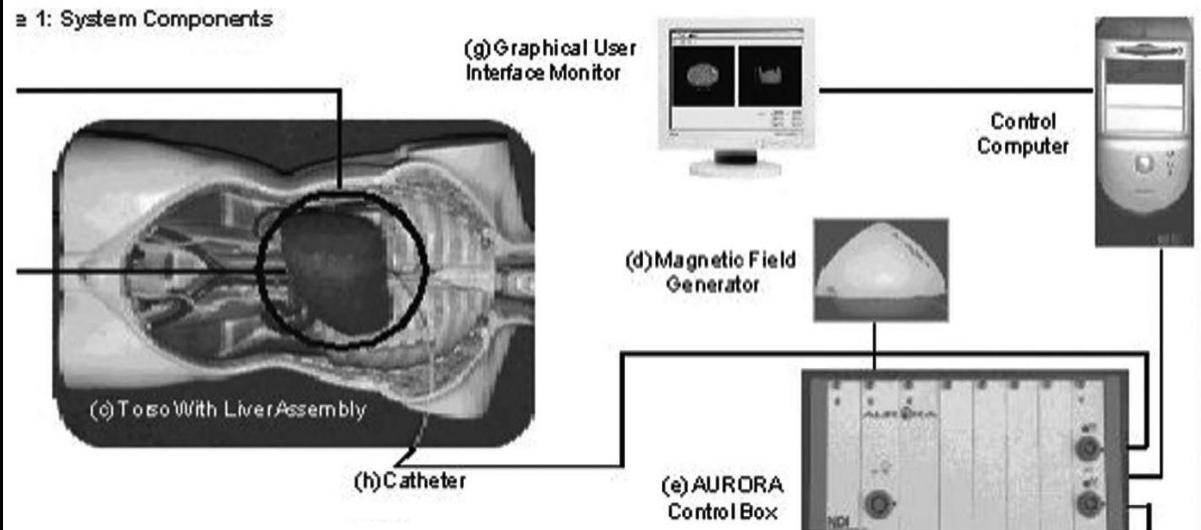
Courtesy Dr S.Drissi
Institut Jules Bordet

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



a.

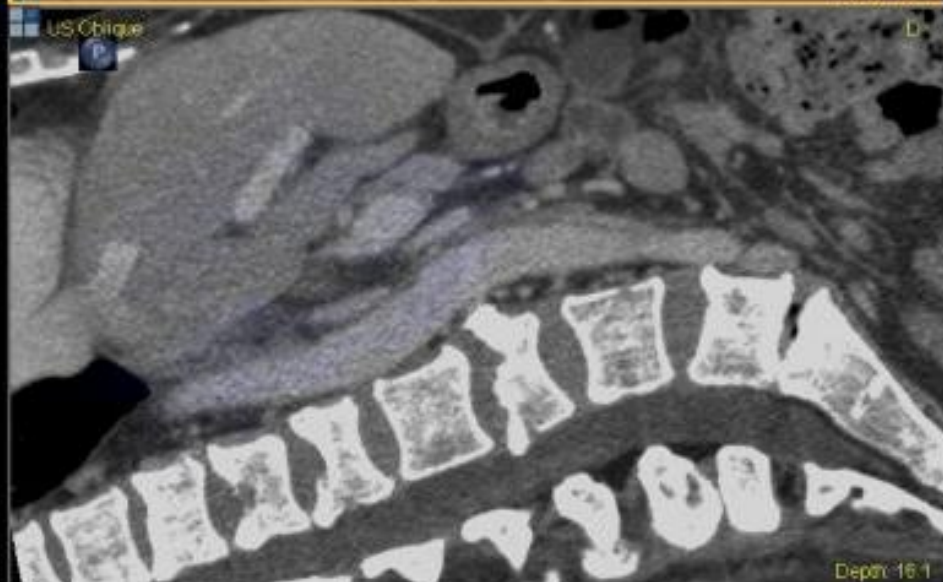
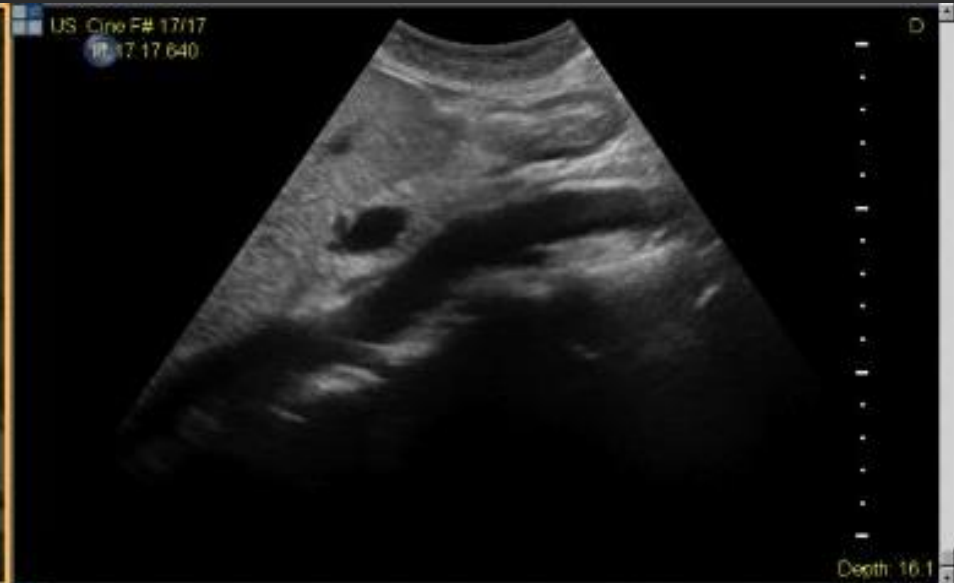
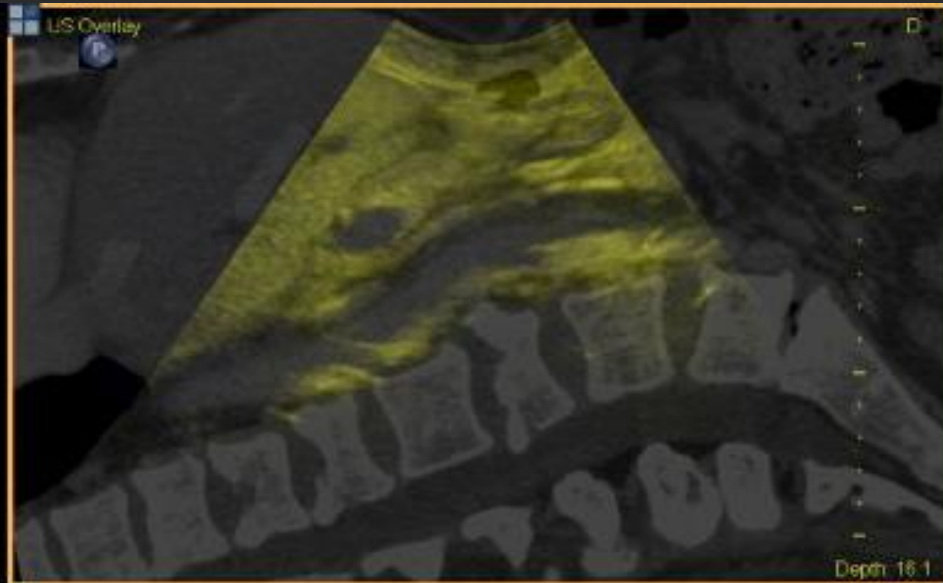
a. 1: System Components



b.

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.

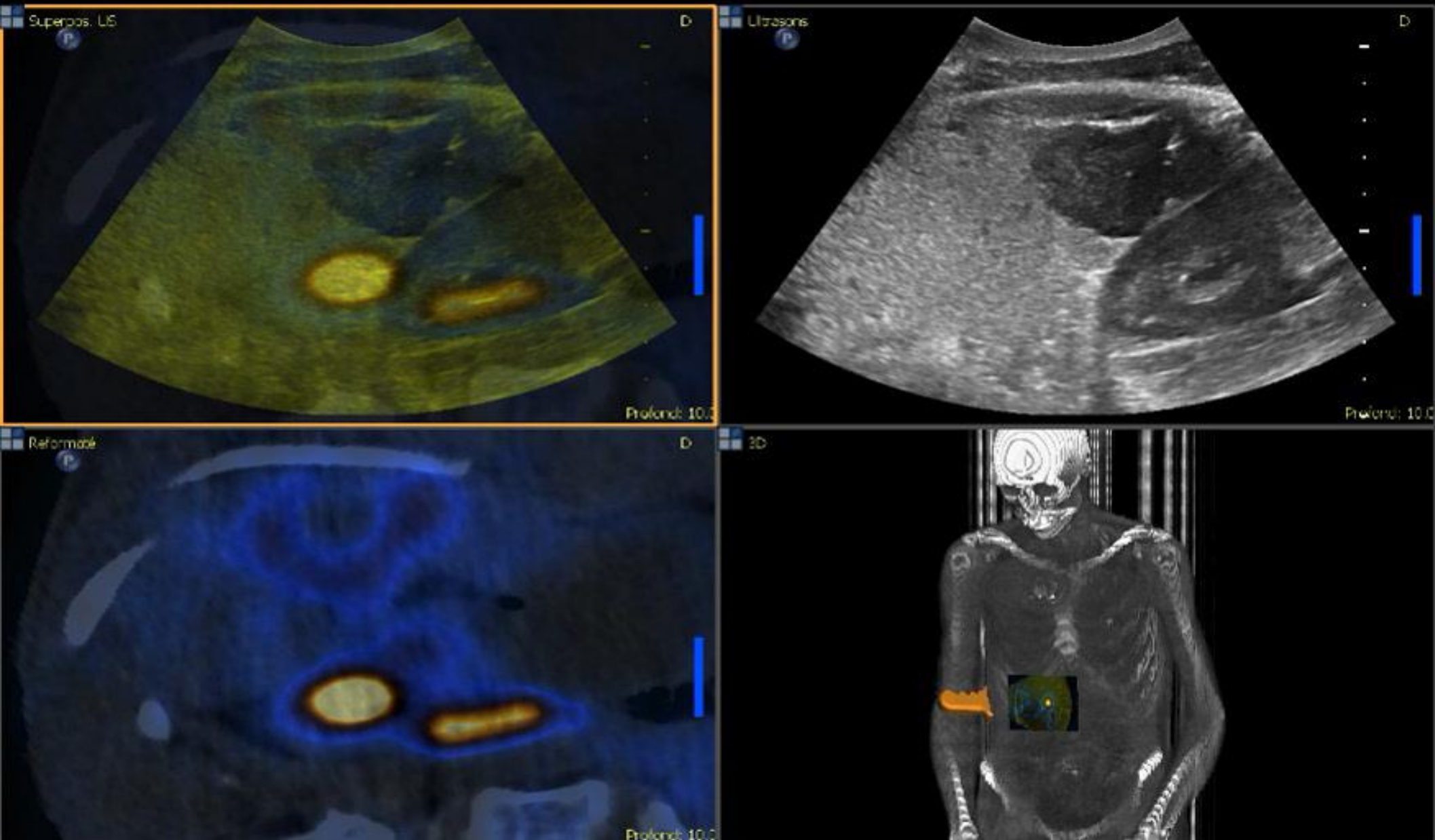
Une fusion des images US est alors possible avec un volume CT, IRM ou PET



CT AND ULTRASOUND FUSION OF AORTA

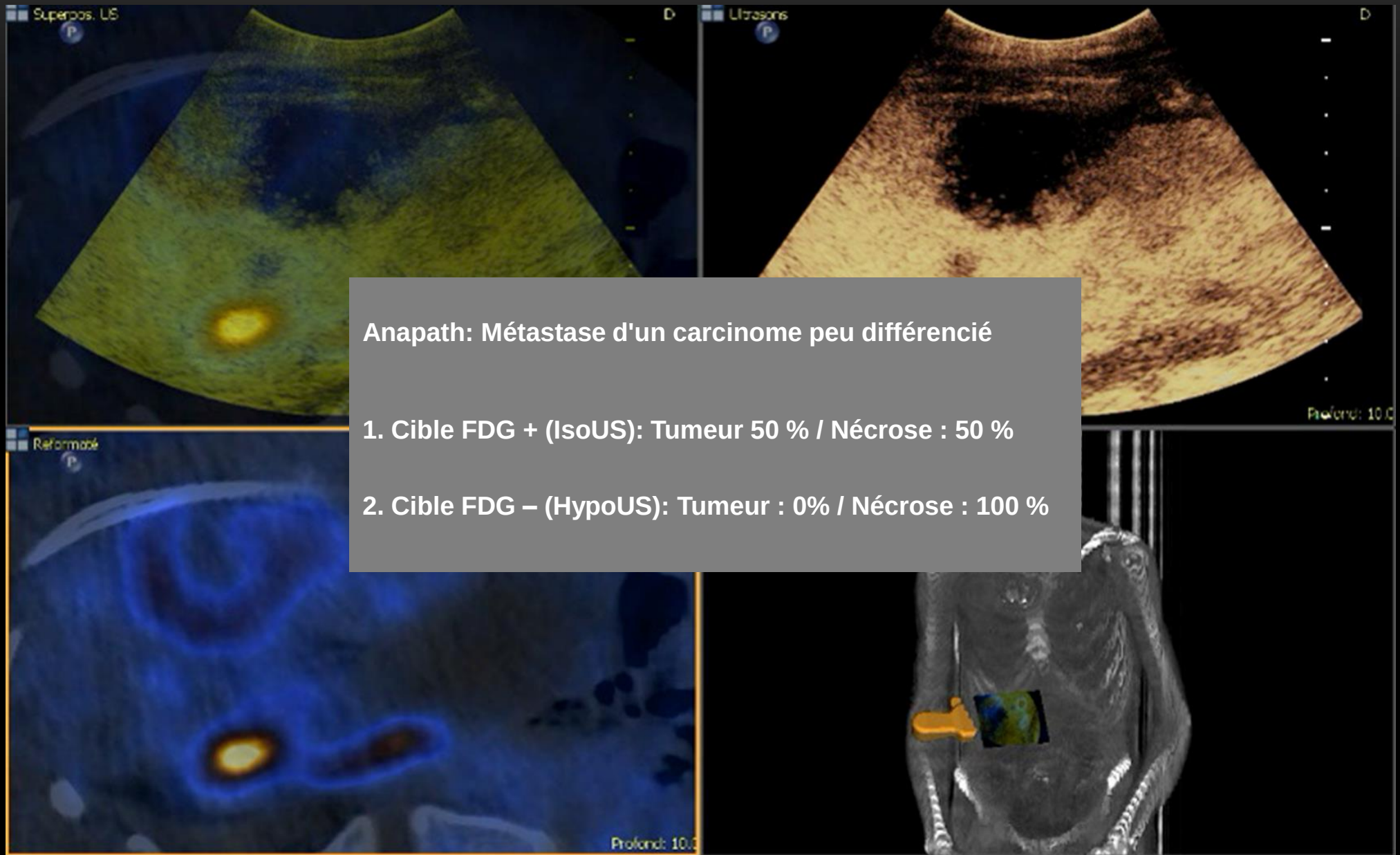


Exemple: Biopsie d'une lésion hépatique – Fusion US + PET-CT

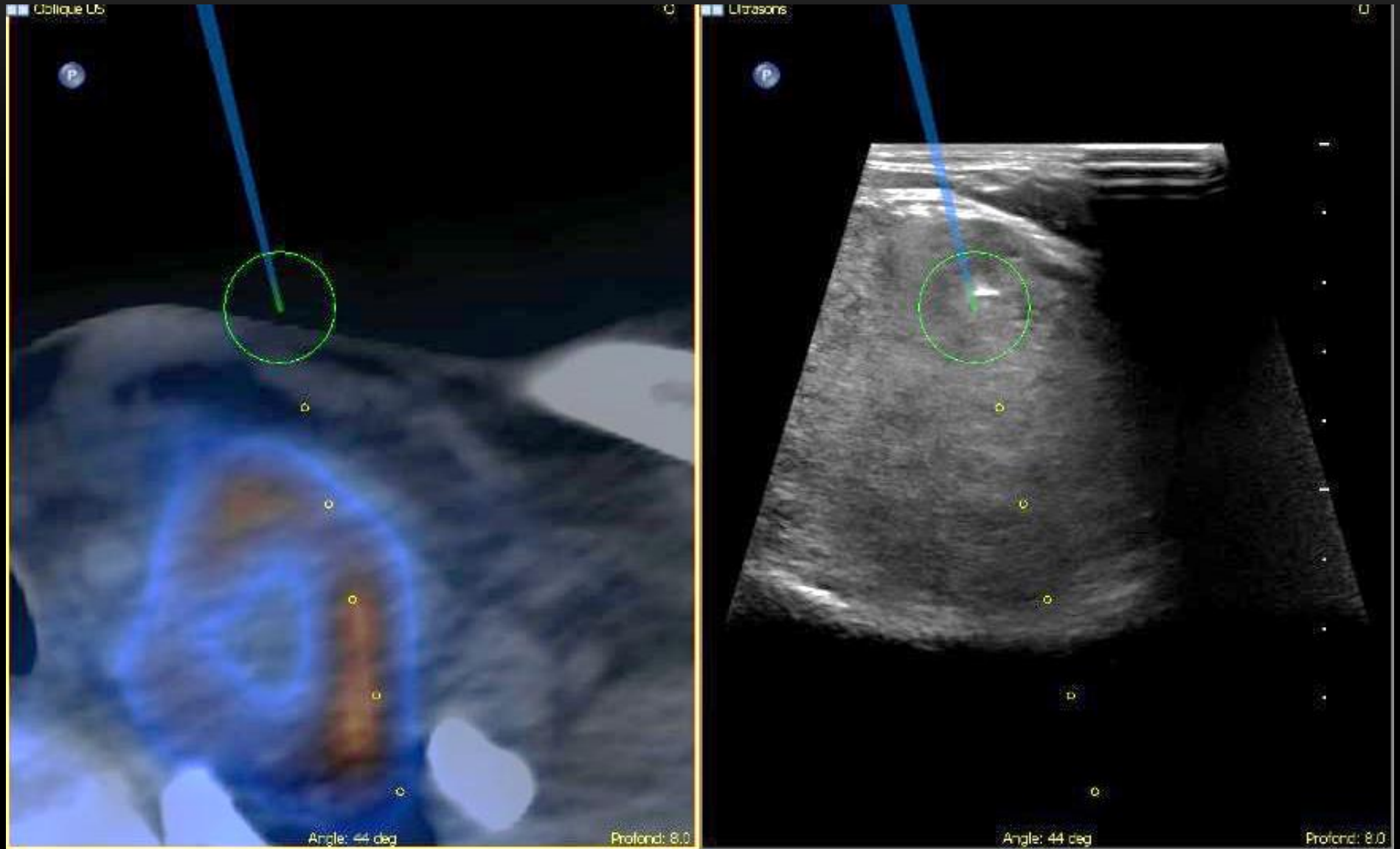


Courtesy Dr S.Drisis
Institut Jules Bordet

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



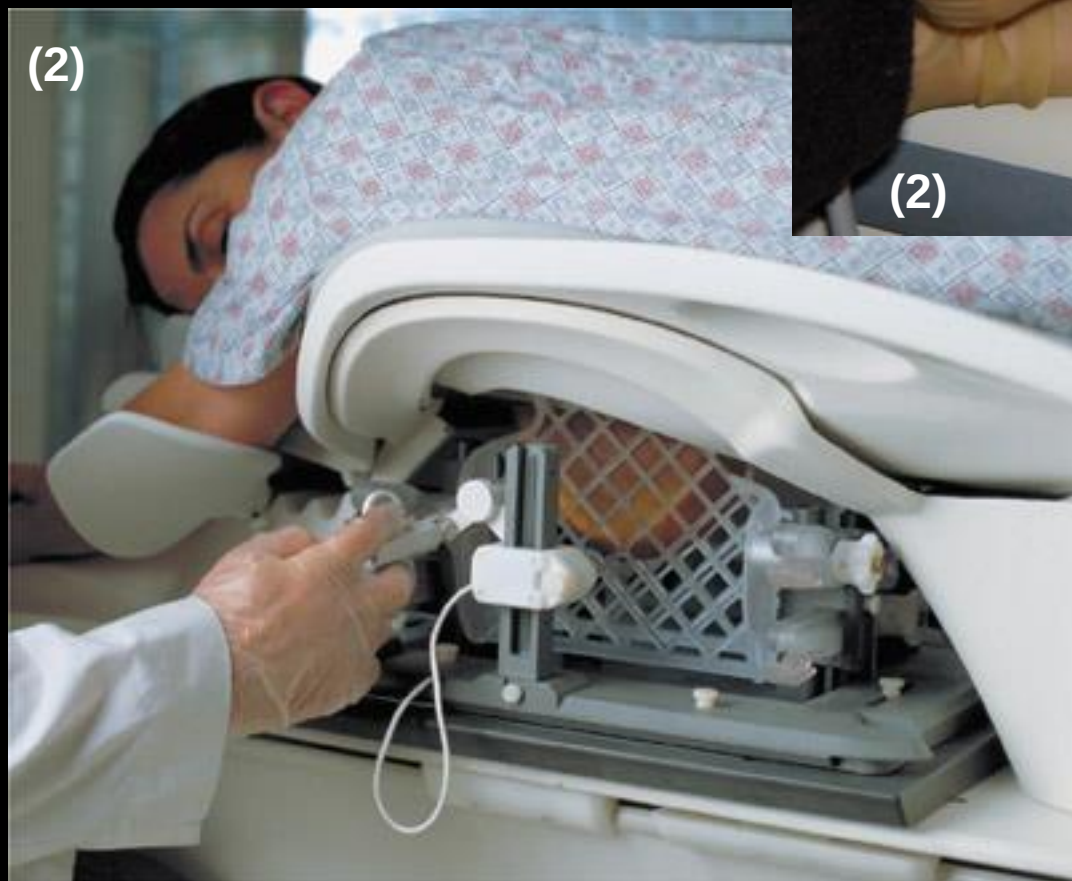
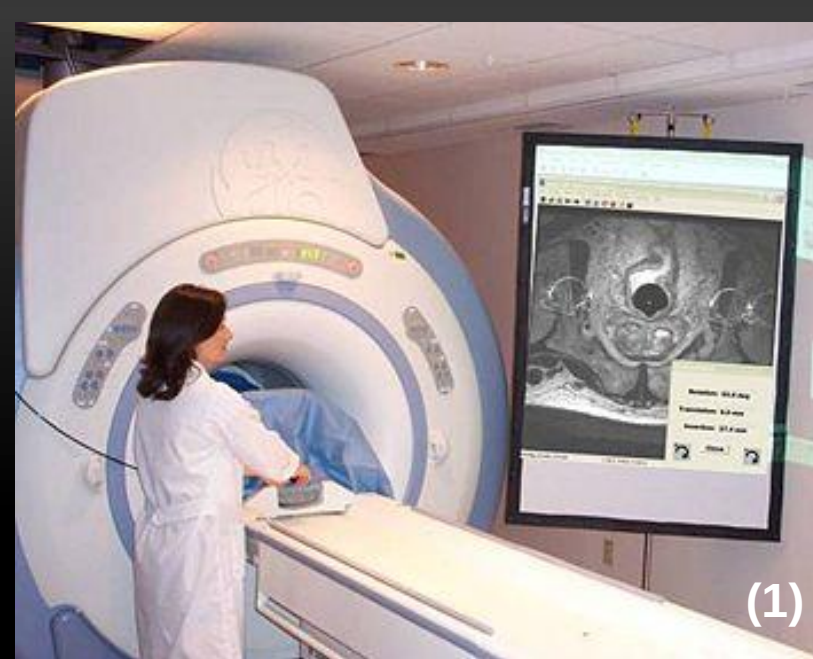
*Exemple: Biopsie d'une masse cervicale – Fusion US + PET-CT
+ Navigation avec détection de l'aiguille !*



Courtesy Dr S.Drasis
Institut Jules Bordet

GUIDAGE: IRM

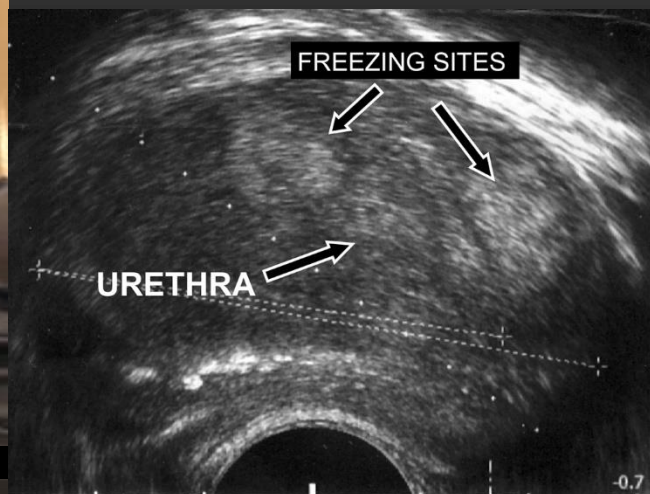
- Avantages
 - **Résolution en contraste +++** (visibilité lésion + résultat)
 - Non irradiant
- Inconvénients
 - Matériel compatible IRM
 - Espace de travail
 - Durée des acquisitions
 - Disponibilité ! Rentabilité...
- Indications:
 - Sénologie (biopsies), Abdomen (ablations tumorales)**



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



EUS



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

Published in final edited form as:

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MRI guided cryoablation for the treatment of benign prostatic hyperplasia

Pejman Ghanouni, M.D., Ph.D.,

Department of Radiology, Stanford University Hospital and Clinics, 300 Pasteur Dr, Rm H1307 MC 5621, Stanford, CA 94305

Harcharan Gill, M.D.,

Department of Urology, Stanford University Hospital and Clinics, 875 Blake Wilbur Dr, MC 5118, Stanford, CA 94305

Elena Kaye, Ph.D.,

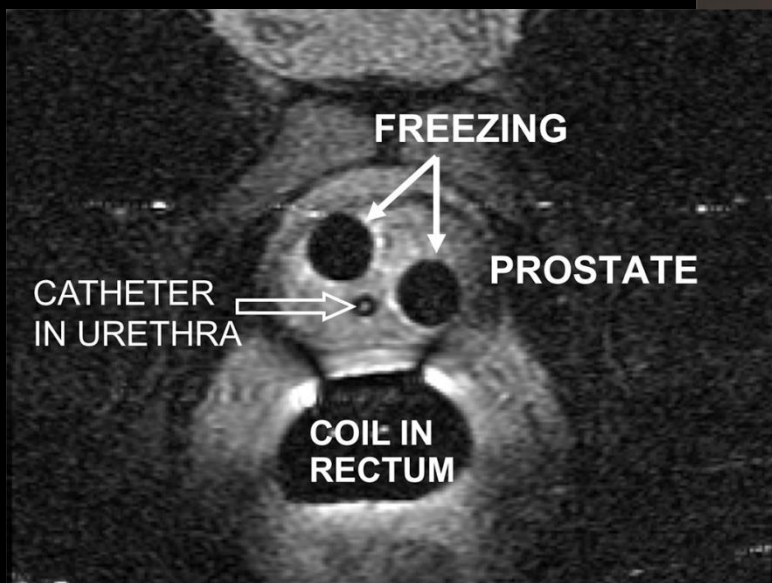
Department of Electrical Engineering, Stanford University, Stanford, CA 94305

Kim Butts Pauly, Ph.D., and

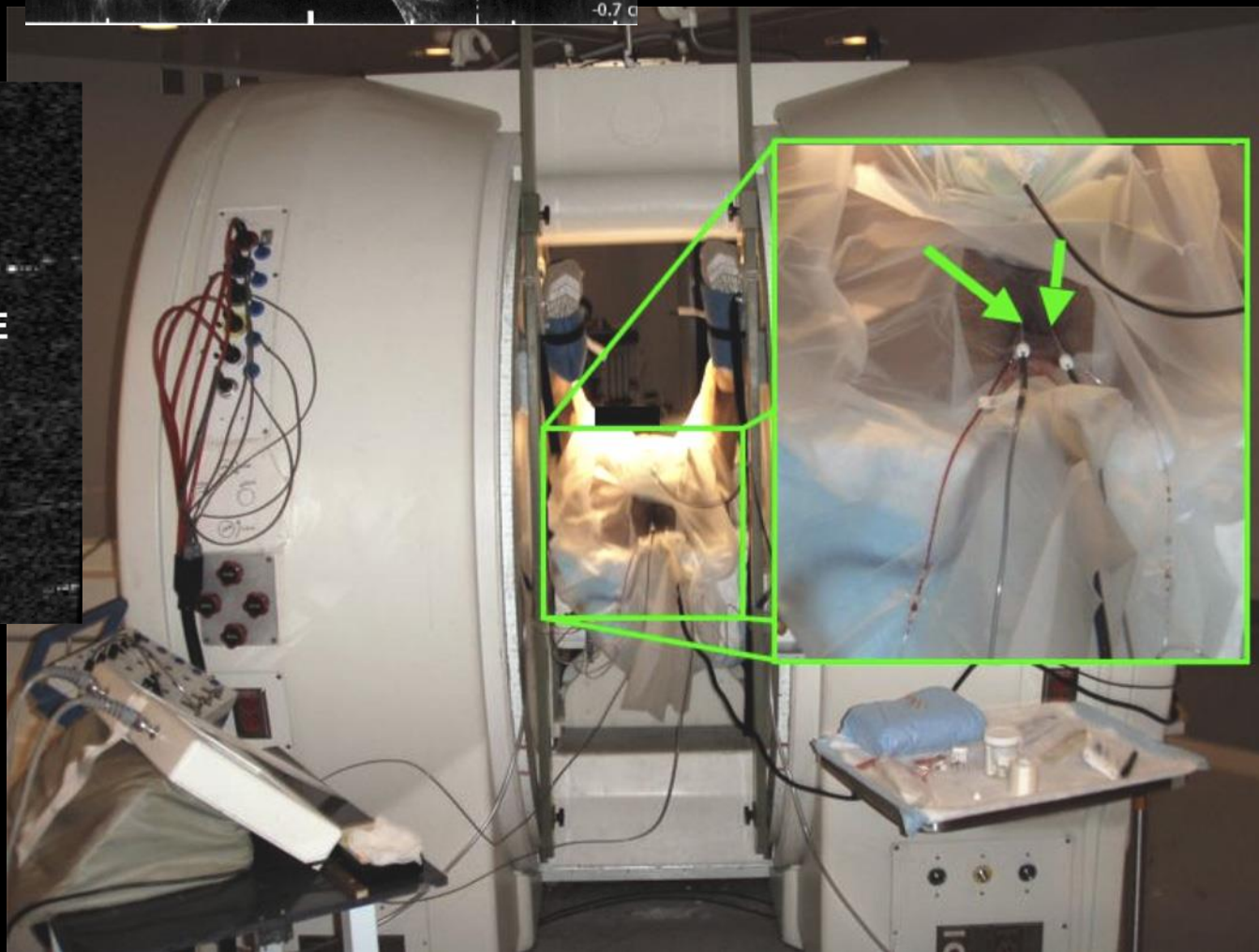
Departments of Radiology and Bioengineering, Stanford University, Stanford, CA 94305

Bruce Daniel, M.D.

Department of Radiology, Stanford University Hospital and Clinics, 300 Pasteur Dr, Rm H1307, MC 5621, Stanford, CA 94305

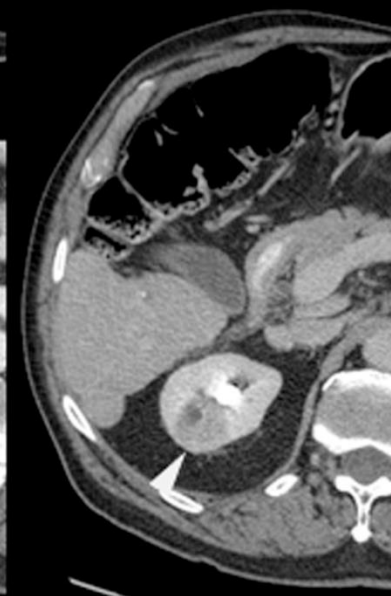
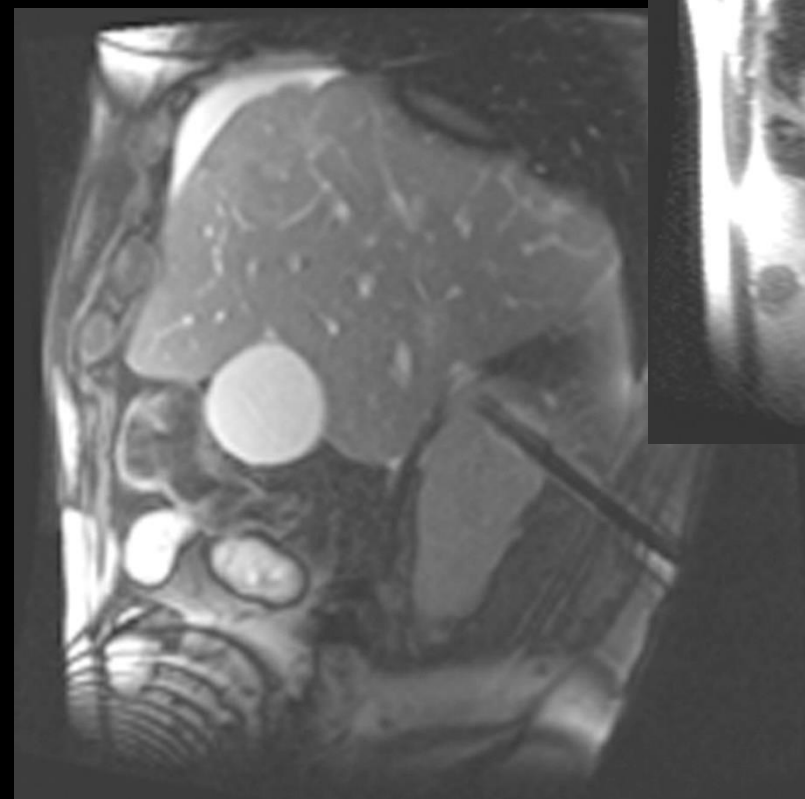
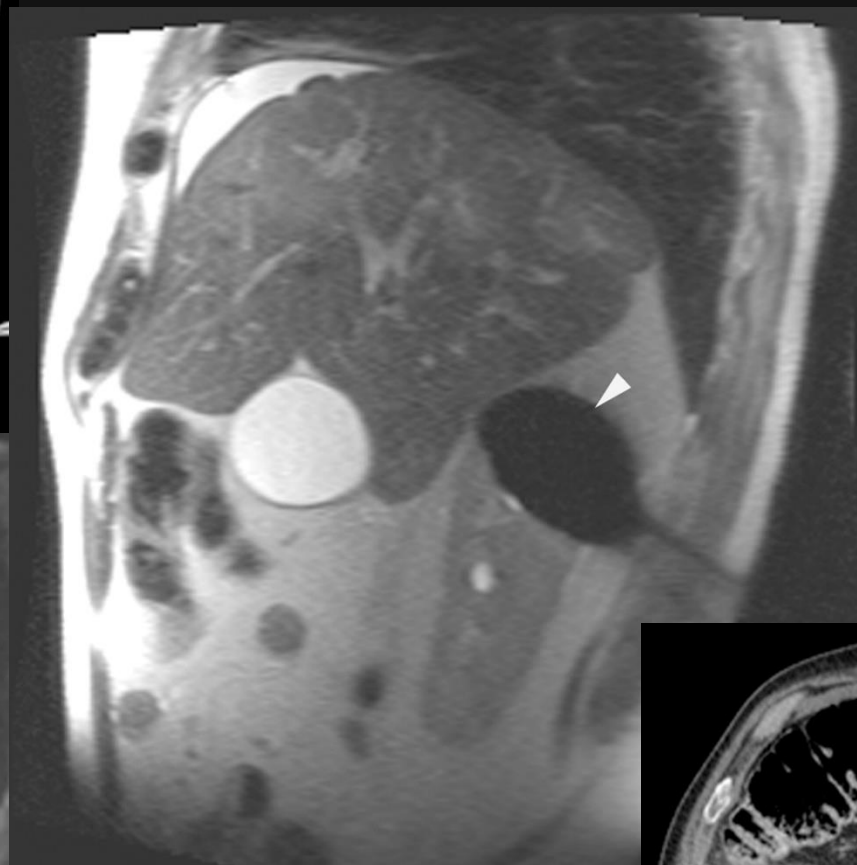


IRM



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

Kamran Ahrar, MD^{1,*}, Judy U. Ahrar, MD¹, Sanaz Javadi, MD¹, Li Pan, PhD², Denái R. Milton, MS³, Christopher G. Wood, MD⁴, Surena F. Matin, MD⁴, and R. Jason Stafford, PhD⁵

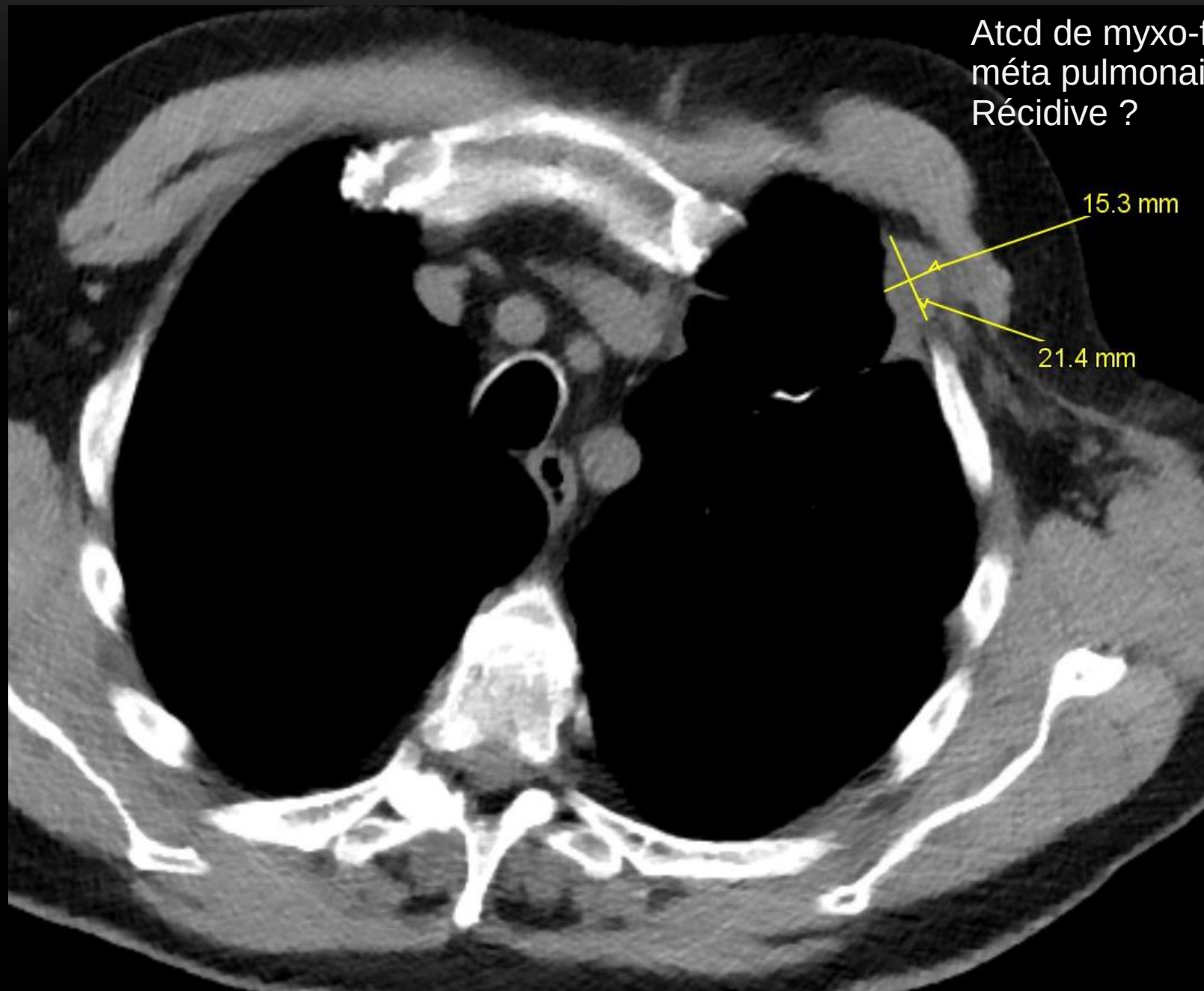


GUIDAGE - SYNTHÈSE

- 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 ?

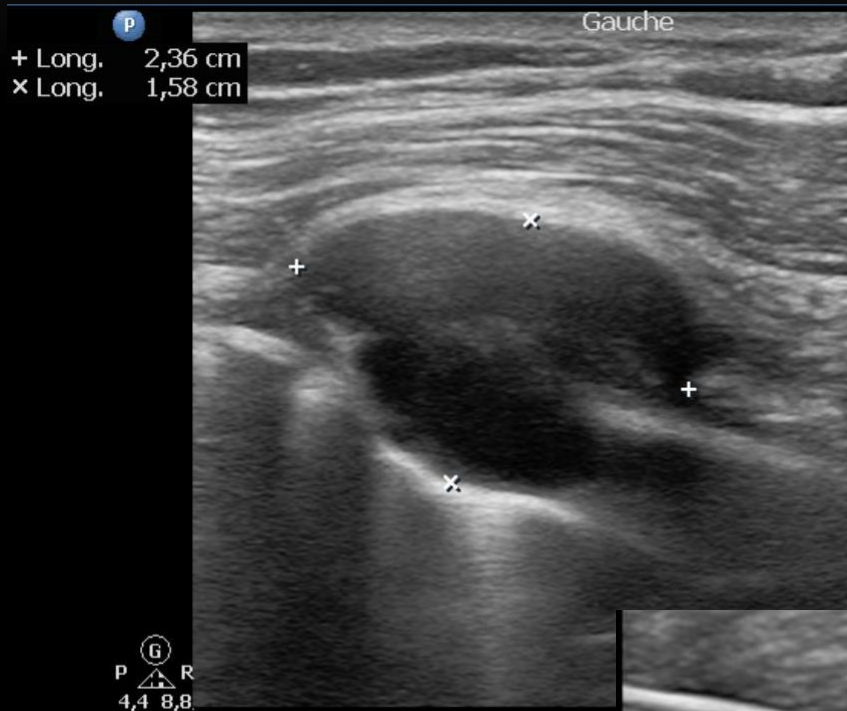


Atcd de myxo-fibrosarcome avec
méta pulmonaires opérées
Récidive ?

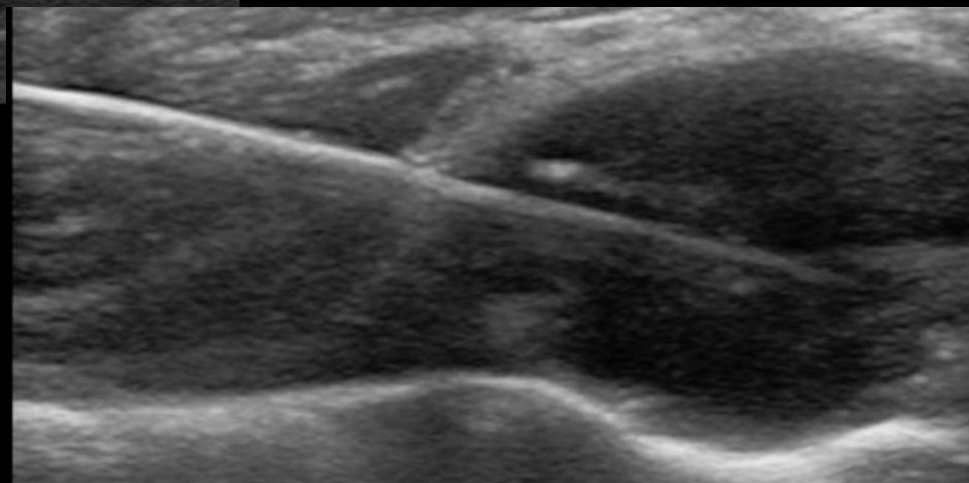
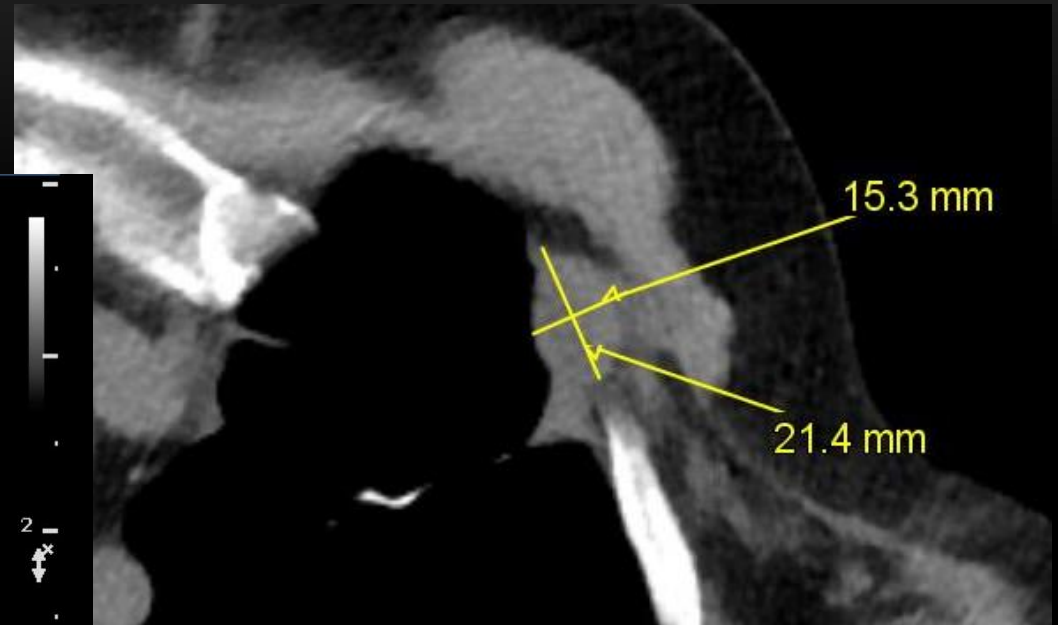
- RX ?
- US ?
- CT ?
- IRM ?
- C-arm CBCT ?

QUELLE MODALITÉ DE GUIDAGE ?

→ Privilégier la simplicité ! 😊



1ER EIC G



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

Thanks for your attention !



KEEP
CALM
AND LOVE

Interventional
Radiology

Fabrice Deprez, MD, MSM, EBIR
CHU UCL Namur, site Godinne
5530 Yvoir
+32.81/42.35.30 – 35.40
+32.472/93.34.80
fabrice.deprez@uclouvain.be

Interventional Radiology
It's like surgery, only

