

Démarche clinique et Secteur respiratoire

NODULES ET MASSES PULMONAIRES

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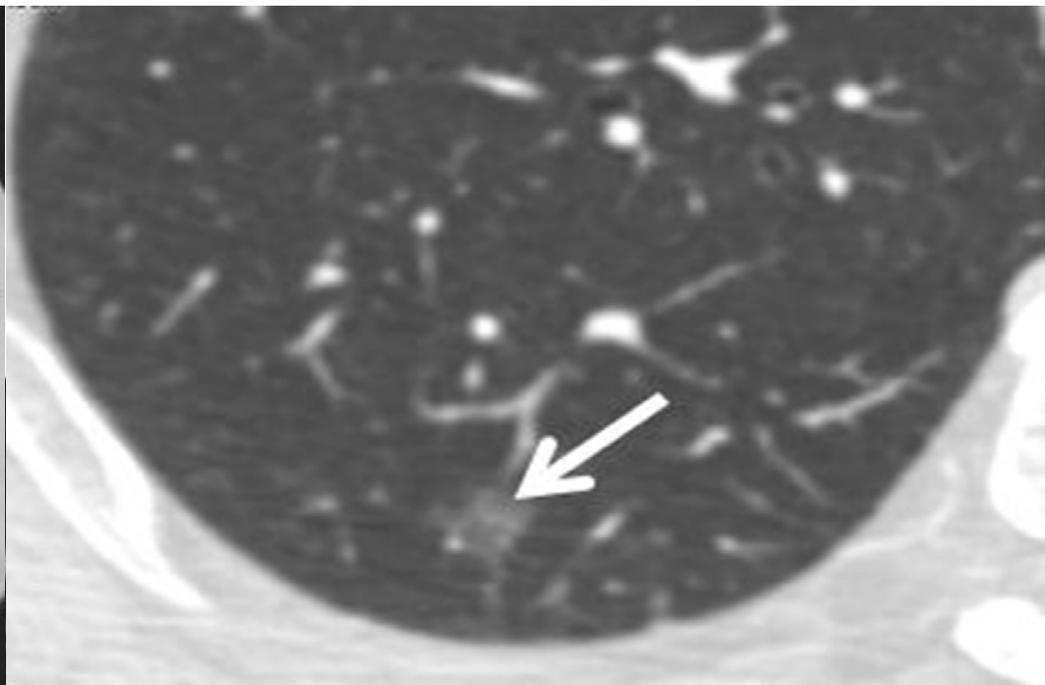
NODULE / MASSE / PSEUDO-NODULE

Définition: opacité pulmonaire focale, circonscrite, plus ou moins sphérique

- Intra-pulmonaire - NODULE ($\leq 3\text{cm}$)
- MASSE ($> 3\text{cm}$)
- Extra-pulmonaire - PSEUDO-NODULE

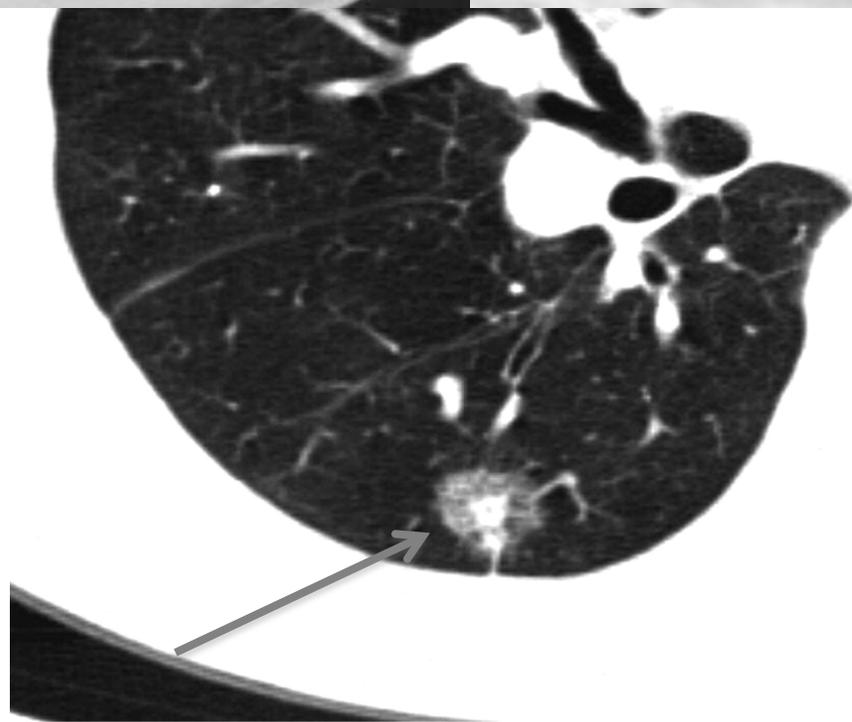
Nodule Pulmonaire: Définition

- Densité
- 3 catégories
 - Solide
 - Semi-solide
 - « verre dépoli »
- *Etude ELCAP (% cancer en fonction de la densité)*
- 7% nodules solides
- 18% nodules en « verre dépoli »
- 63% nodules semi-solides

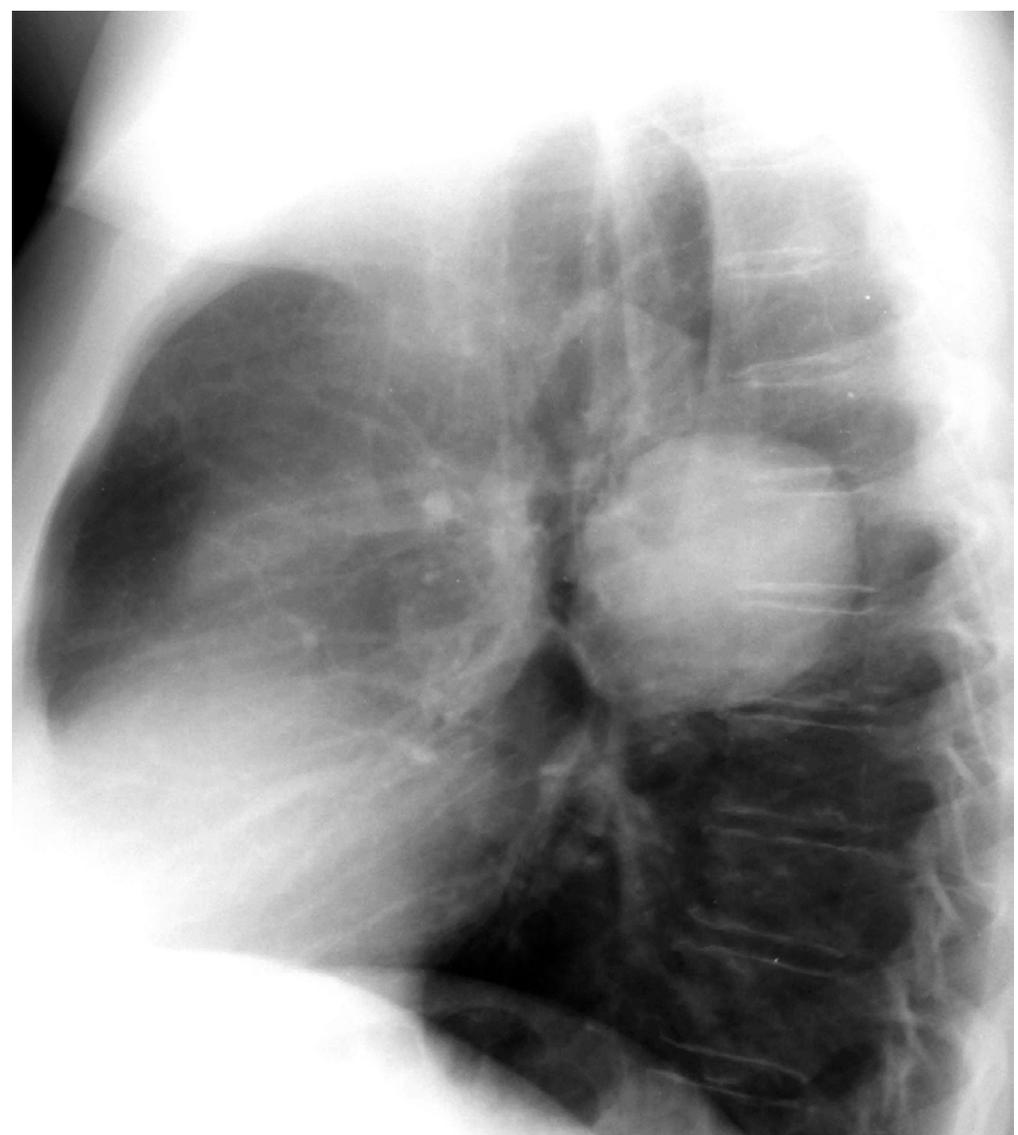


Solid

Ground-glass



Semi-solid



MASSE (INTRA-) PULMONAIRE

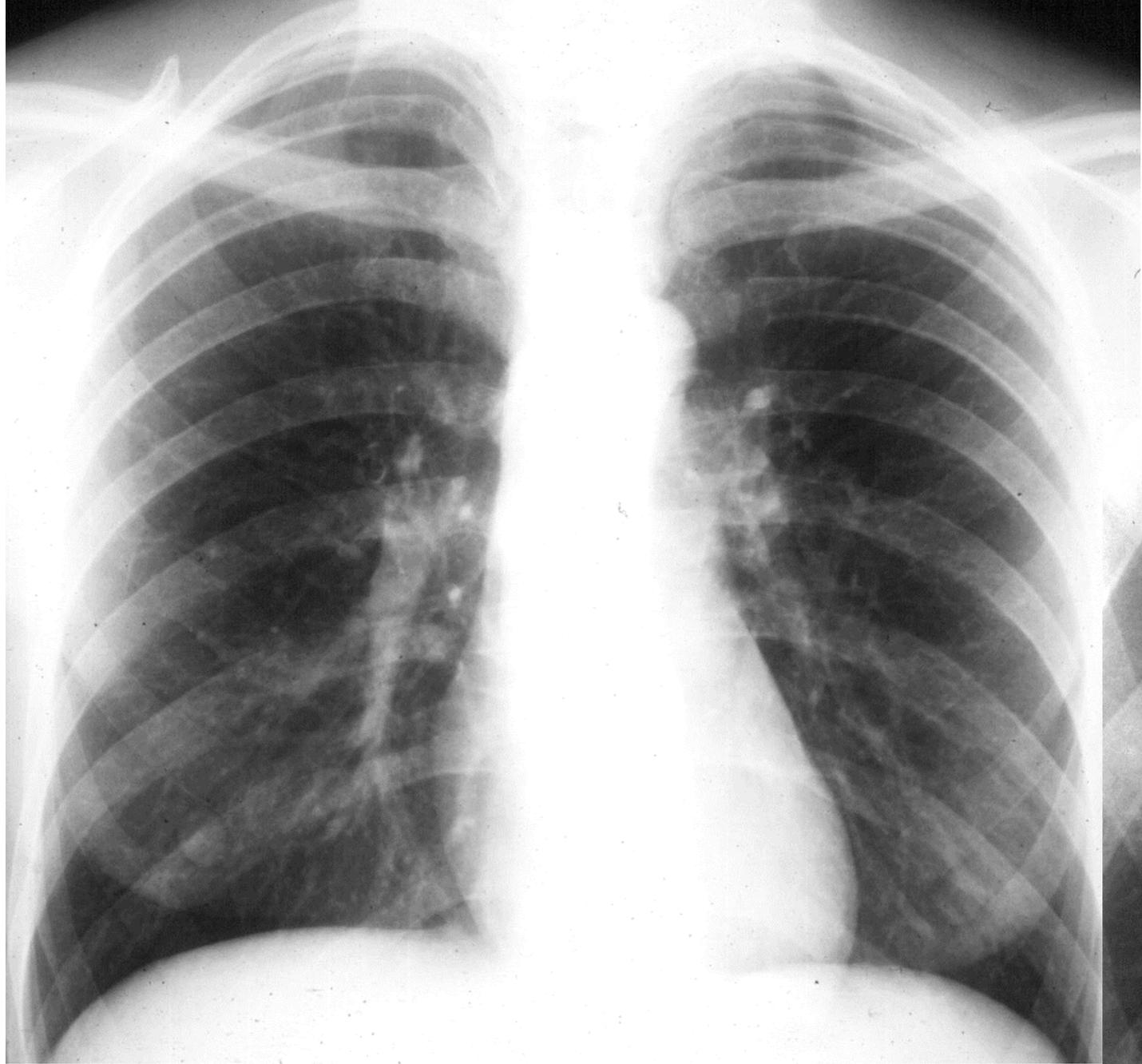
NODULE PULMONAIRE (NP)

- Découverte relativement fréquente :
3 à 4 observations / 100 examens RT
- Circonstance de découverte
 - fortuitement
 - dans un contexte clinique
(corrélations radio-cliniques)

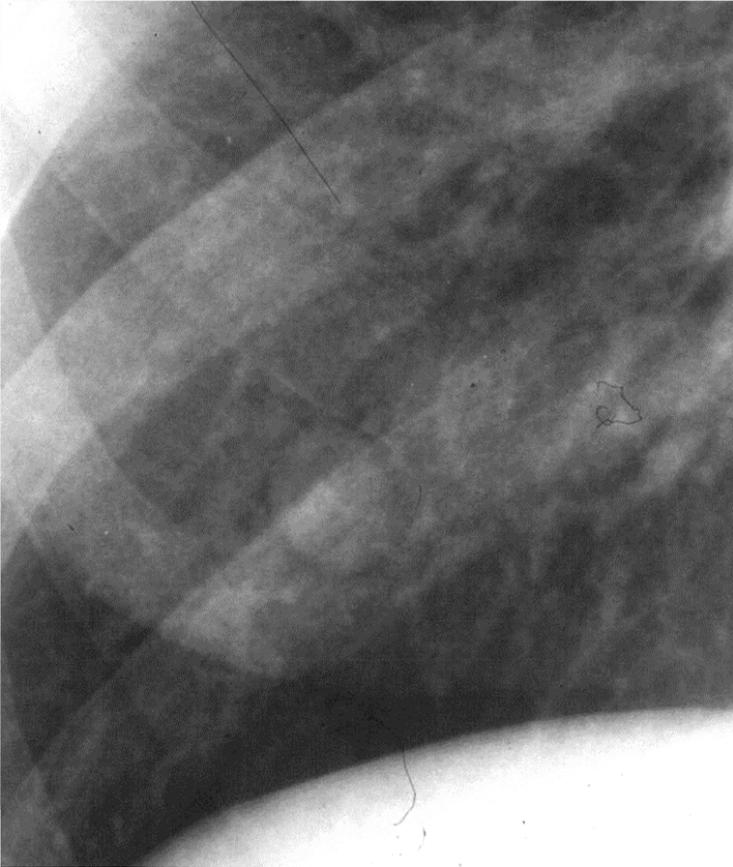
BENIN (60 %) et **MALIN** (40%)

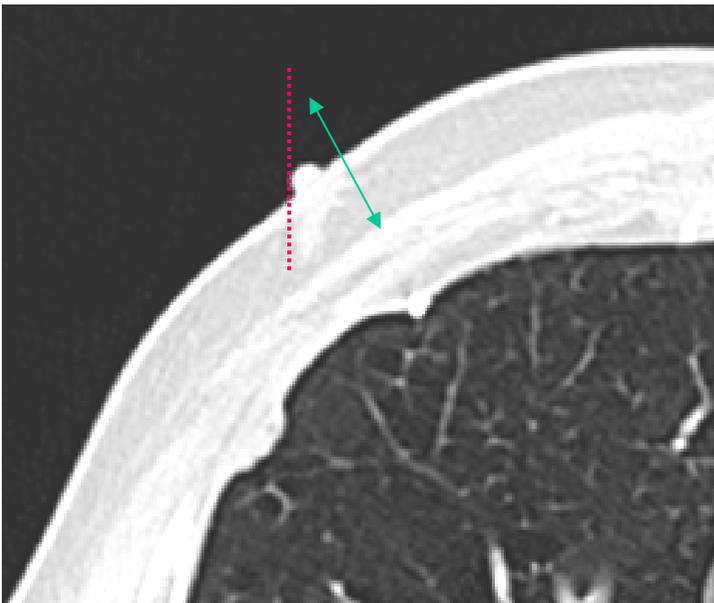
Sur Examen CT

- 50% des fumeurs ont au moins 1 nodule pulmonaire
- Nombre de nodules augmente avec les nouveaux CT
- 99% des nodules < 4 mm sont bénins



PSEUDO-NODULE
(mamelon)





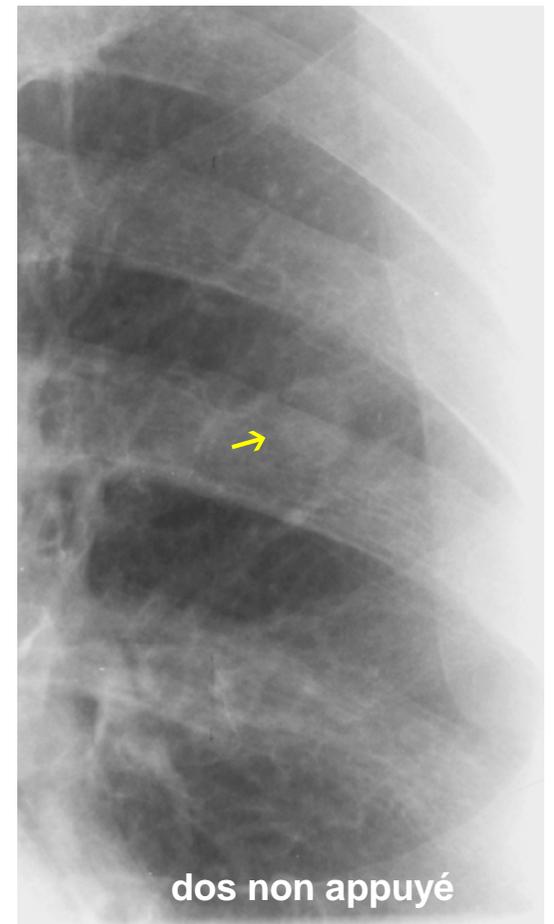
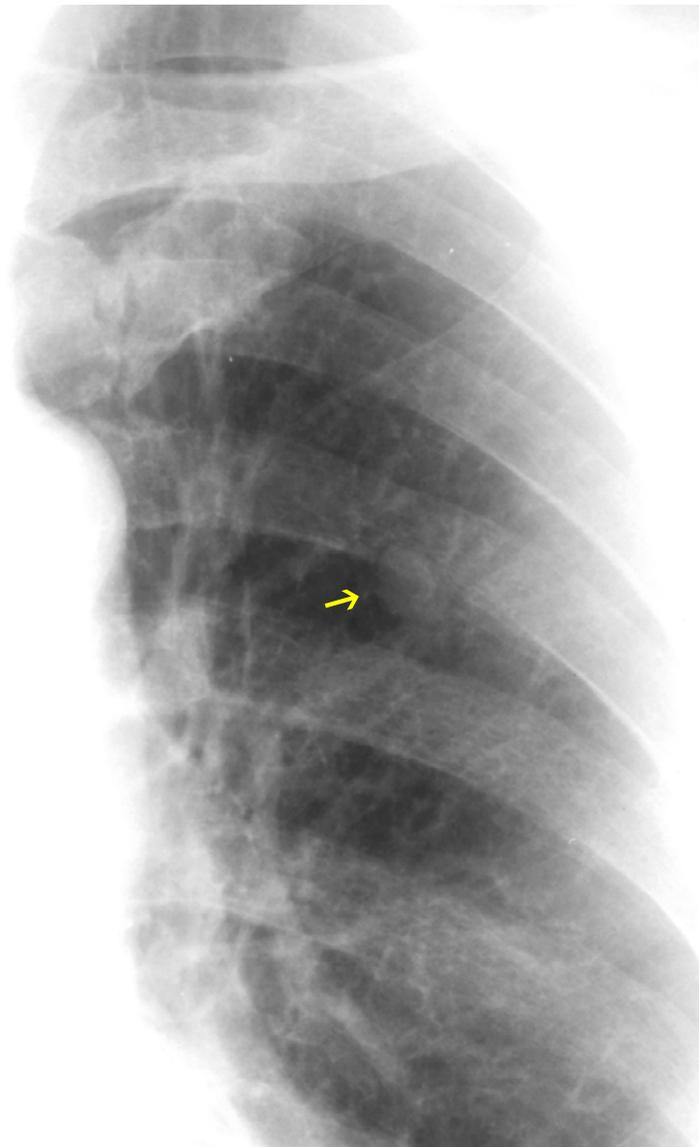
mamelon (pseudo-nodule)

axe du mamelon
tangence sur
le contour
externe
du mamelon

contours

- externe > net
- interne > flou

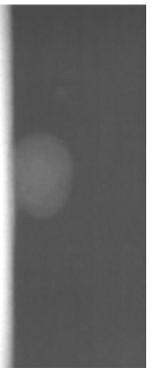
→ **signe du mamelon**



**NODULE
OU
PSEUDO-NODULE ?**

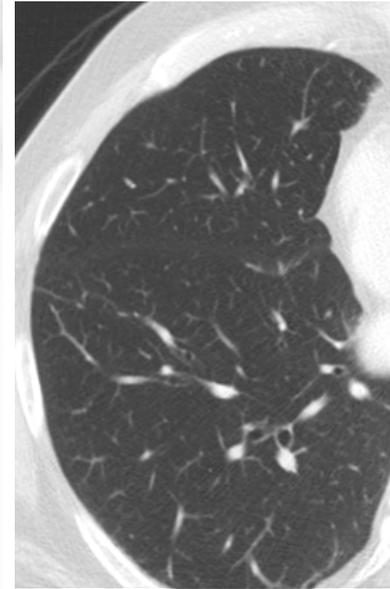


RADIOSCOPIE





10 ans auparavant



2 examens CT réalisés !!

respecter les algorithmes diagnostiques diminue les faux + et les investigations inutiles.

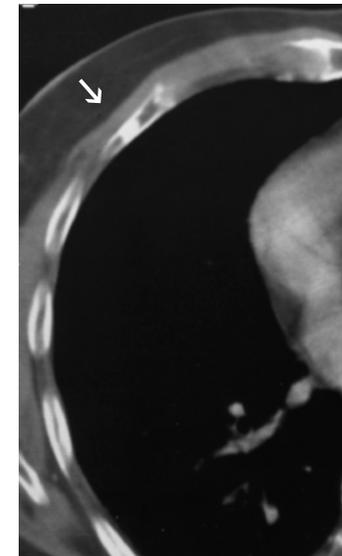
pseudo-nodule costal
(îlot osseux compact banal)

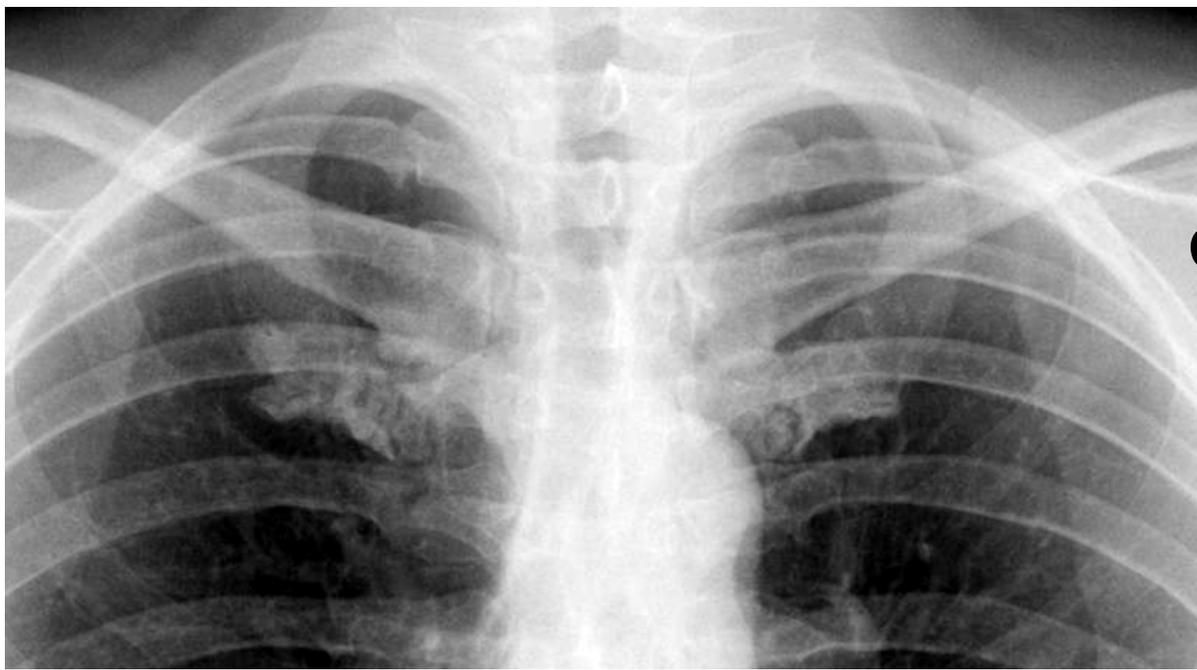
EXAMEN COMPLEMENTAIRE INITIAL = RADIOSCOPIE

15 à 20% des "nodules" sont en réalité des pseudo-nodules



radioscopie / cliché





**calcification du cartilage
des 1ères côtes**



pseudo-fracture

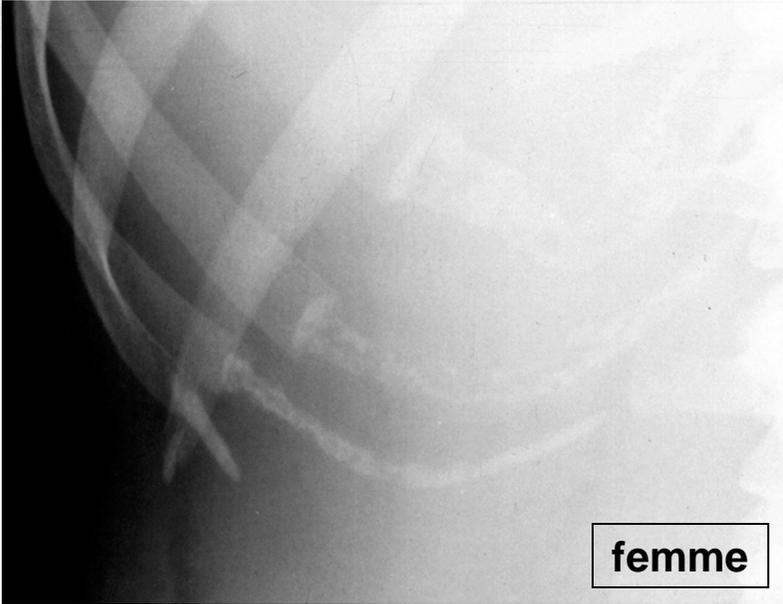
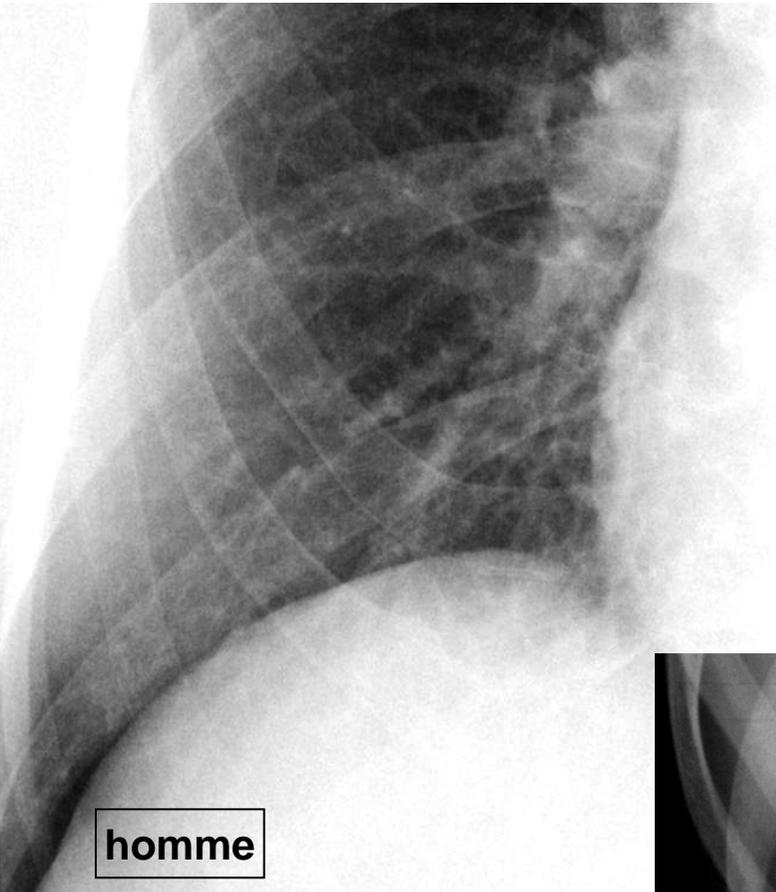


pseudo-nodule

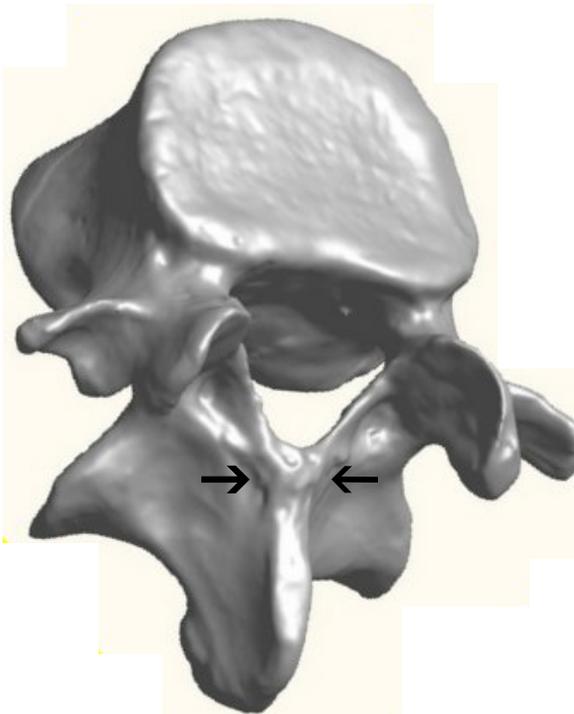
**calcifications des
cartilages costaux**

♂ marginales

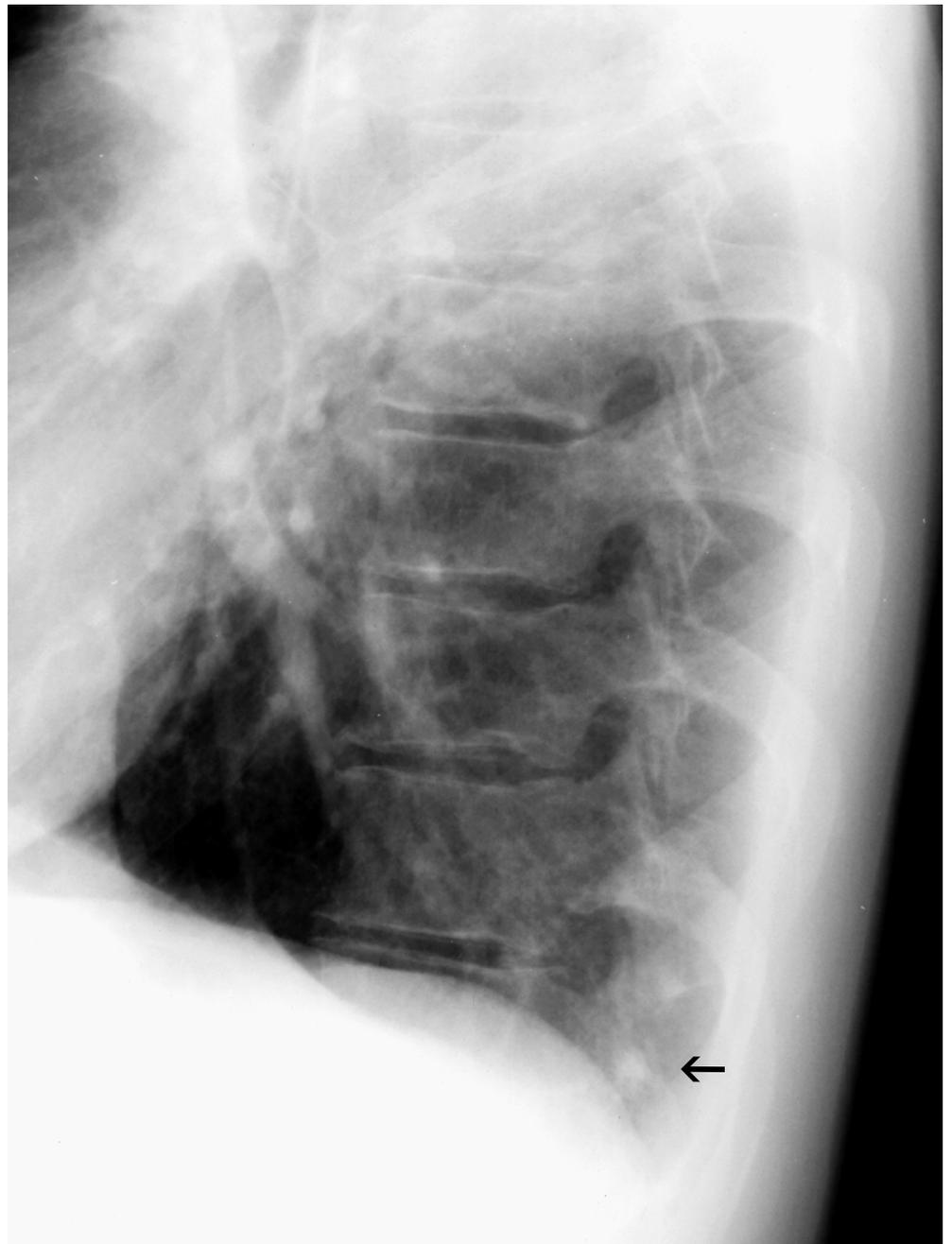
♀ centrales
annulaires



sexe et cartilages costaux



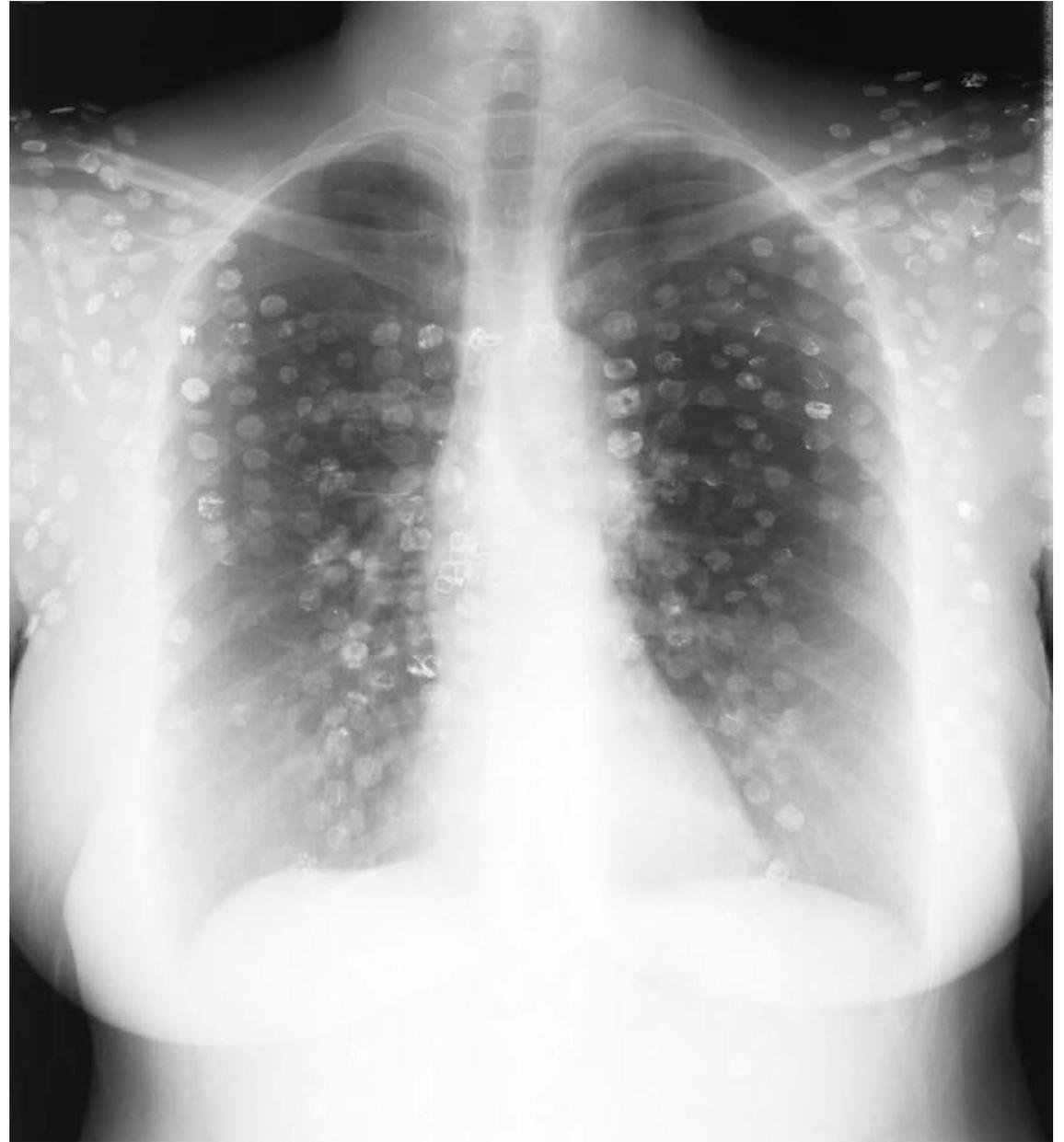
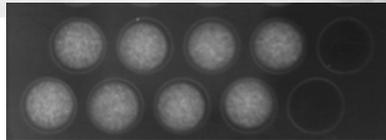
**pseudo-nodule vertébral (70%)
(D11 / D12 / L1)**



superposition d'objets divers



comprimés



superposition d'objets divers



EVALUATION INITIALE D'UN NP

- NODULE (80 %) ou PSEUDO-NODULE (20 %)

↳ **RADIOSCOPIE** ↙

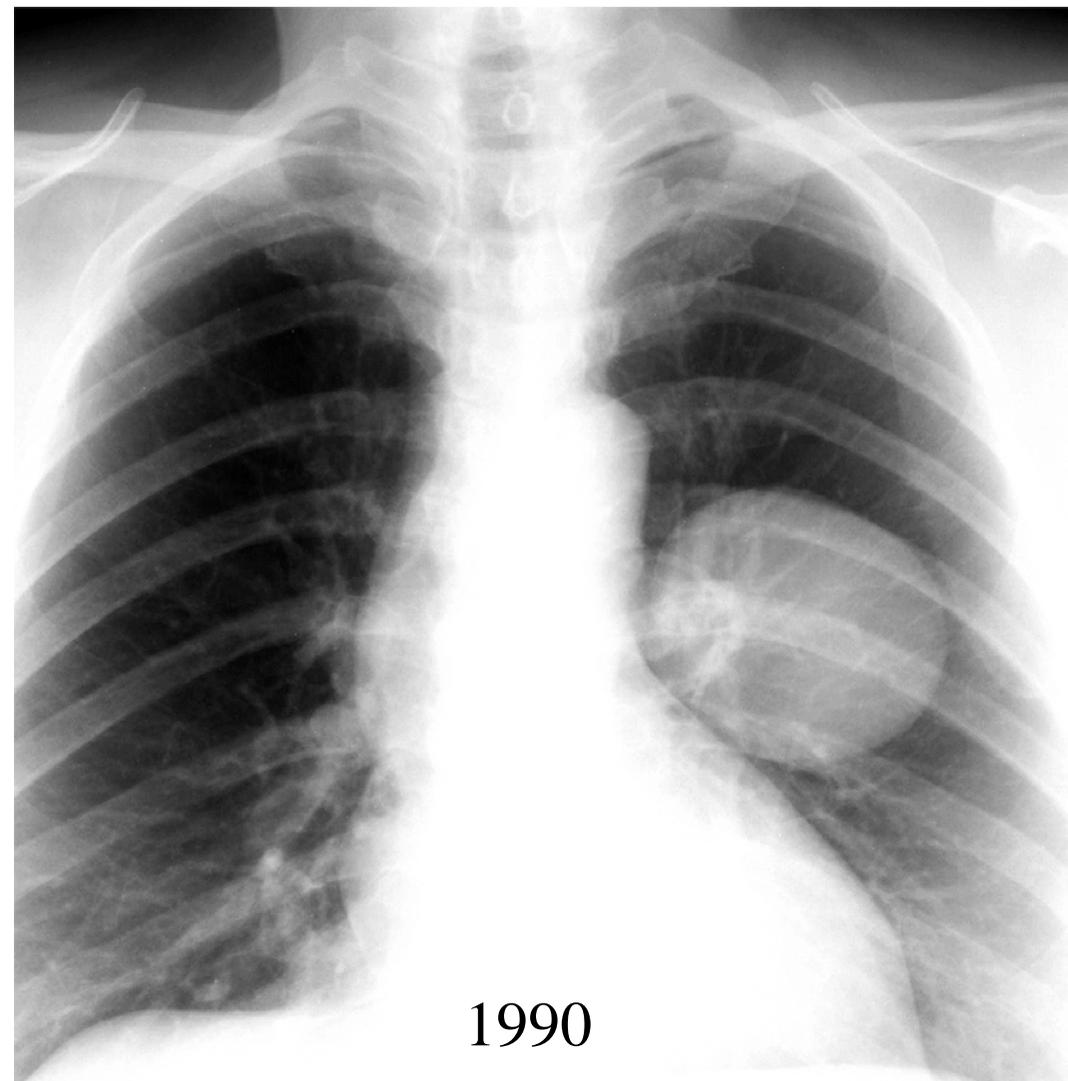
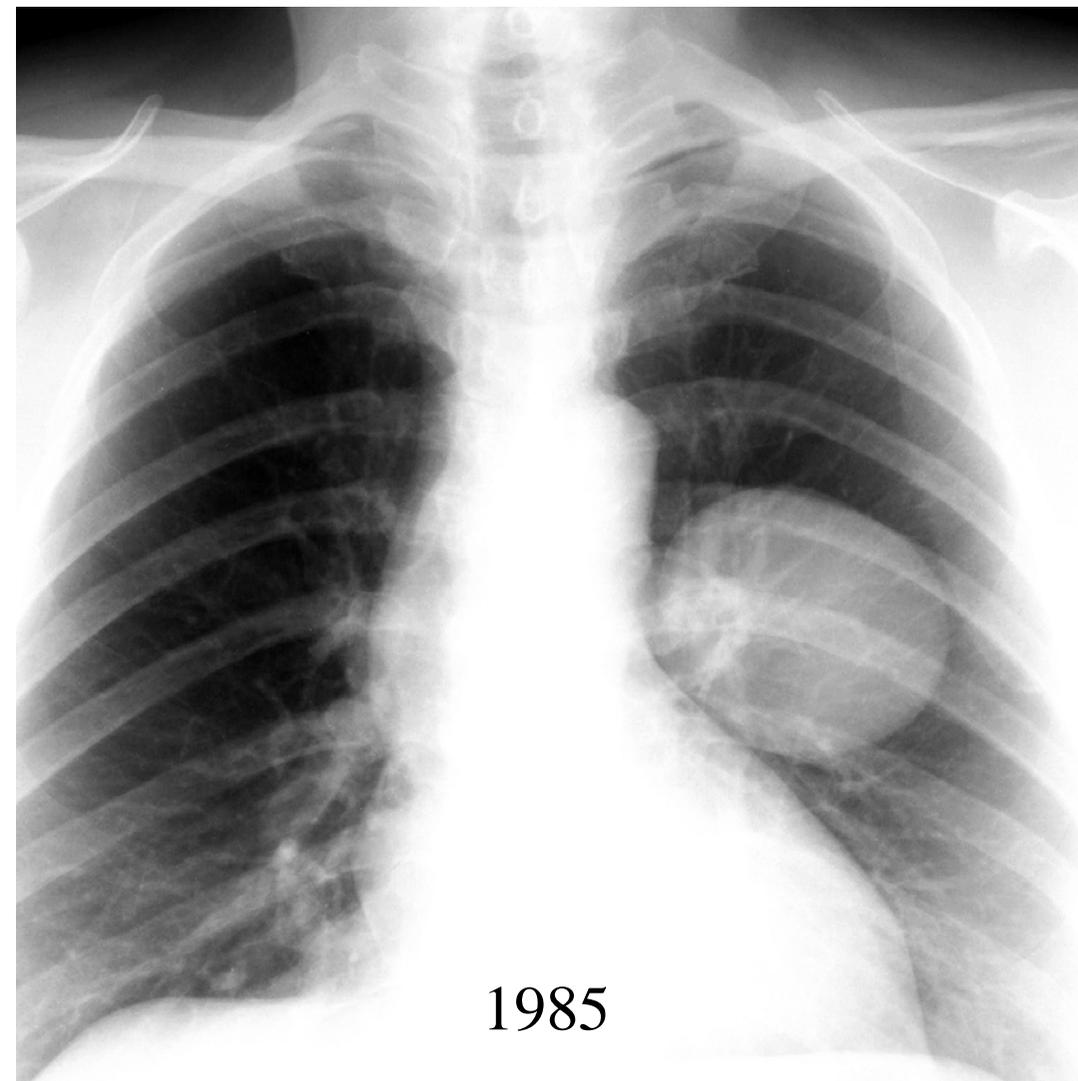
CT Low dose

- NODULE : STABLE ? ou EVOLUTIF ?

↳ **COMPARAISON** ↙

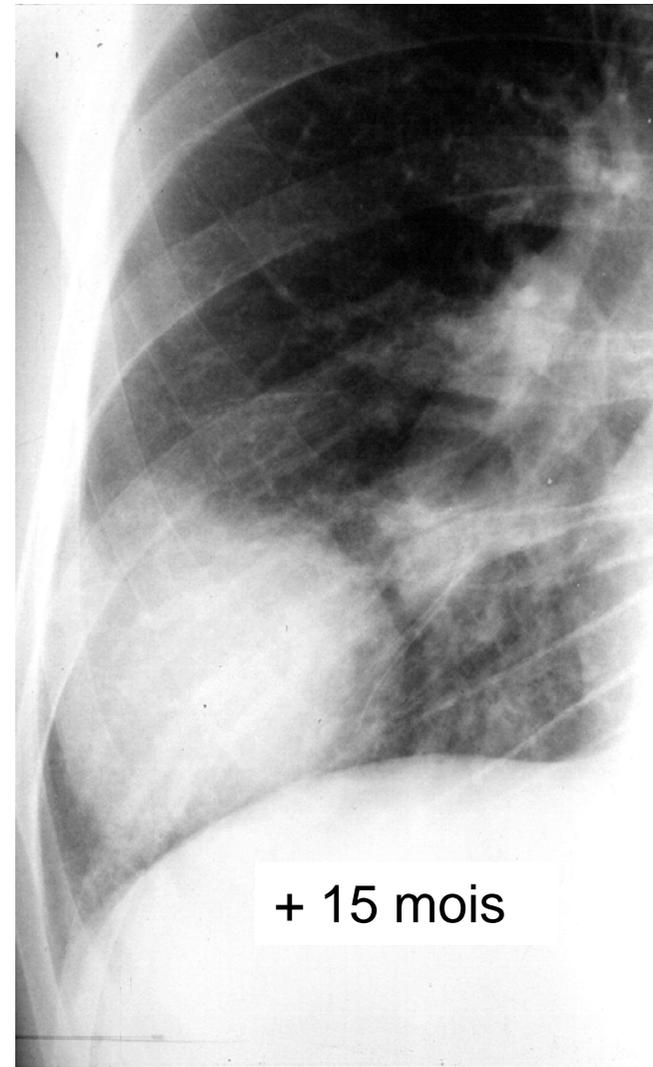
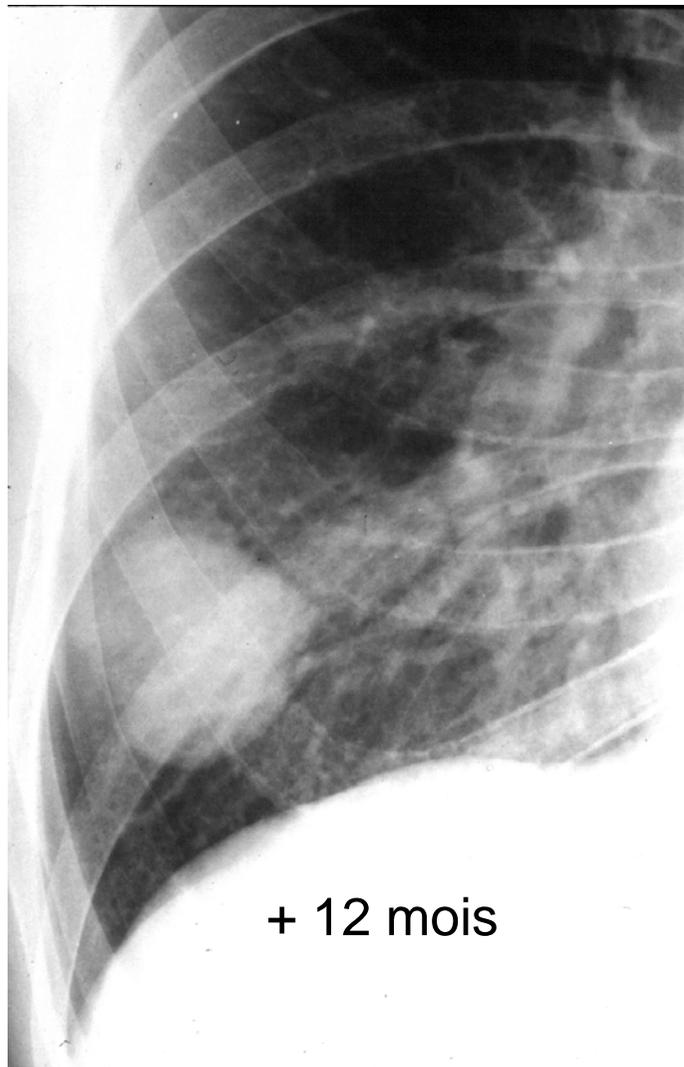
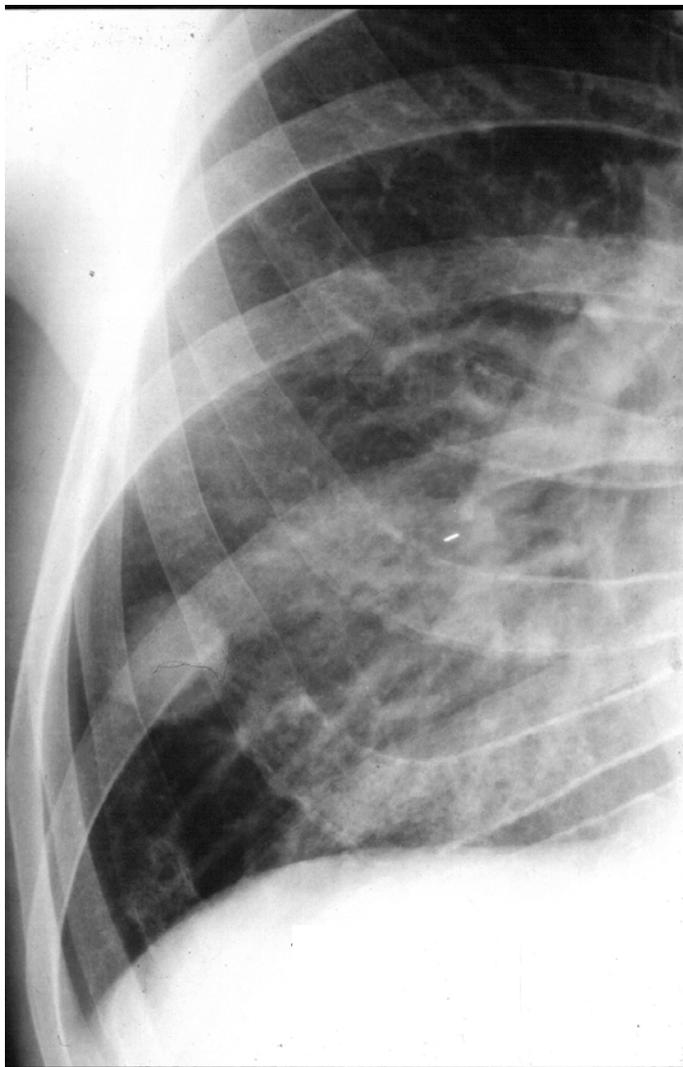
AVEC CLICHES

ANTERIEURS



LESION STABLE (HAMARTOME)

(≥ 2 années \rightarrow lésion bénigne)



VOL : 7.2 cm^3

58 cm^3

195 cm^3

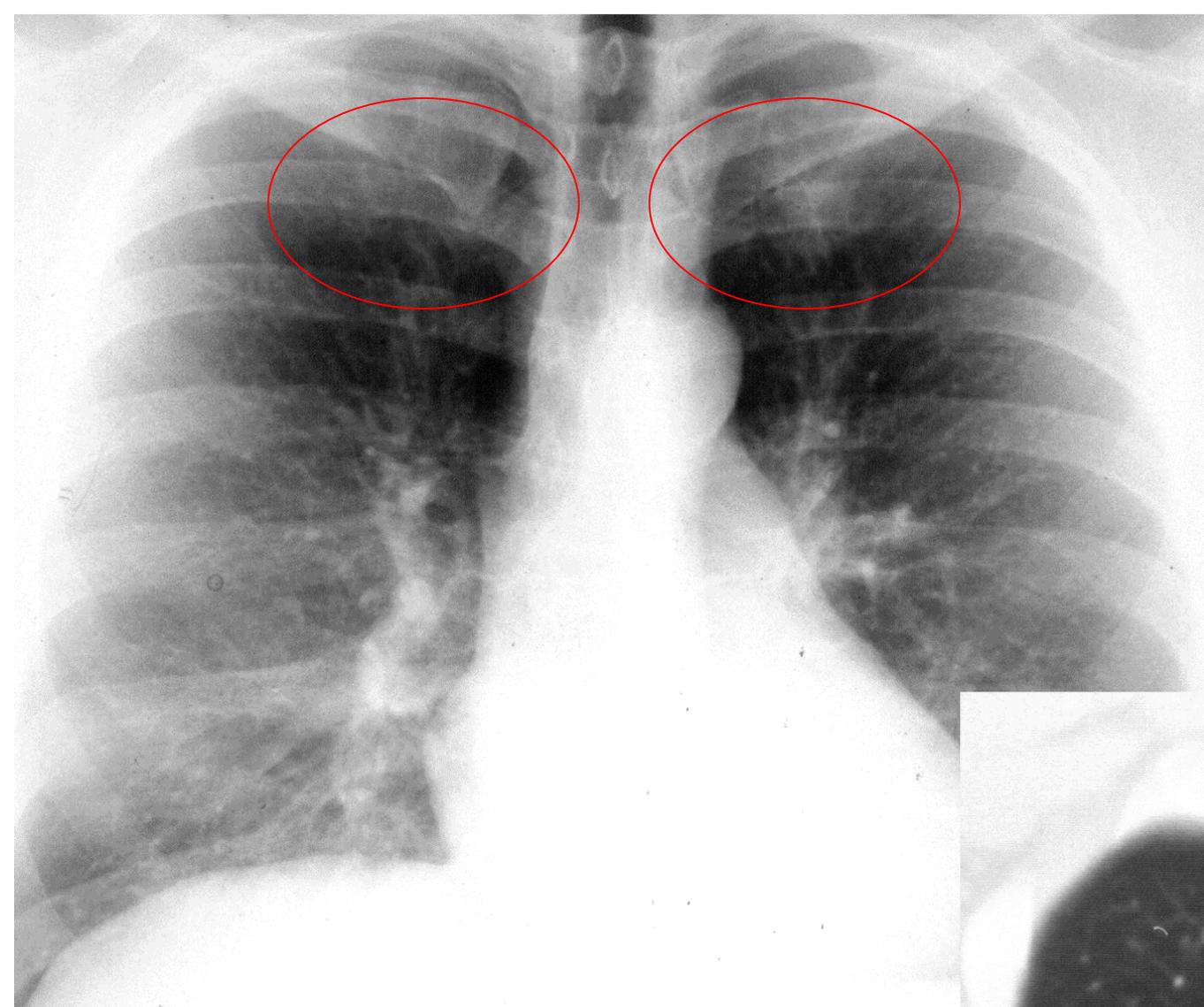
TEMPS DE DOUBLEMENT DE VOLUME : 120 JOURS
(CANCER BRONCHIQUE)

CANCER BRONCHIQUE

- TEMPS DE DOUBLEMENT DE VOLUME
1 à 6/7 MOIS (suivant type histologique)

	temps moyen de doublement (1x) (mois)	années nécessaires pour un diamètre de :		
		1 cm (30x)	3 cm (35x)	10 cm (45x)
adénocarcinome (~50%)	6/7	13.2	15.4	17.6
épidermoïde (~30%)	3	7.2	8.4	9.6
anaplasique à p.c. (~15%)	1	2.4	2.8	3.2
anaplasique à g.c. (~5%)	3	7.1	8.2	9.4

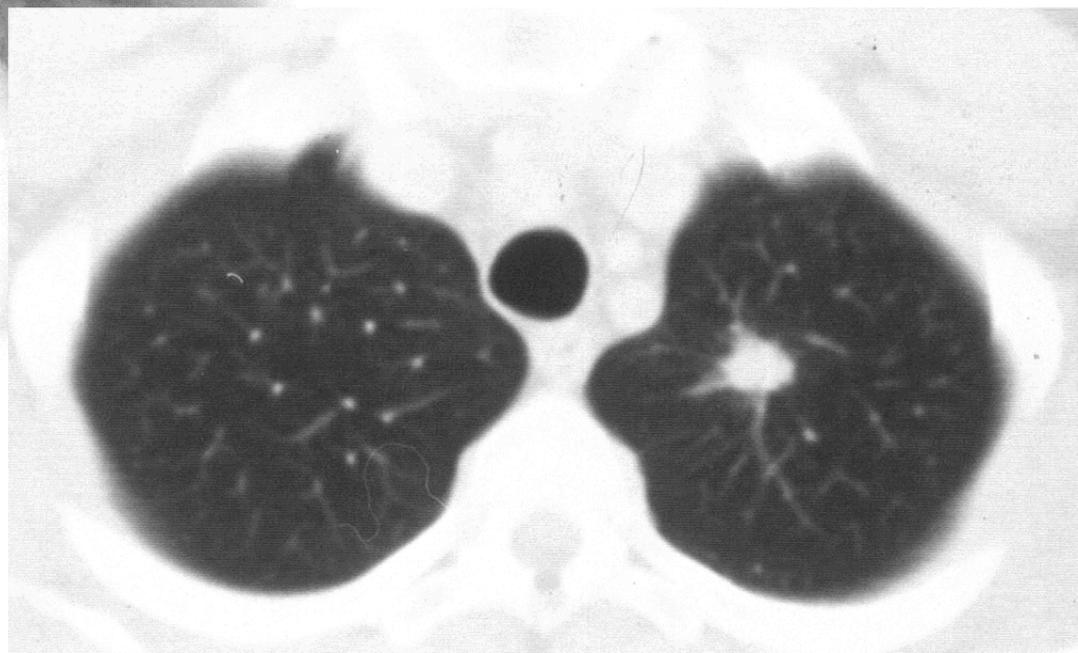
- $VOLUME = \frac{4}{3} \pi R^3 \rightarrow 25 \% \nearrow$ du diamètre
= VOLUME x 2

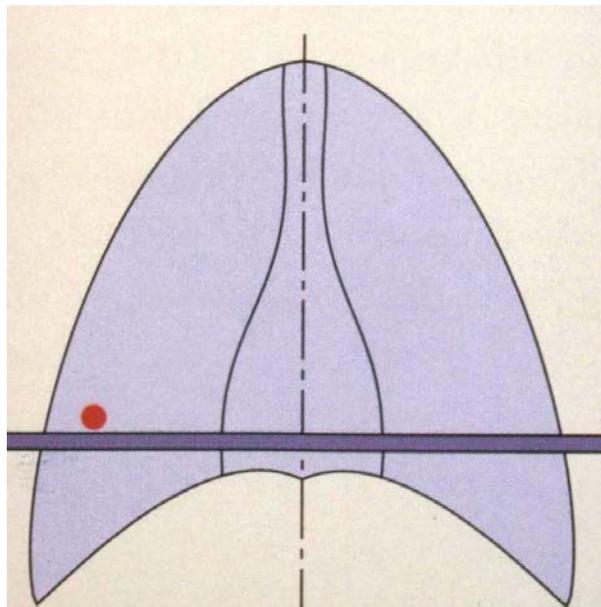
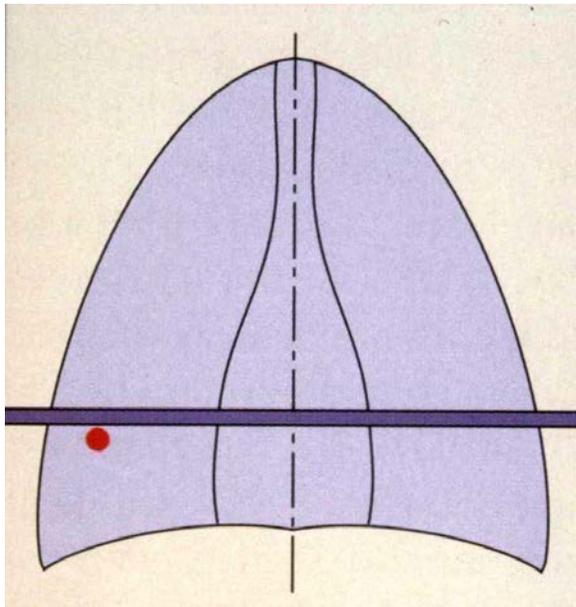


CANCER BR.

TDM > RT

NODULE ??



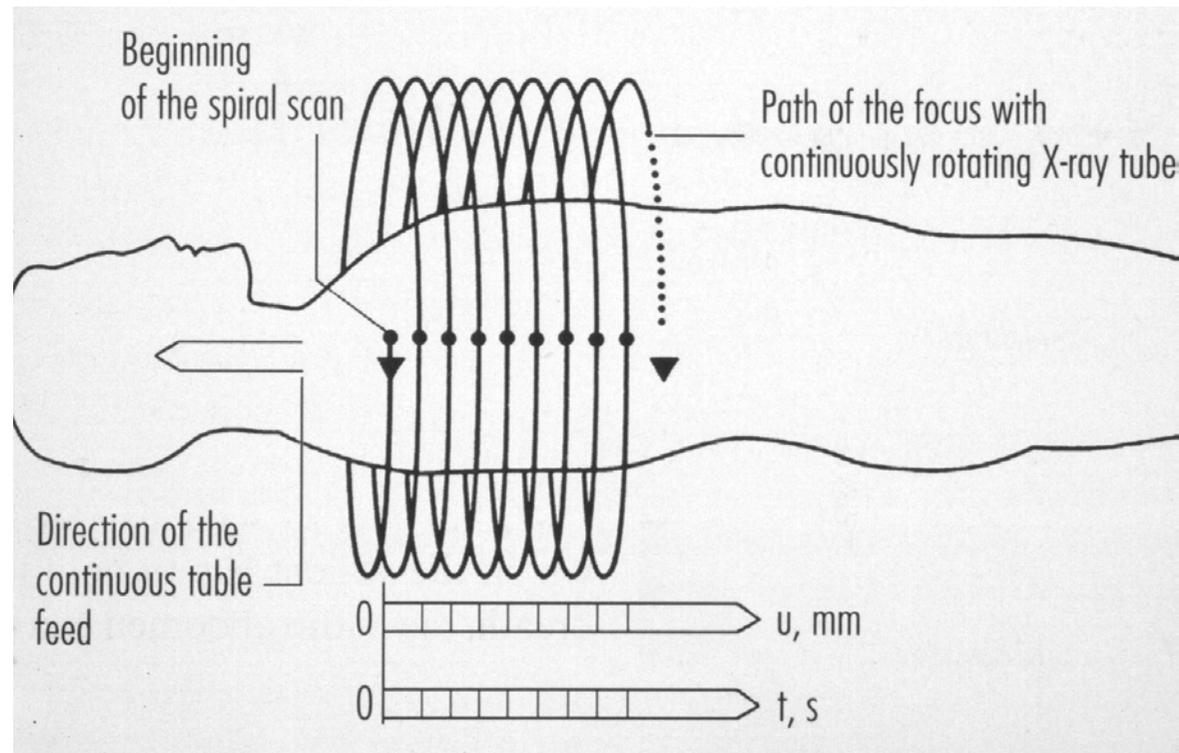


Degrés différents d'inspiration

~~LIMITE DE LA TDM
SEQUENTIELLE~~

TDM SPIRALEE →

- apnée unique
- acquisition volumique
- 50 % de nodules supplémentaires détectés

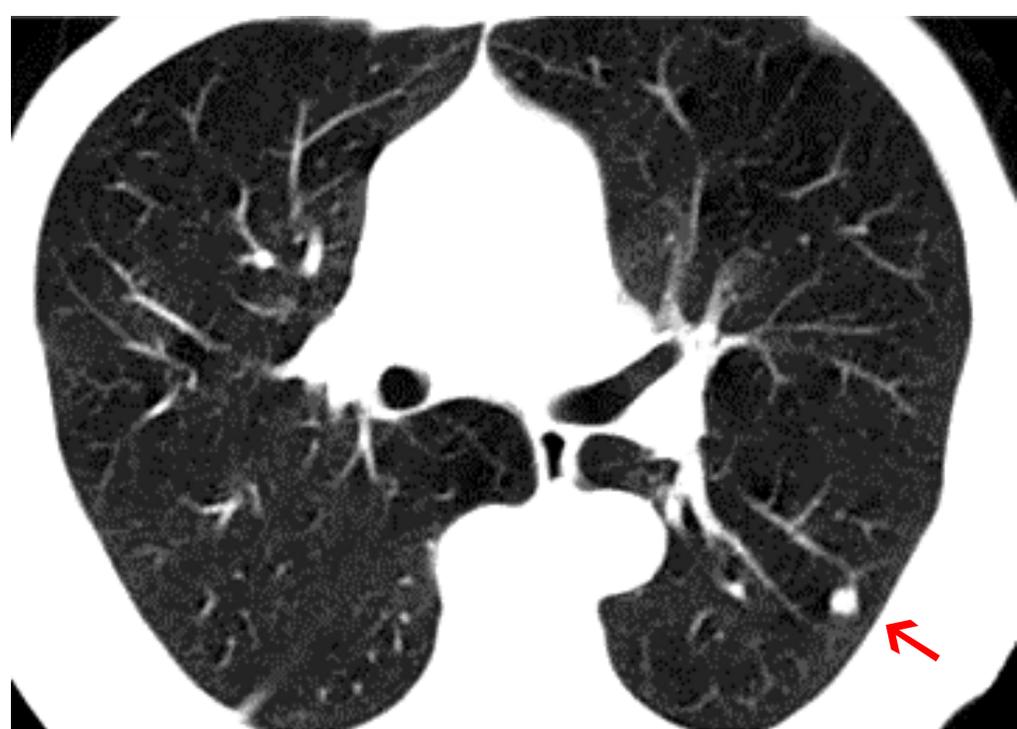
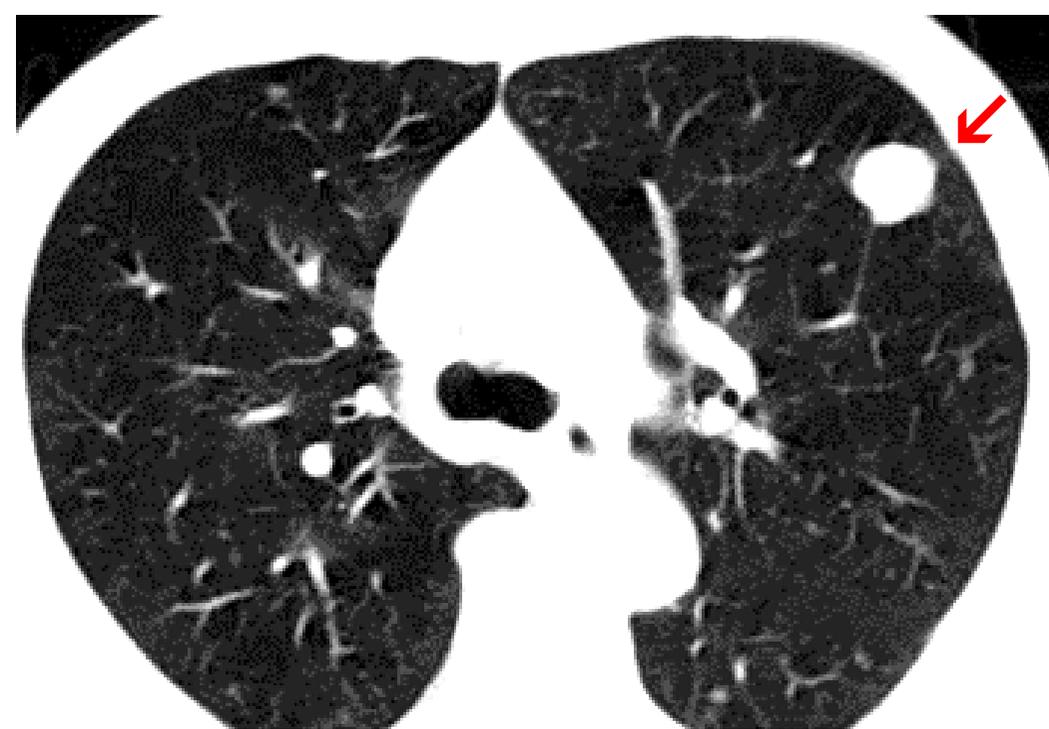


EVALUATION TDM DU NP

- DETECTION +++ > RADIOGRAPHIE TH. (RT)
- CARACTERISATION +++ > RT
- **TDM SPIRALEE** > ~~TDM SEQUENTIELLE~~
(+ 50 % de NP)



METASTASES



SIGNES MORPHOLOGIQUES TDM D'UN NP

NODULE

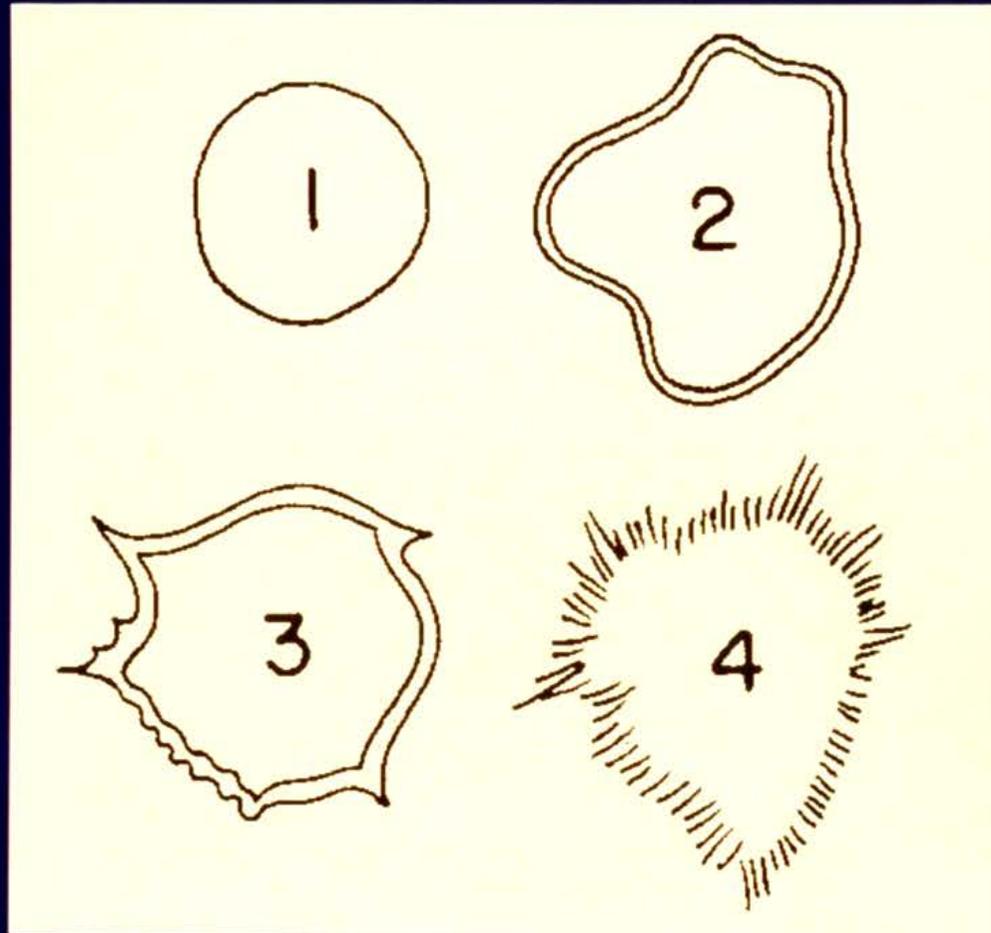
- CONTOURS
- CALCIFICATIONS
- DENSITES
- NECROSE / CAVITATION
- BRONCHOGRAMME
AERIQUE

ENVIRONNEMENT DU NODULE

- SIGNE DE LA BRONCHE
- SIGNE DU VAISSEAU
NOURRICIER
- CROISSANT AERIQUE
- SIGNE DU HALO
- SIGNE DE LA QUEUE
PLEURALE
- SIGNE DE LA BASE
PLEURALE

Figure 1 . ASPECTS DU CONTOUR D' UN NODULE PULMONAIRE

1. bénin
métastase
tum. carcinoïde

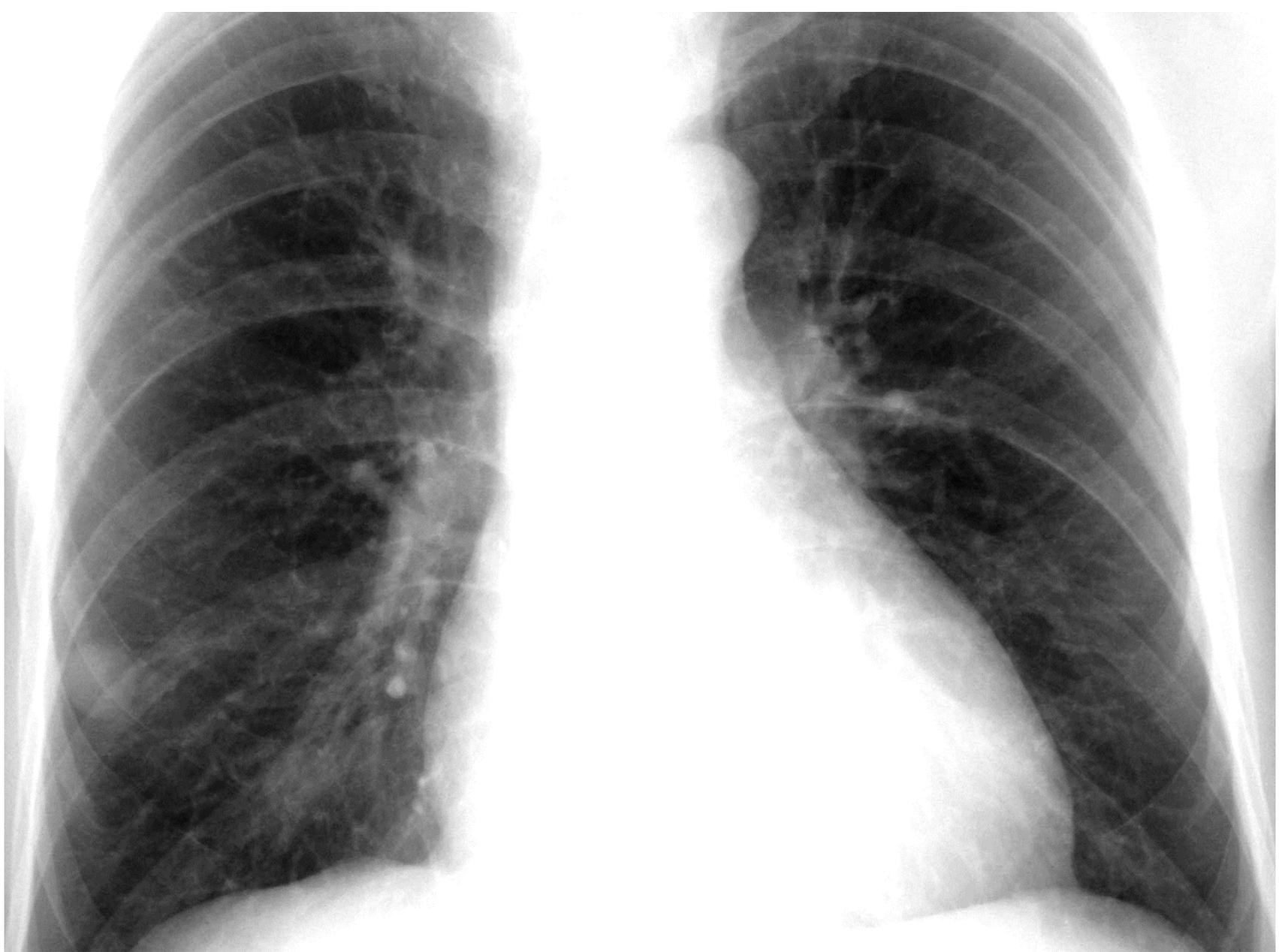


2. malin (75%)
bénin (25%)

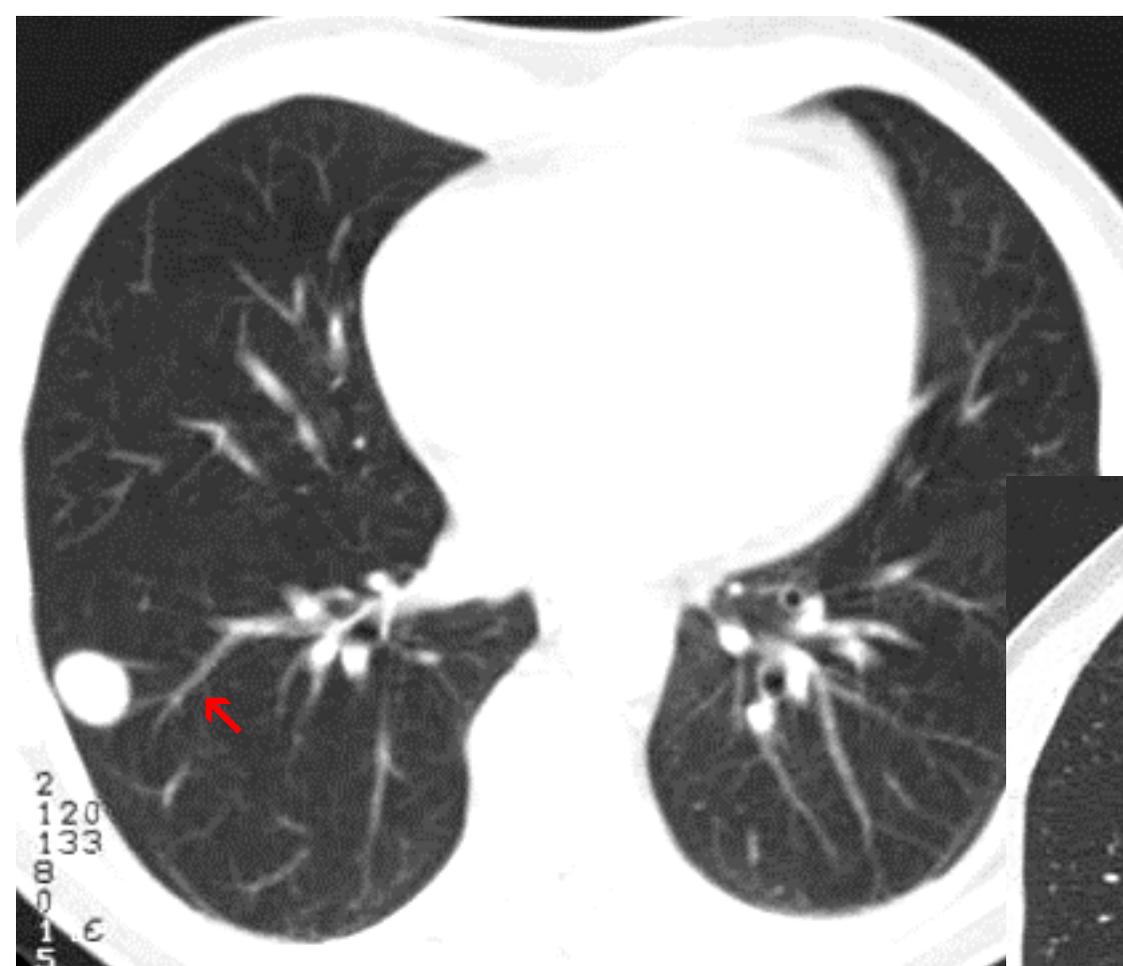
3. malin
(bénin)

4. malin

1. lisse 2. lobulé 3. irrégulier 4. spiculé



NP (antécédent de fibrosarcome)



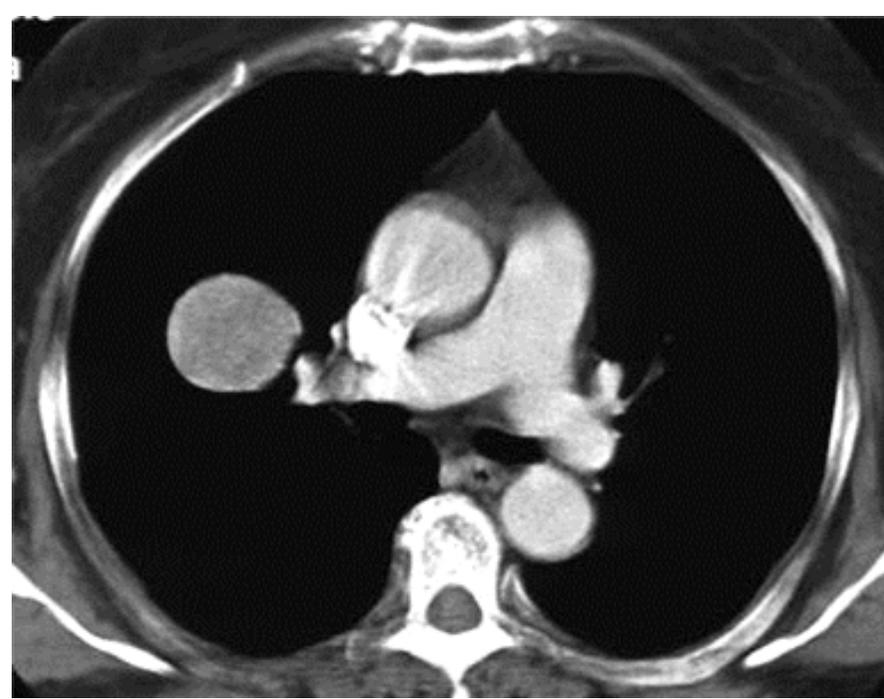
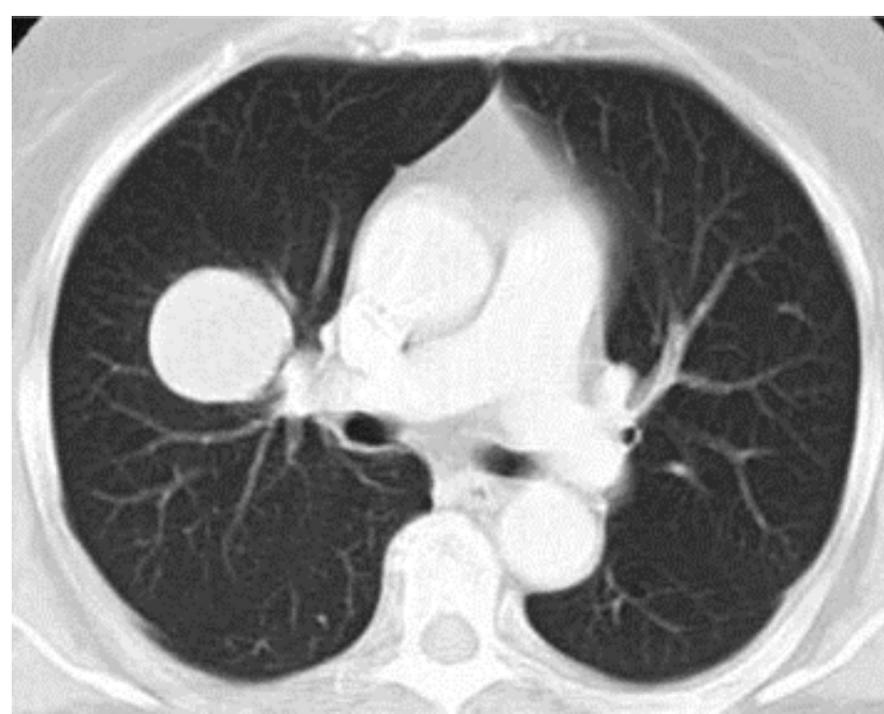
Coupe 8 mm



Coupe 1 mm



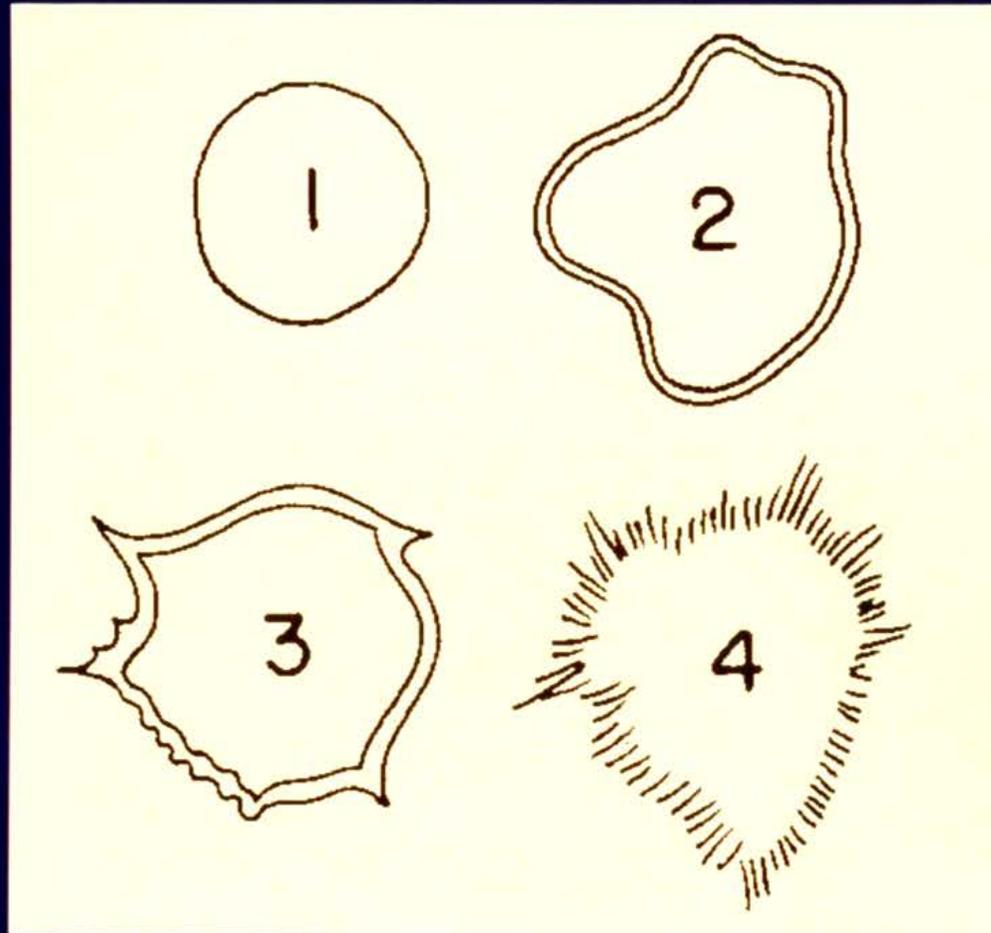
METASTASE UNIQUE
lisse , connexion vasculaire



TUMEUR CARCINOÏDE : lisse

Figure 1 . ASPECTS DU CONTOUR D' UN NODULE PULMONAIRE

1. bénin
métastase
tum. carcinoïde

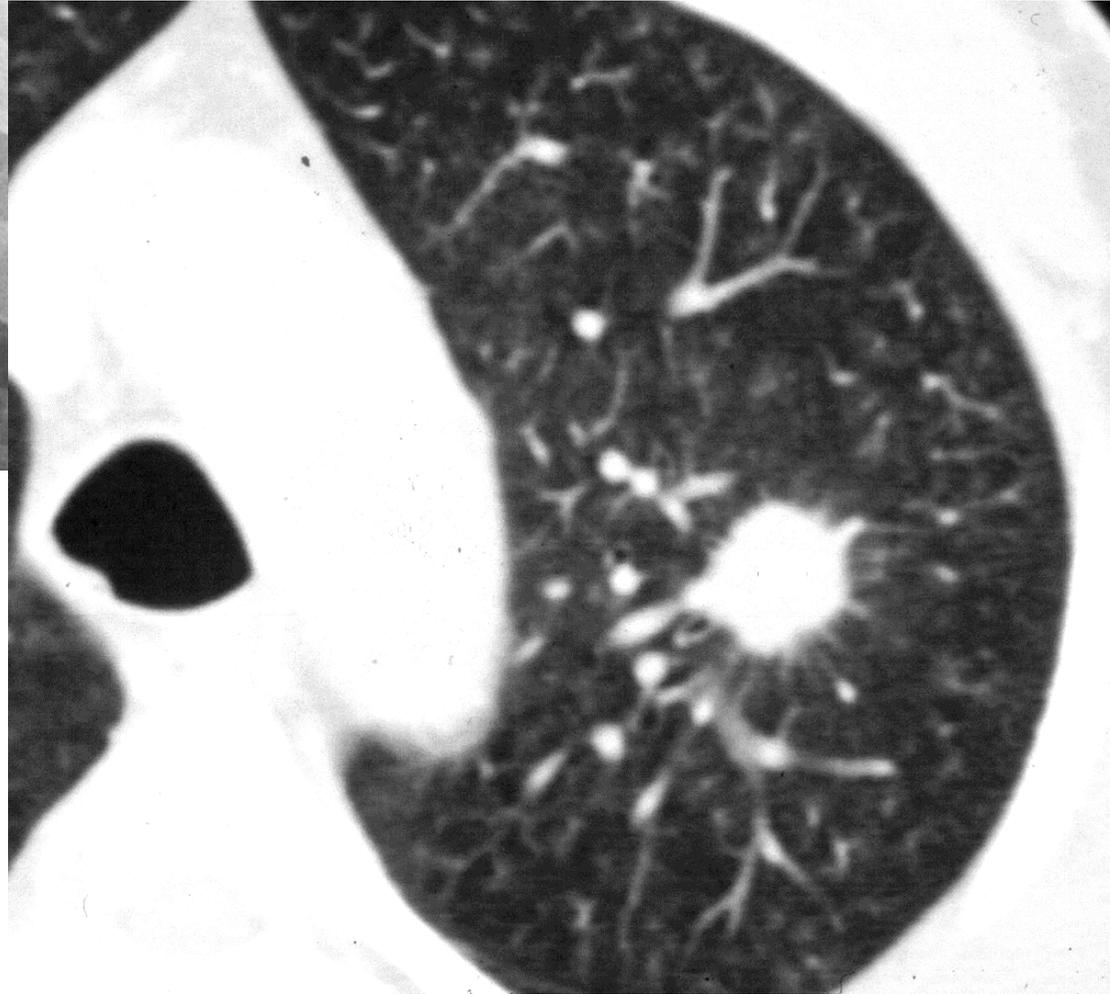


2. malin (75%)
bénin (25%)

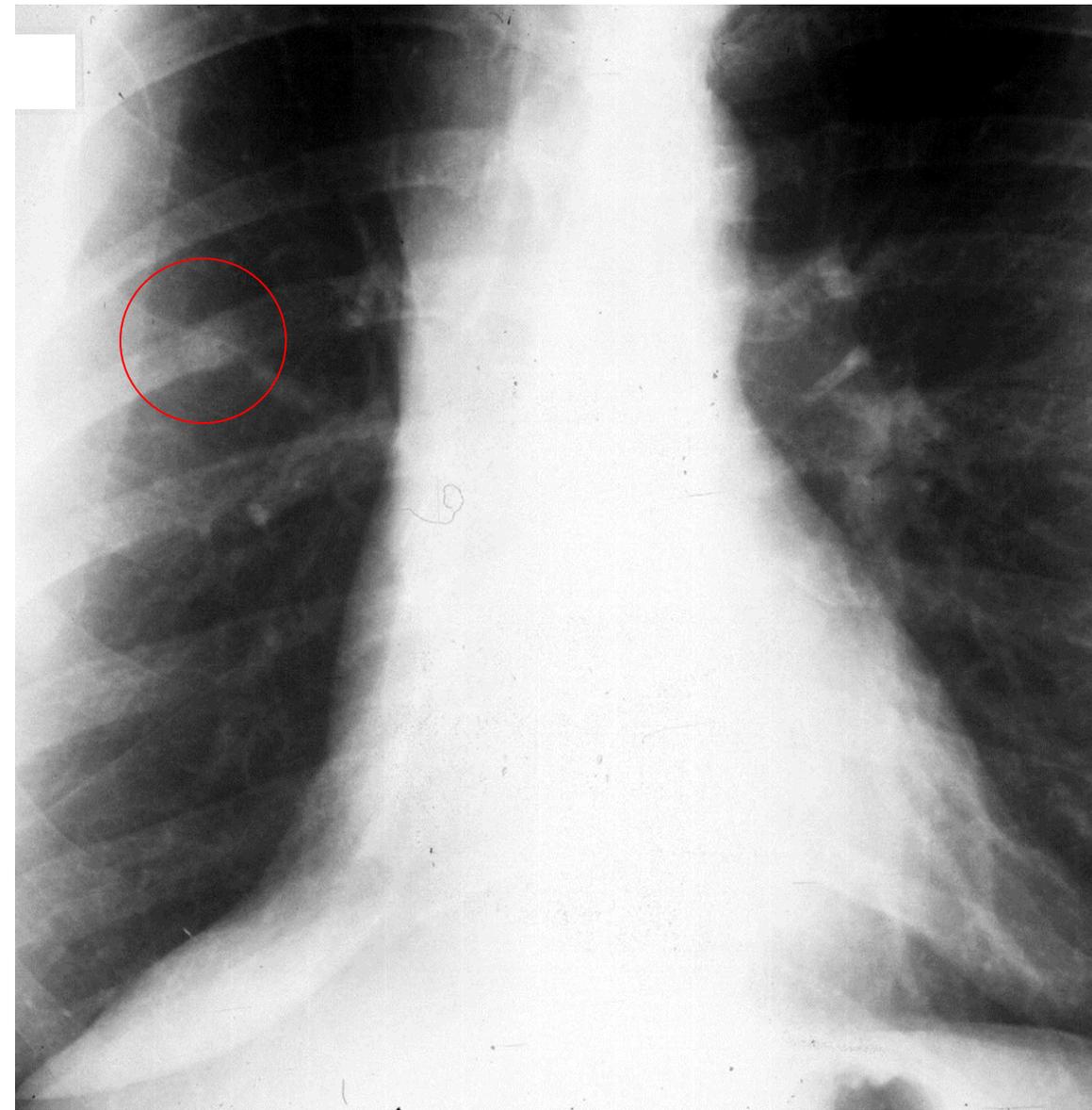
3. malin
(bénin)

4. malin

1. lisse 2. lobulé 3. irrégulier 4. spiculé



CANCER BR. : spiculé
(corona radiata)



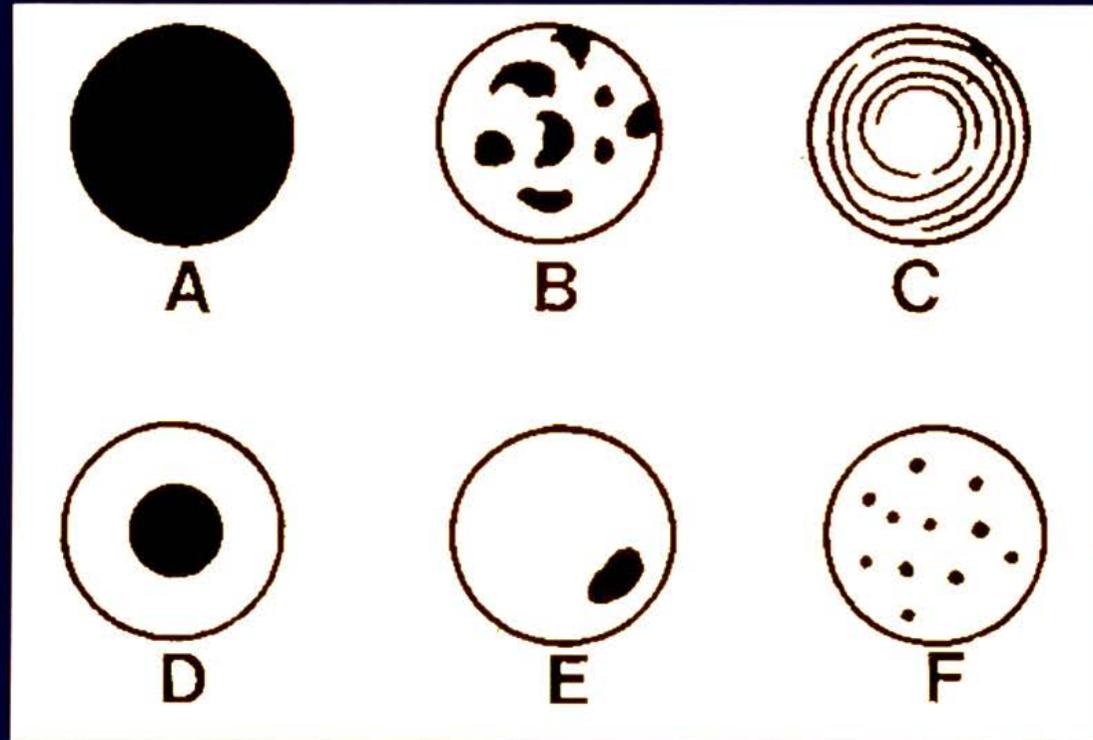
NP : peu visible sur la RT



TDM : lobulé / spiculé
CANCER BRONCHIQUE

Figure 2 . ASPECTS DES CALCIFICATIONS INTRANODULAIRES

A,B,C,D
bénin
(malin)



E,F
malin
(bénin)

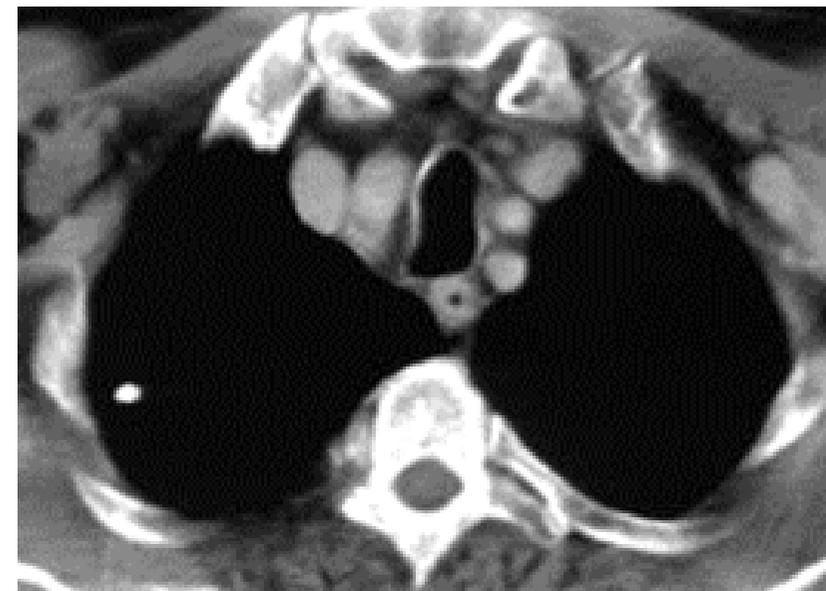
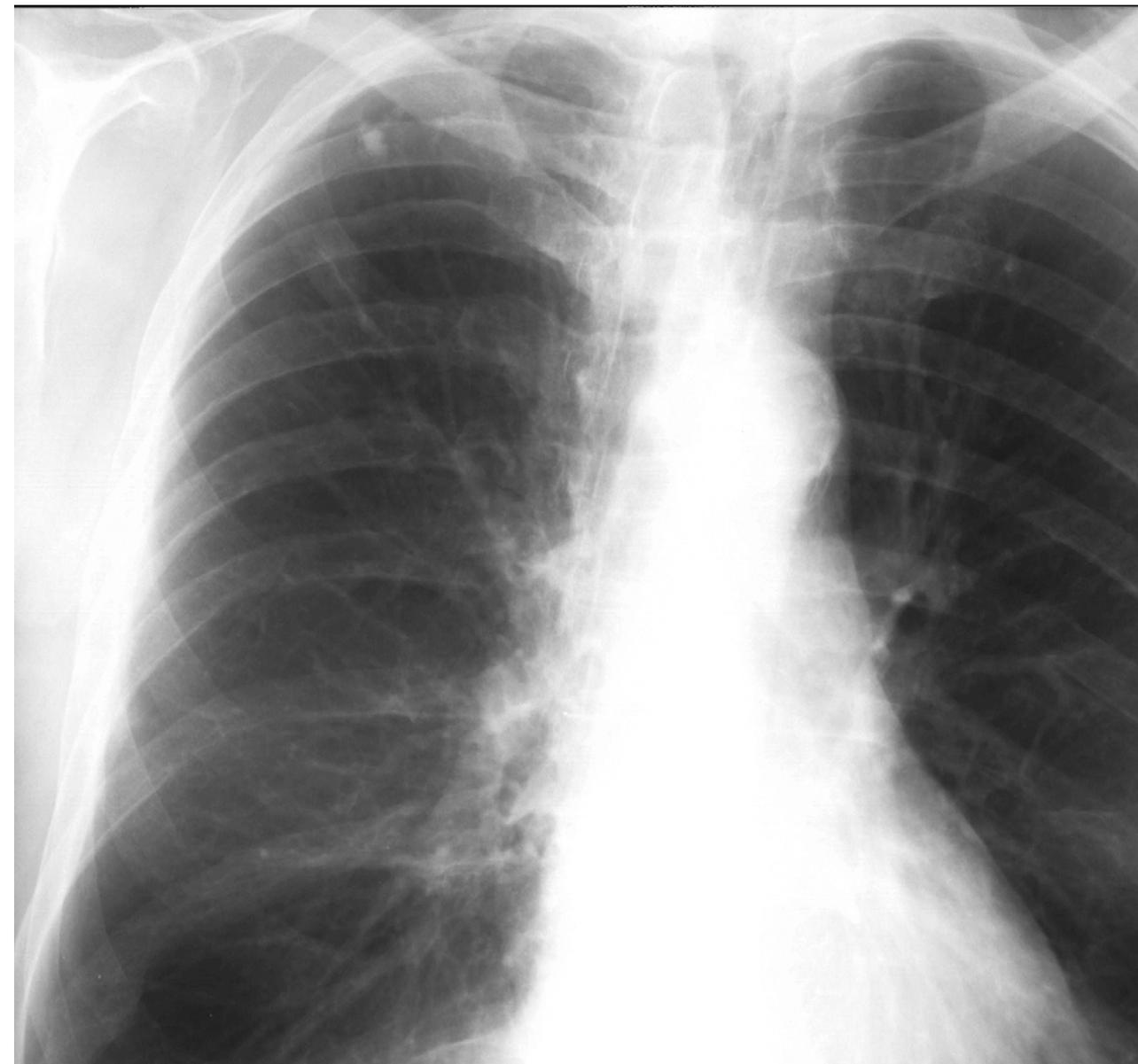
A. diffus B. " en popcorn " C. laminé
D. central E. excentrique F. ponctué

CALCIFICATIONS INTRA-NODULAIRES

- **TYPES BENINS** (rarement MALINS)
 - A. **DIFFUS** - granulome tbc., métastase (ostéosarcome)
 - B. « **EN POPCORN** » - hamartome (15 %)
 - C. **LAMINE** - granulome tbc.
 - D. **CENTRAL** - granulome tbc., histoplasmosse, métastase (ostéosarc.)

- **TYPES MALINS** (rarement BENINS)
 - E. **EXCENTRIQUE** - « scar carcinoma »
 - F. **PONCTUE**
 - cancer bronchique (6%)
 - tumeur carcinoïde (33%)
 - (hamartome)

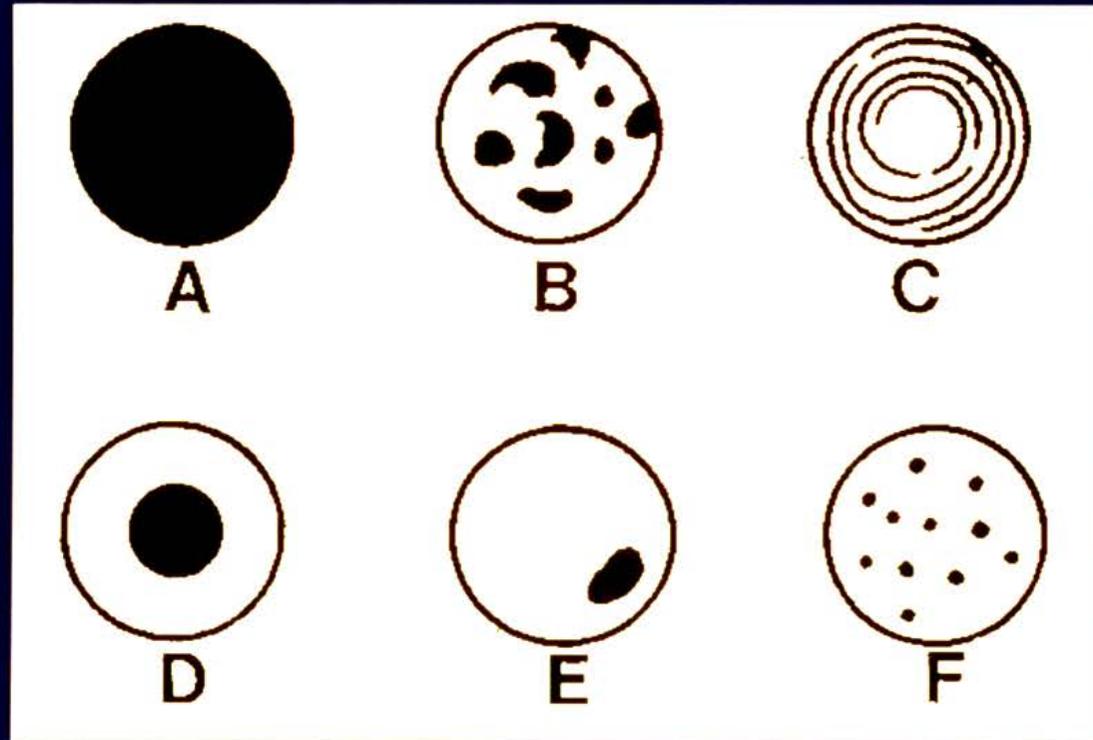
Hamartome: malformation tissulaire d'aspect tumoral composé d'éléments constitutifs présents dans l'organe dans lequel ils se développent



GRANULOME TBC CALCIFIE

Figure 2 . ASPECTS DES CALCIFICATIONS INTRANODULAIRES

A,B,C,D
bénin
(malin)

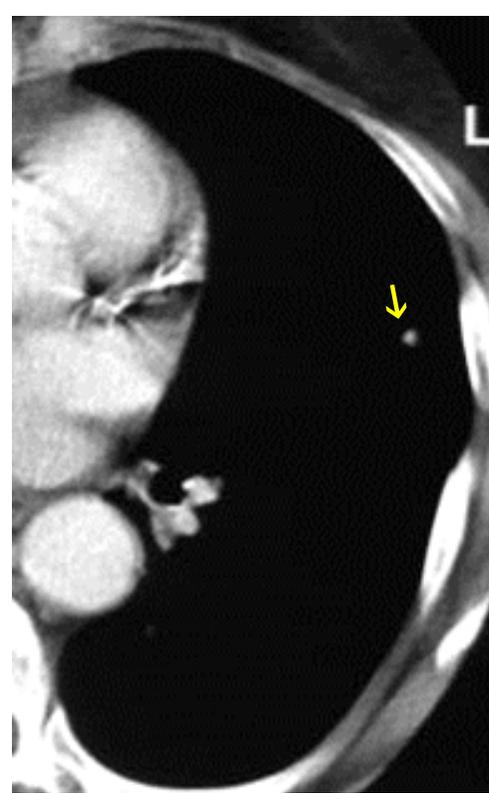
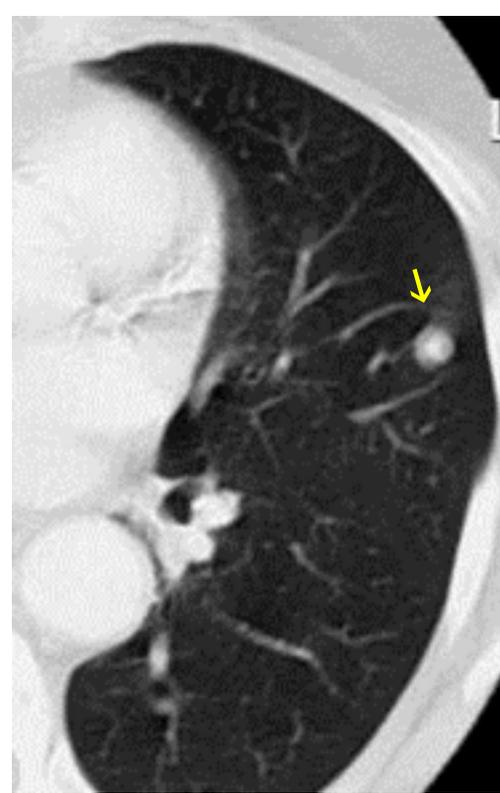
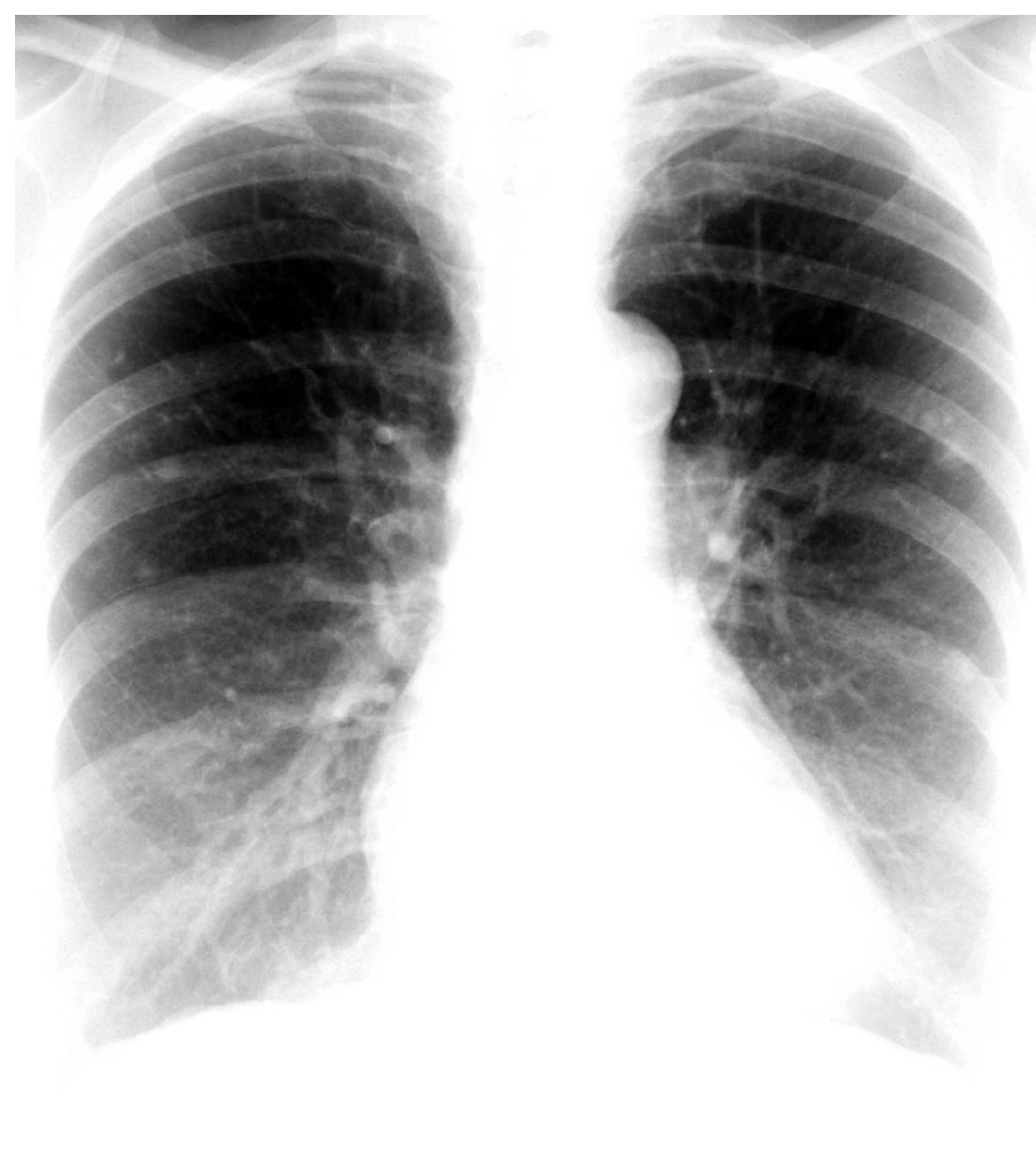


E,F
malin
(bénin)

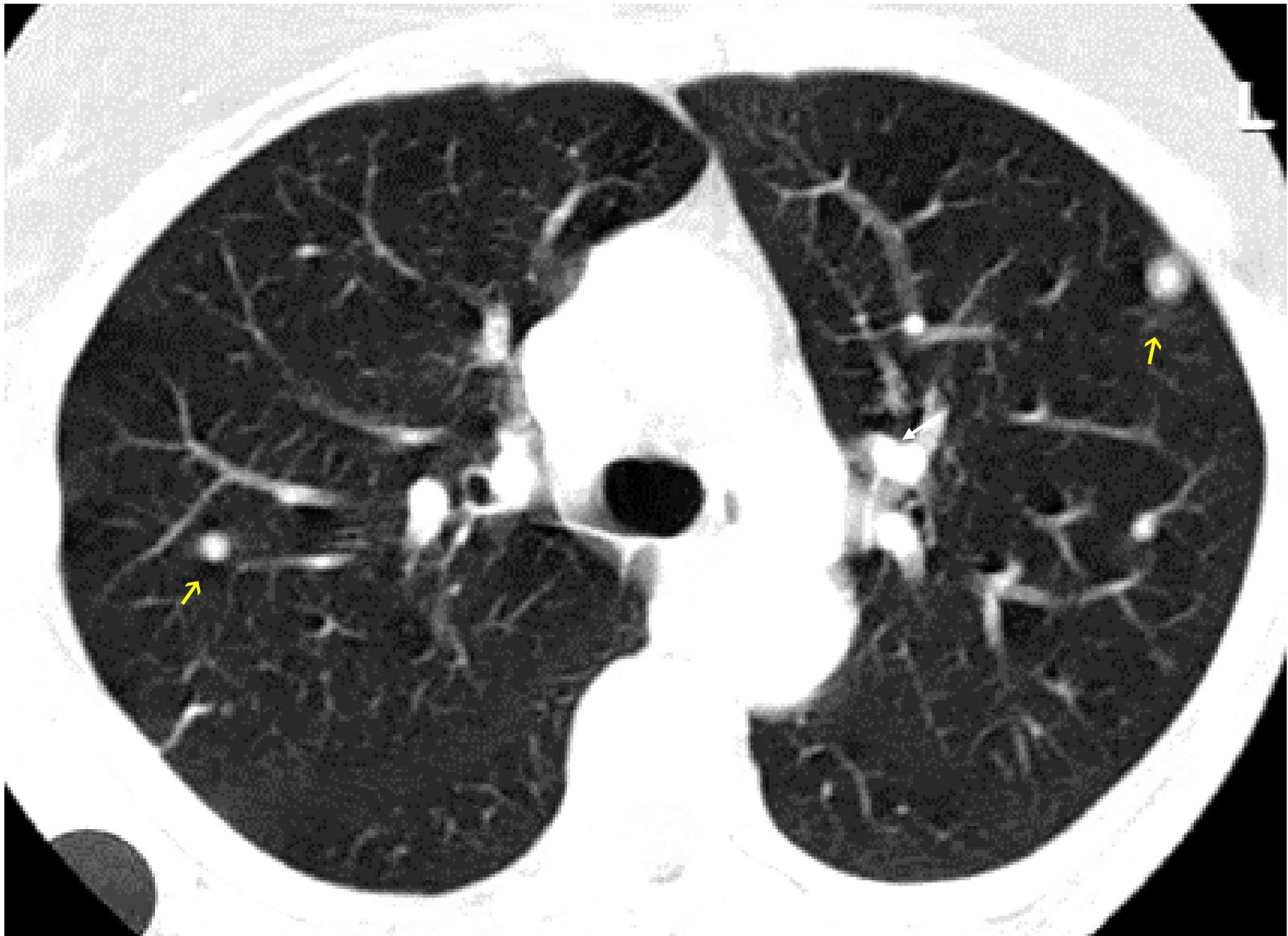
A. diffus B. " en popcorn " C. laminé
D. central E. excentrique F. ponctué



HAMARTOME : lisse , calc.en « popcorn »



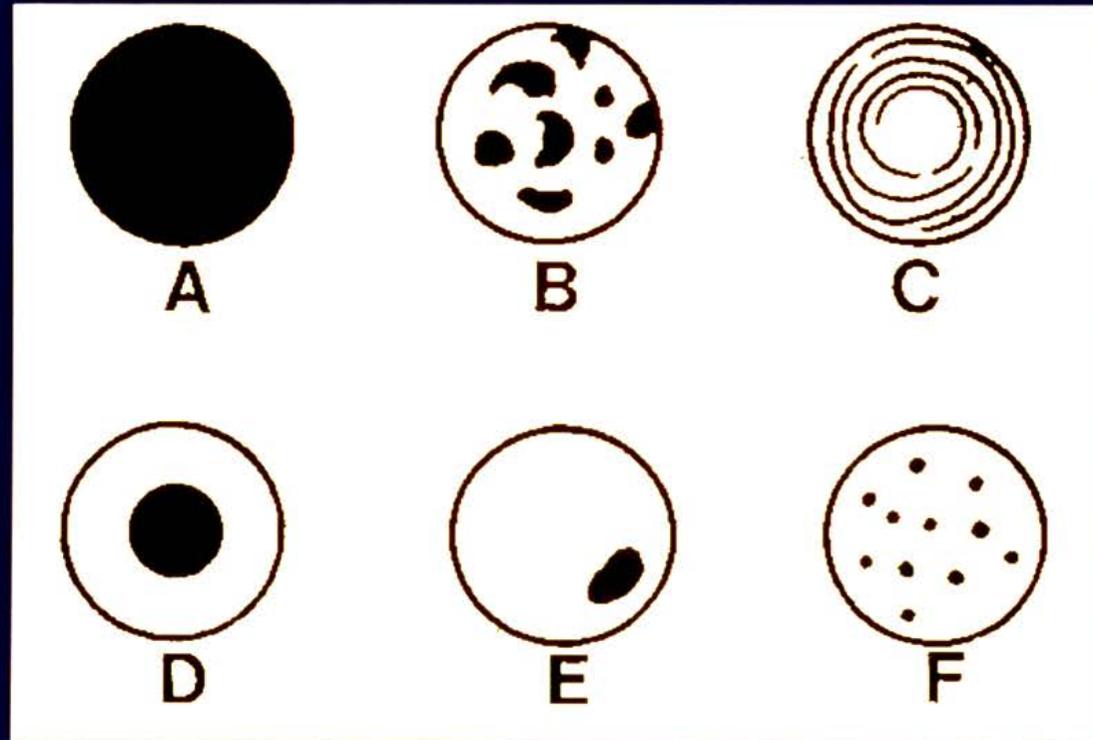
HISTOPLASMOSE : granulomes calc.



HISTOPLASMOSE ; GRANULOME : nidus central calcifié

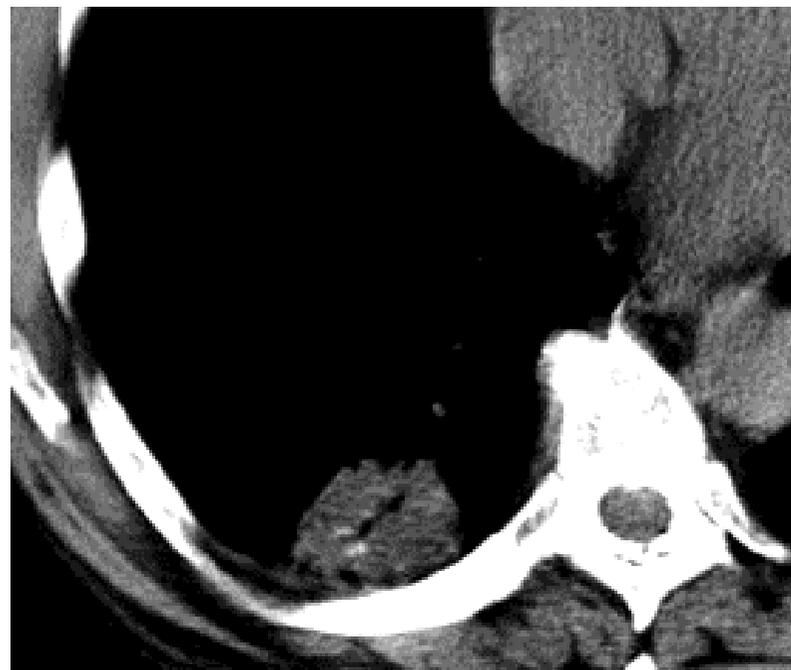
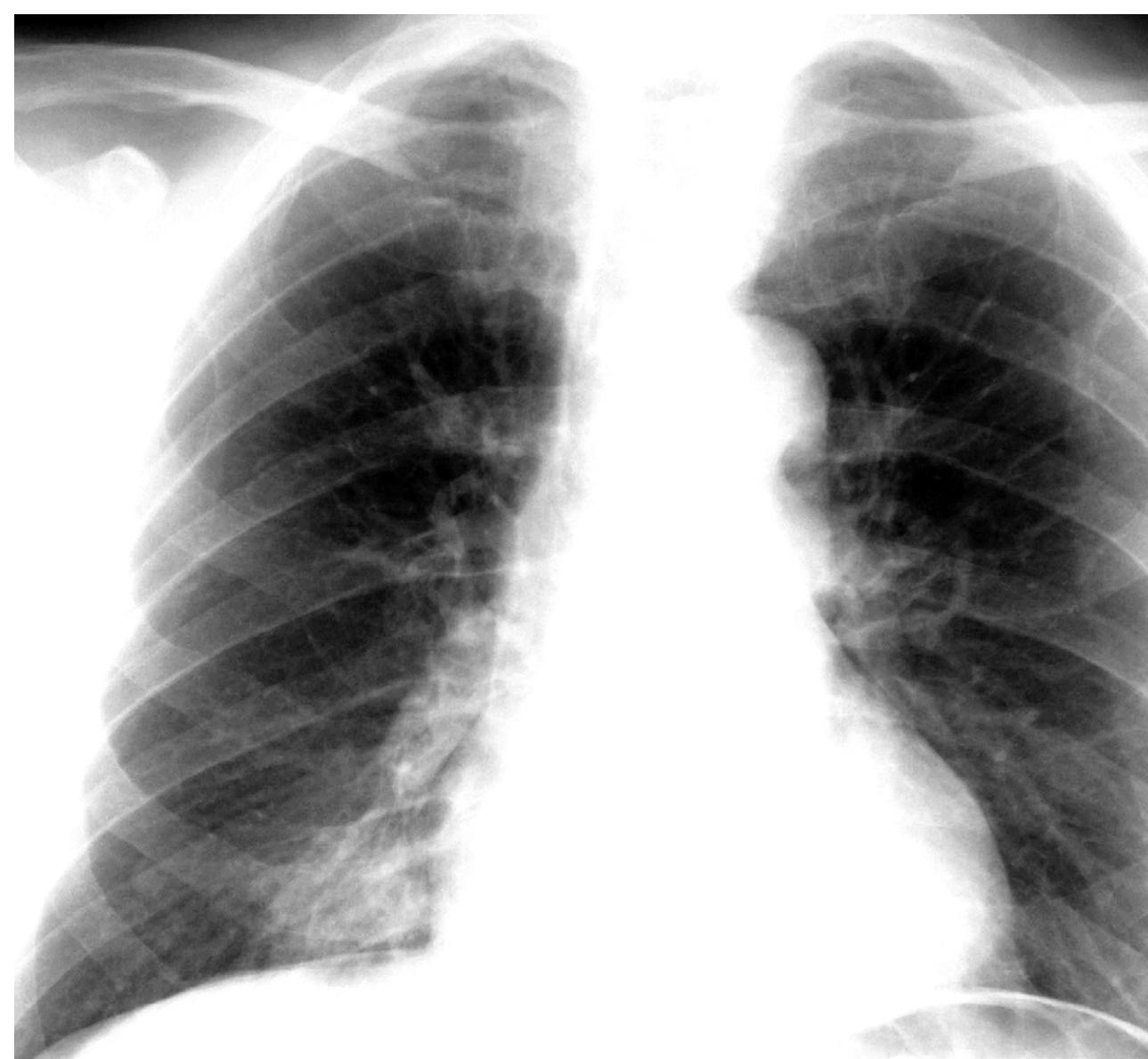
Figure 2 . ASPECTS DES CALCIFICATIONS INTRANODULAIRES

A,B,C,D
bénin
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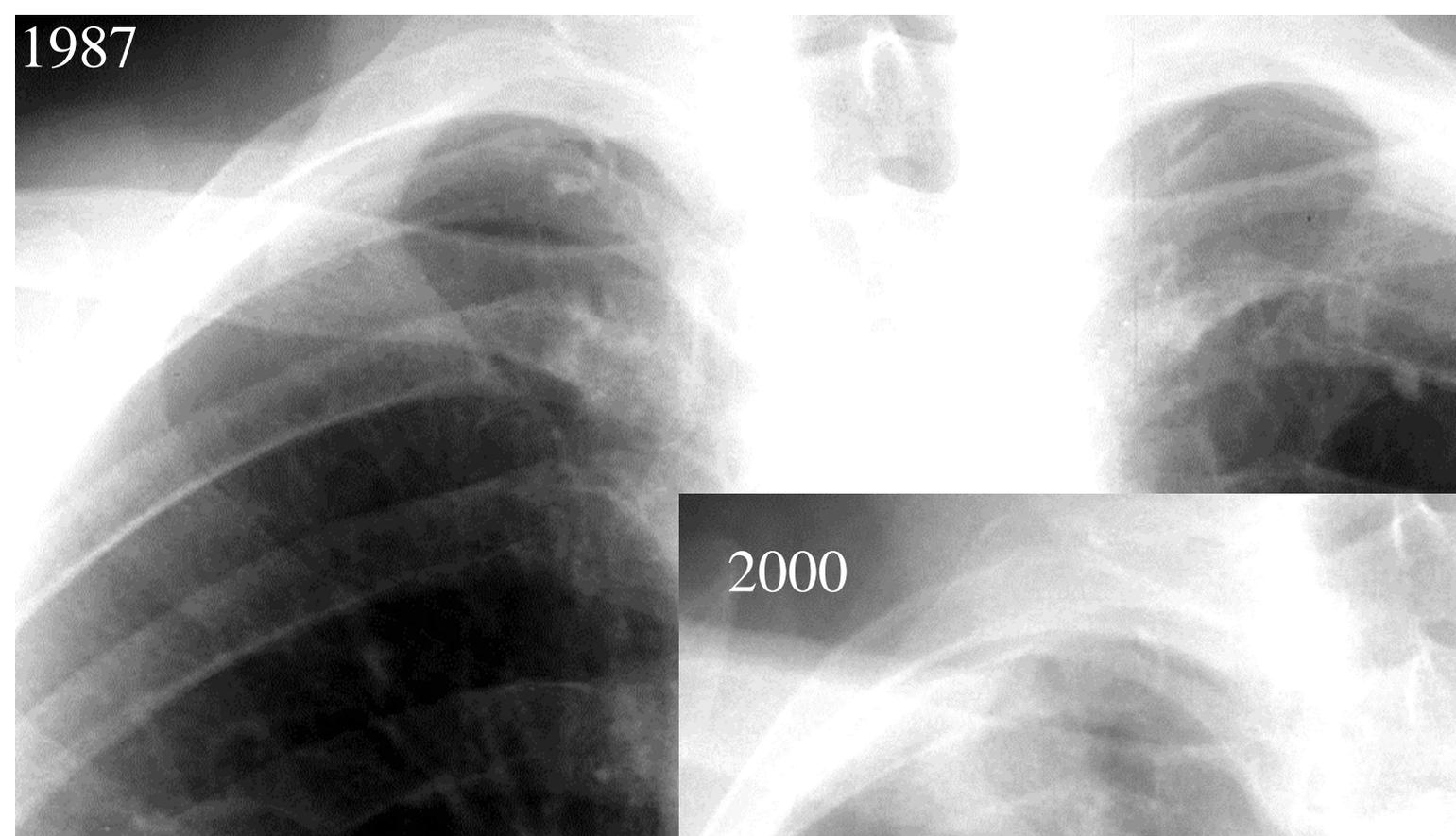
E,F
malin
(bénin)

A. diffus B. " en popcorn " C. laminé
D. central E. excentrique F. ponctué

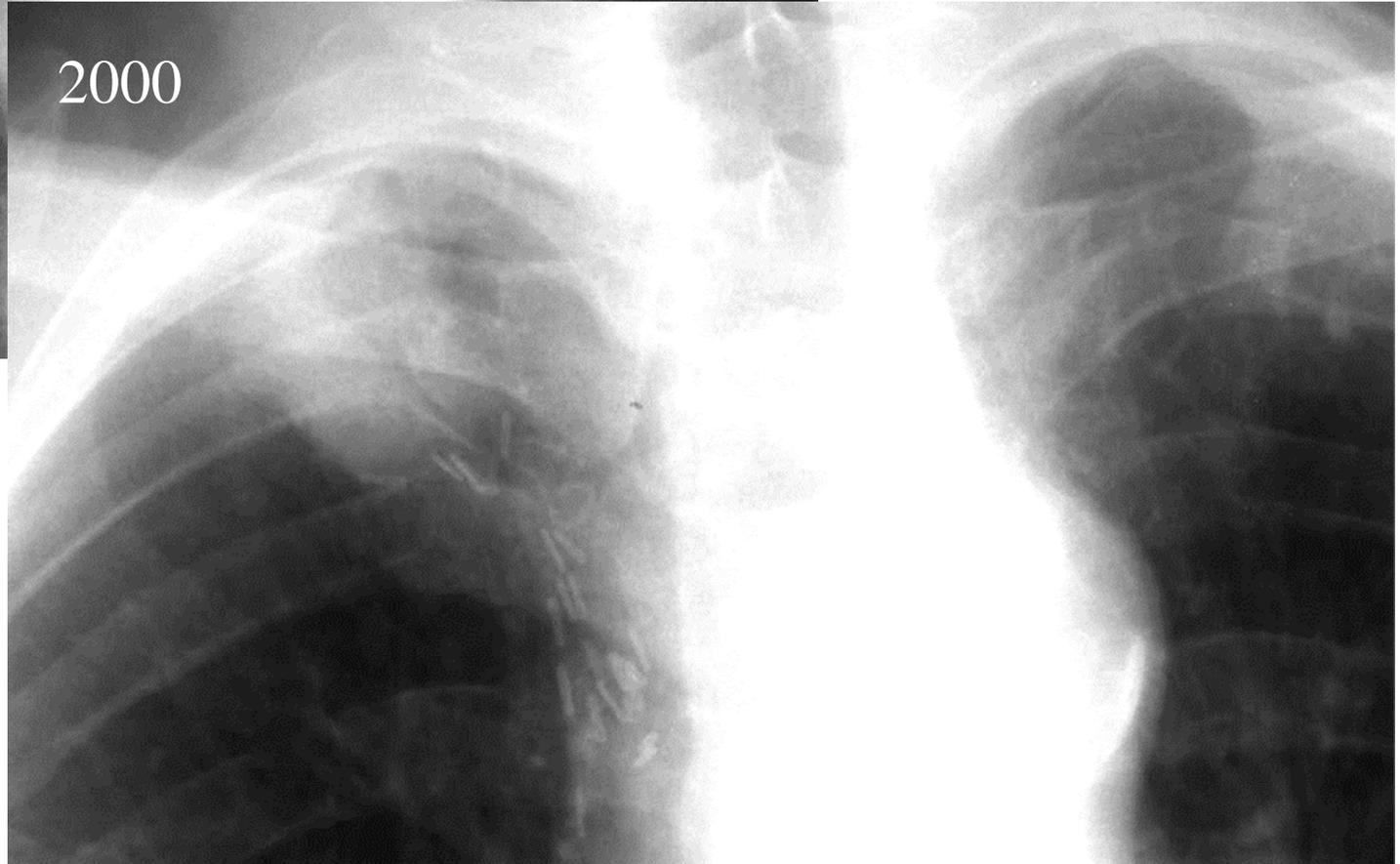


bronchogramme aérique , calcifications
ponctuées

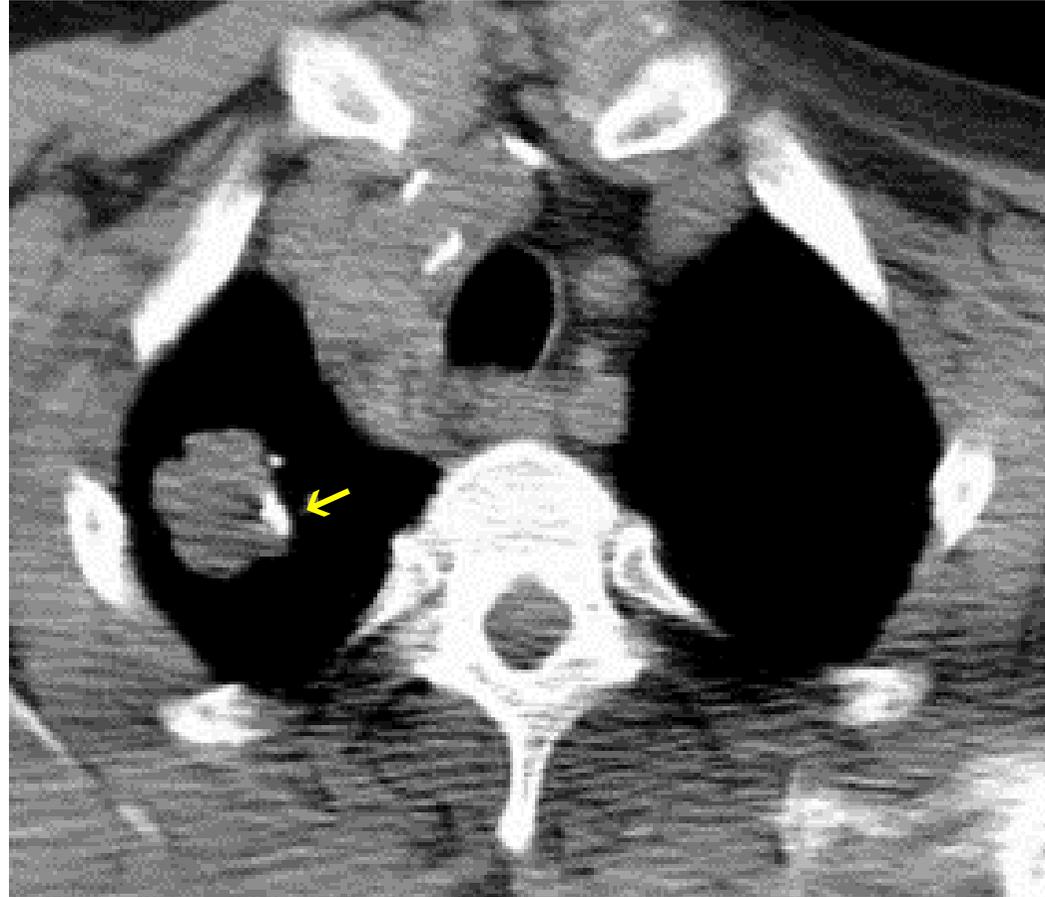
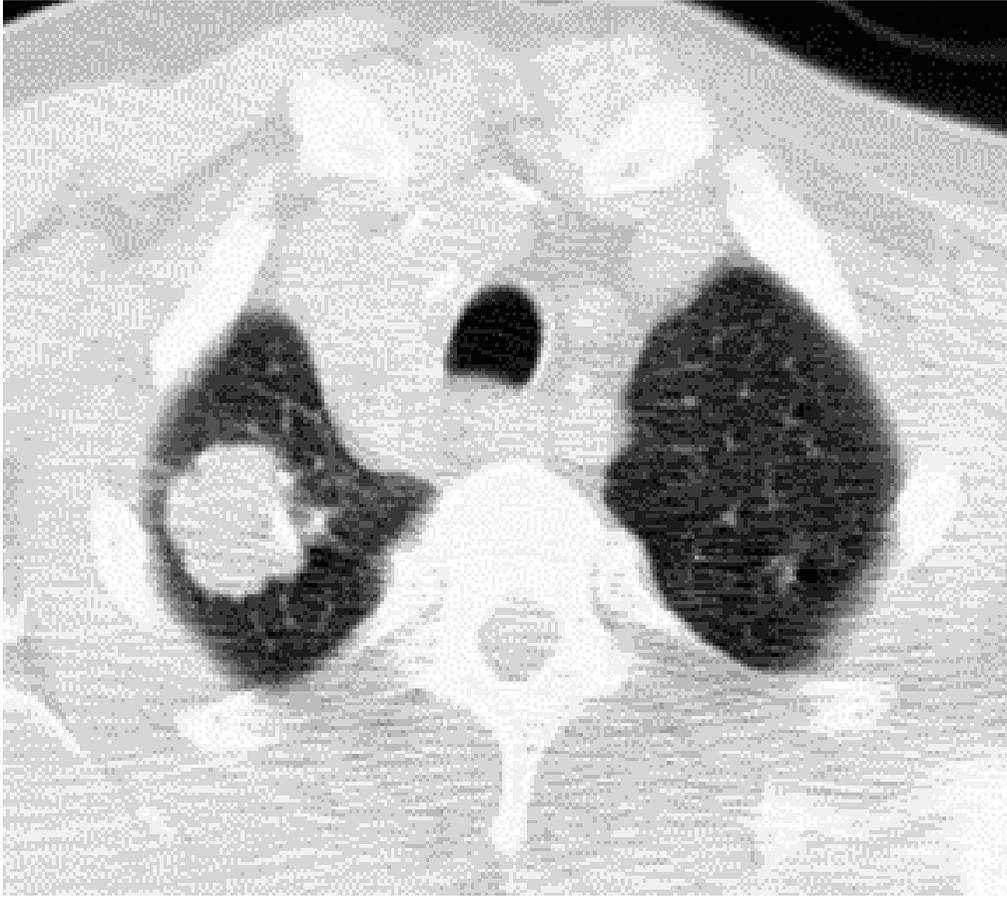
Carcinome lépidique (BAC)



MICRO-GRANULOMES
TBC. CALCIFIES
←



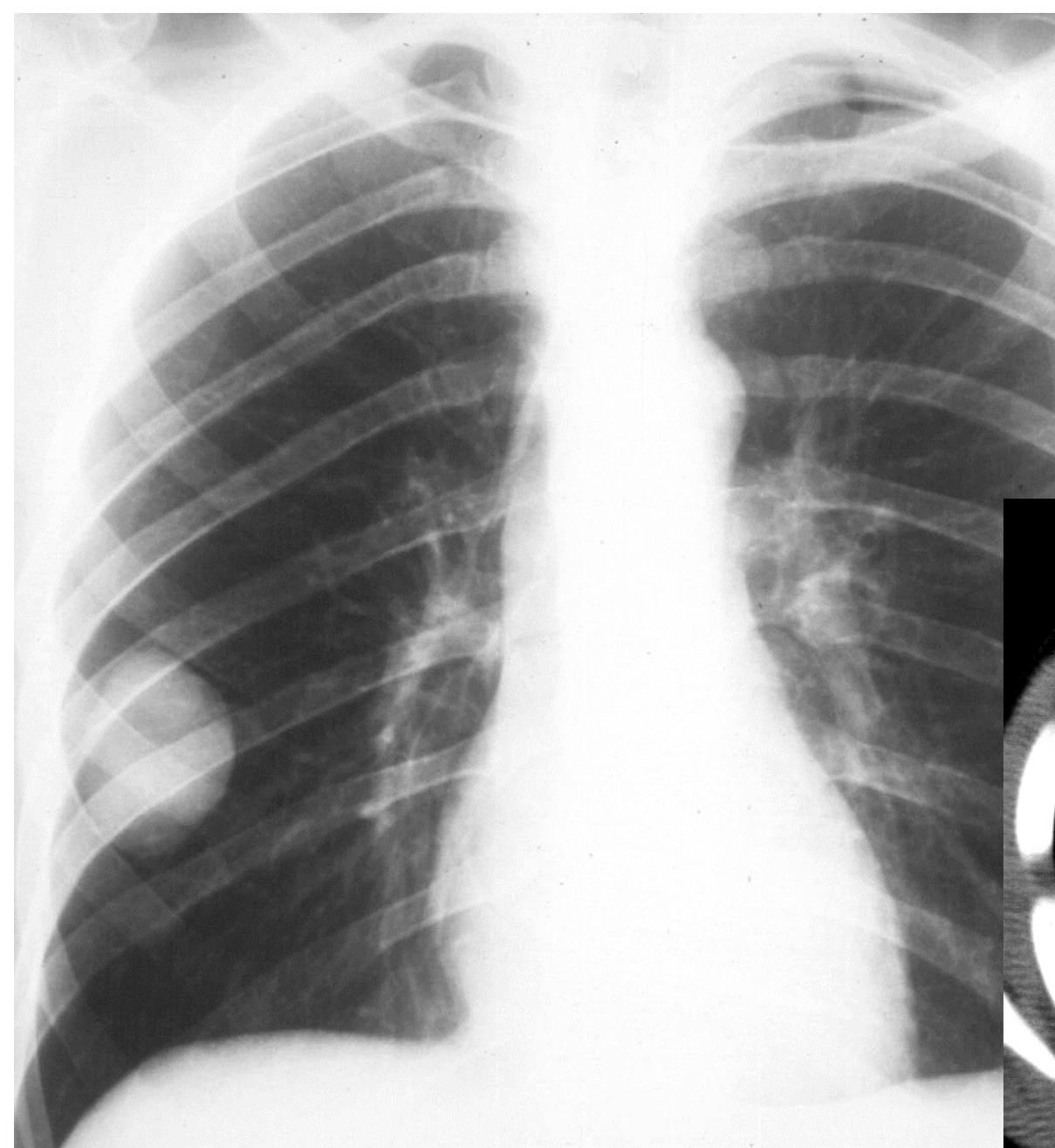
" SCAR CARCINOMA "
→



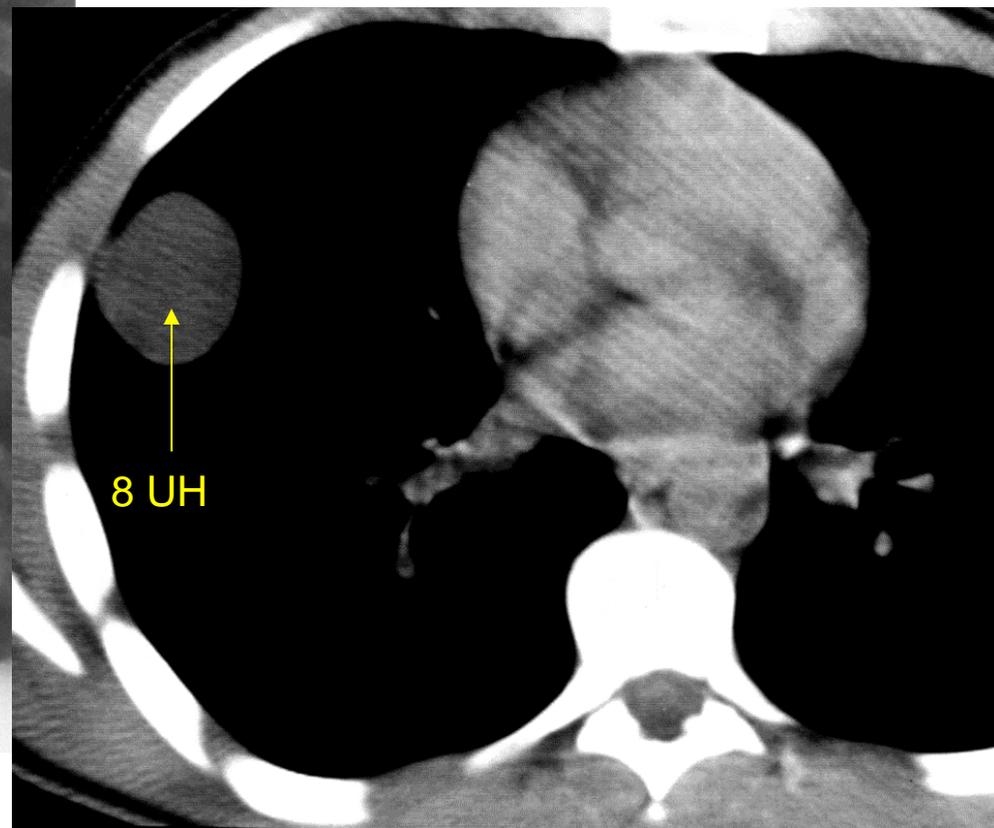
" SCAR CARCINOMA " : calcification excentrique

DENSITES INTRA-NODULAIRES

- **CALCIQUE** (> 250 UH) - BENIN
- (MALIN : CANCER BR.)
- **TISSULAIRE** (30-70 UH) - BENIN / MALIN
- **HYDRIQUE** (0-20 UH) - BENIN (KYTE HYDAT.)
- **GRAISSEUSE** (-80/-100 UH) - HAMARTOME (50%)

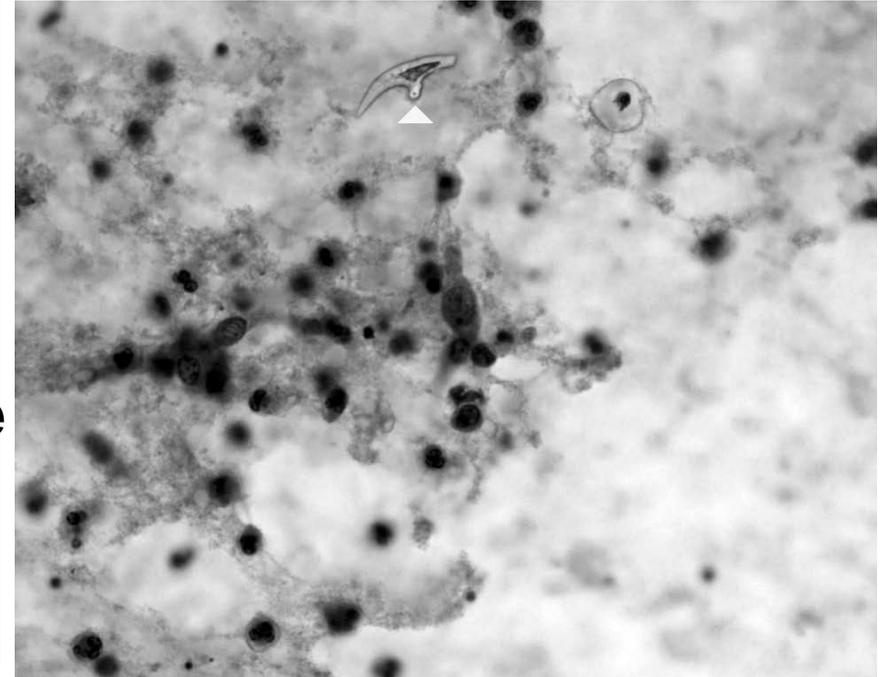
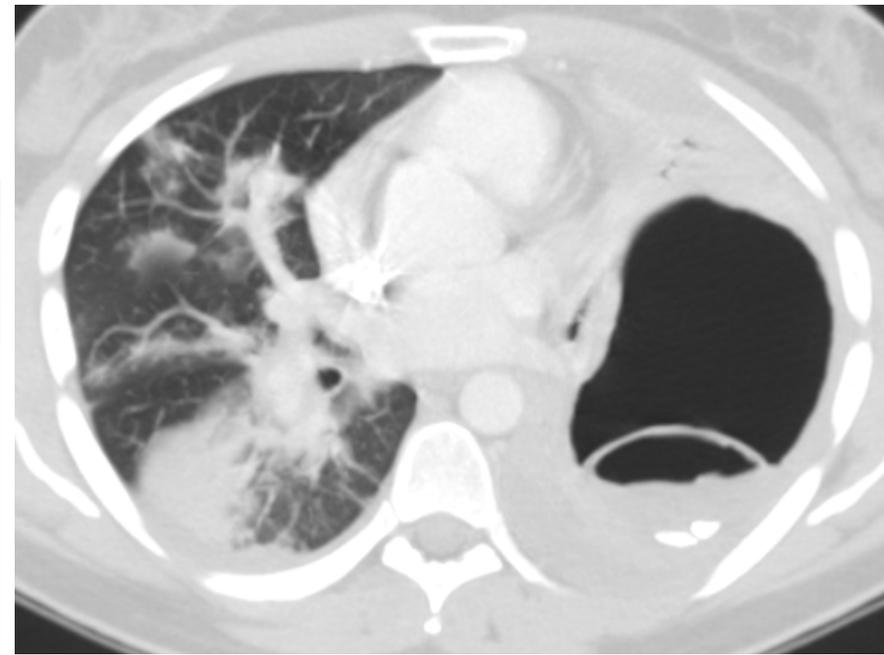
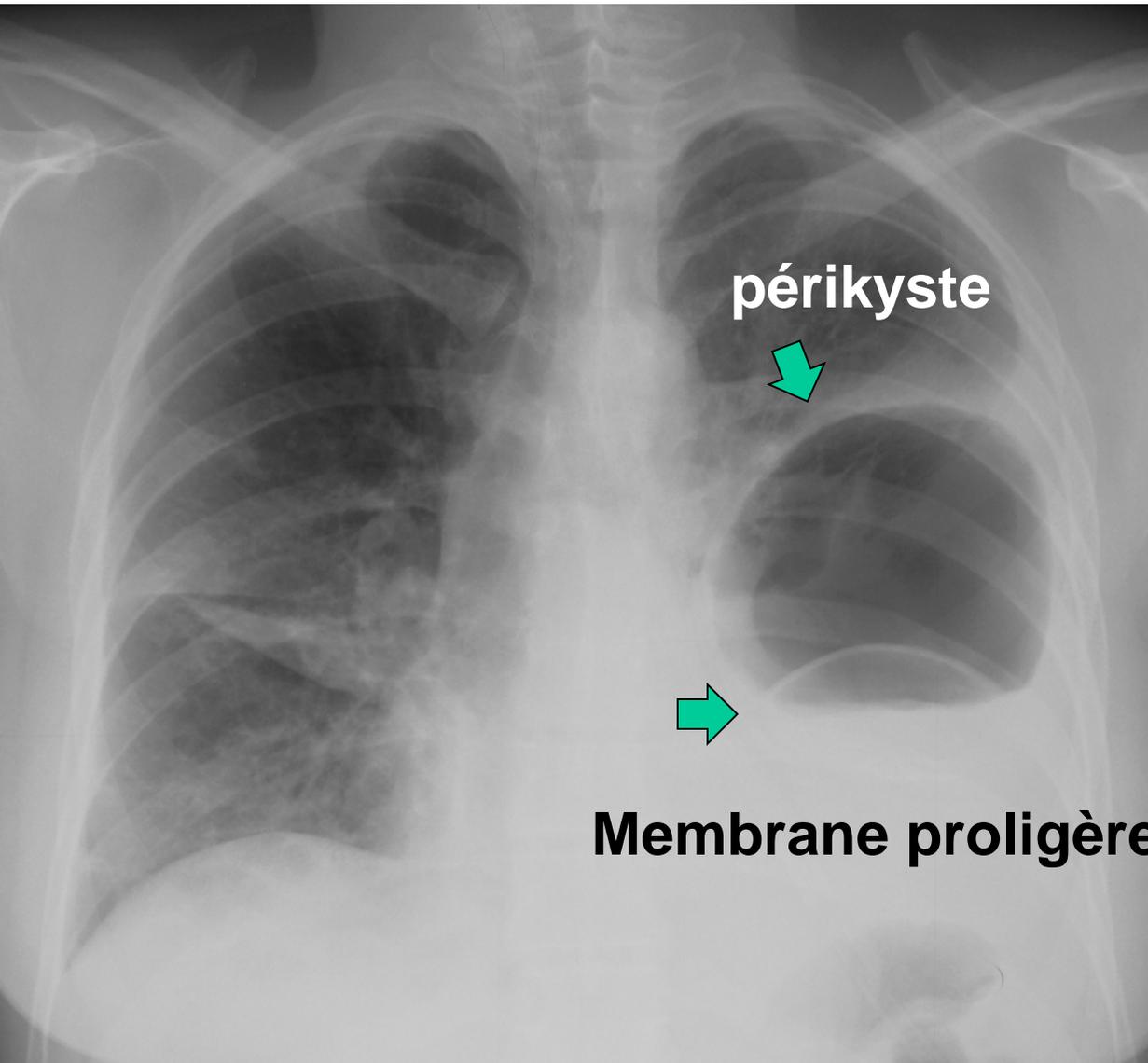


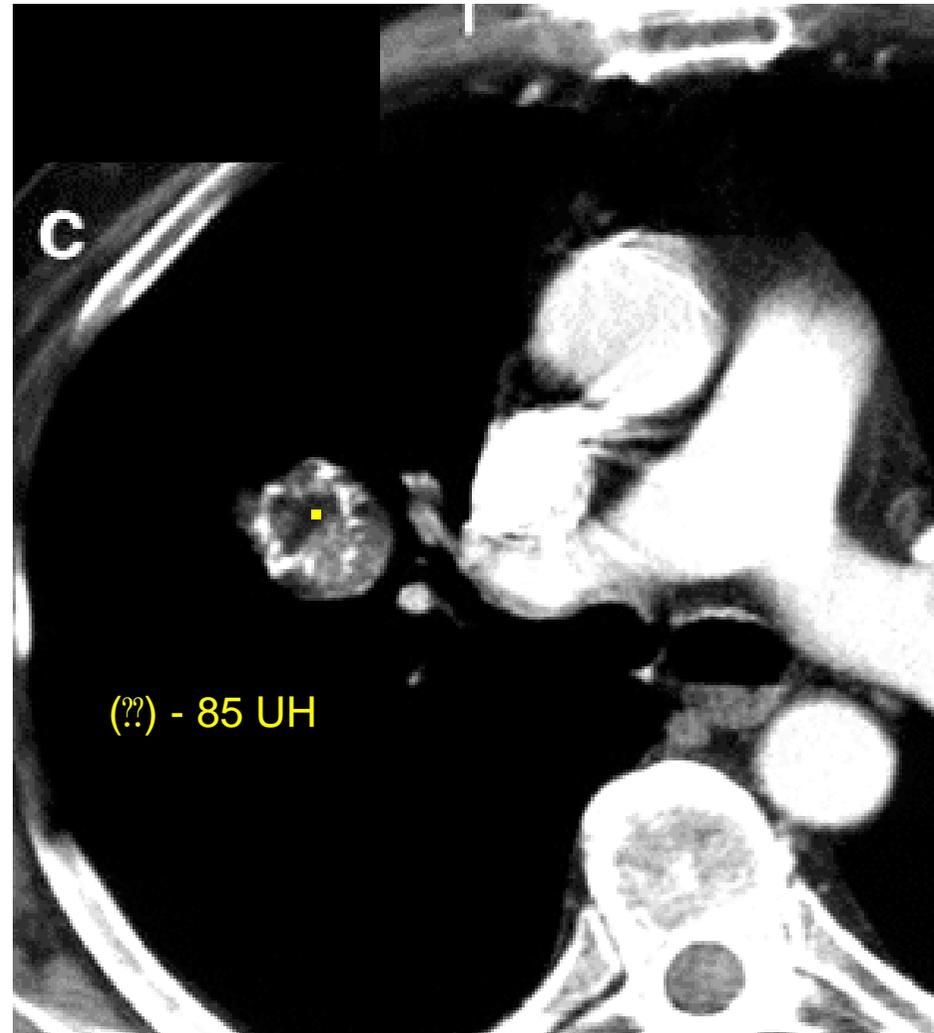
contour lisse , densité aqueuse



KYSTE HYDATIQUE

Niveau hydro-aérique

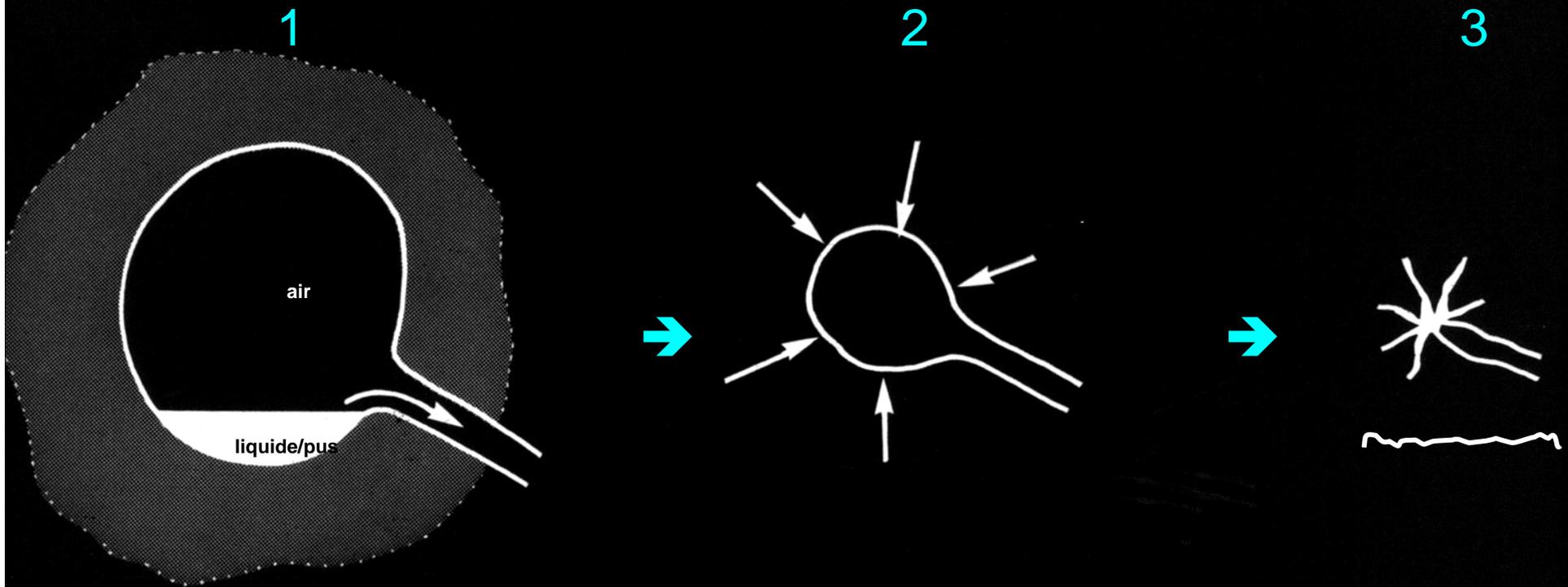




HAMARTOME (HAMARTOCHONDROME) : lisse , calcifications en « popcorn » (15%) , graisse (50%)

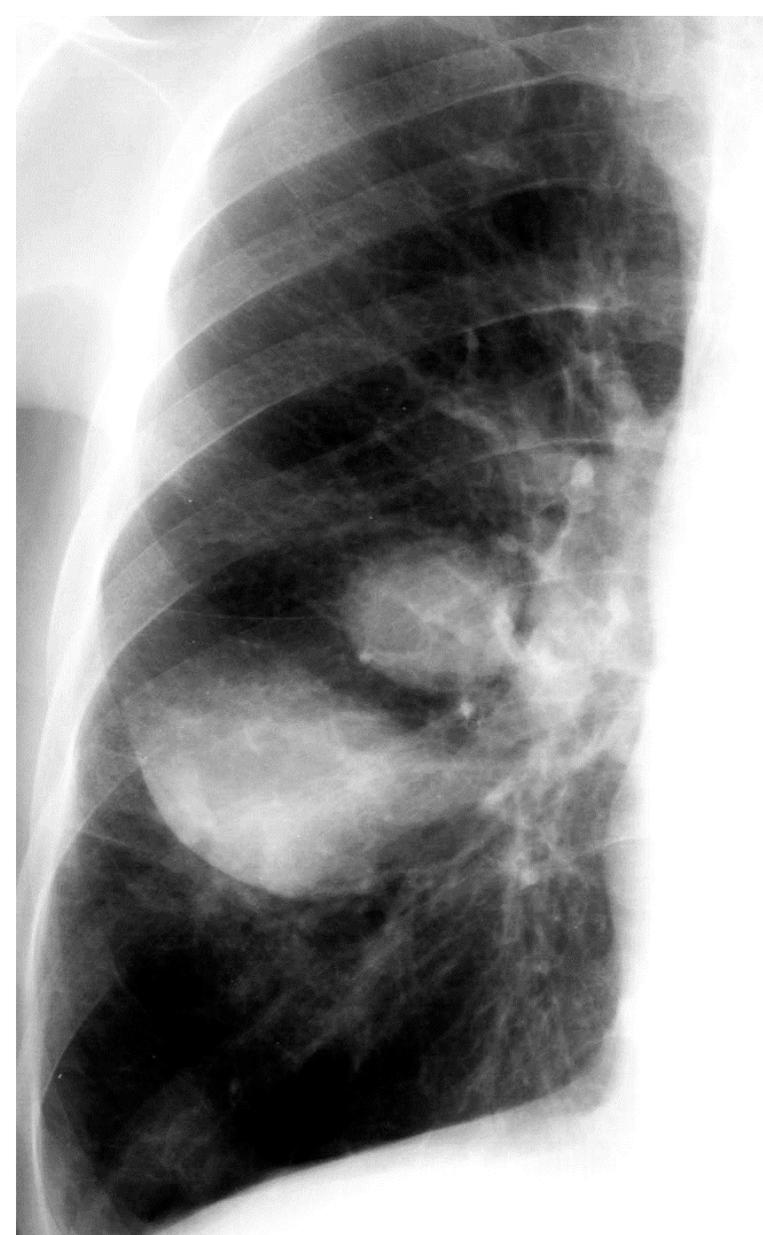
NP : CAVITATION / NECROSE

- DENSITES MIXTES : LIQUIDES
ET TISSUS NECROSES : 20 à 80 UH
- DENSITE AERIQUE : - 800 UH
 - MALIN
 - CANCER BR.
 - METASTASE (CHIMIOOTHERAPIE)
 - BENIN
 - LESION tbc.
 - ABCES
 - INFARCTUS



EVOLUTION ABCES / CAVERNE TBC

- 1** cavitation (bronche de drainage)
- 2** détersion complète, diminution de volume
- 3** cicatrice stellaire ou linéaire

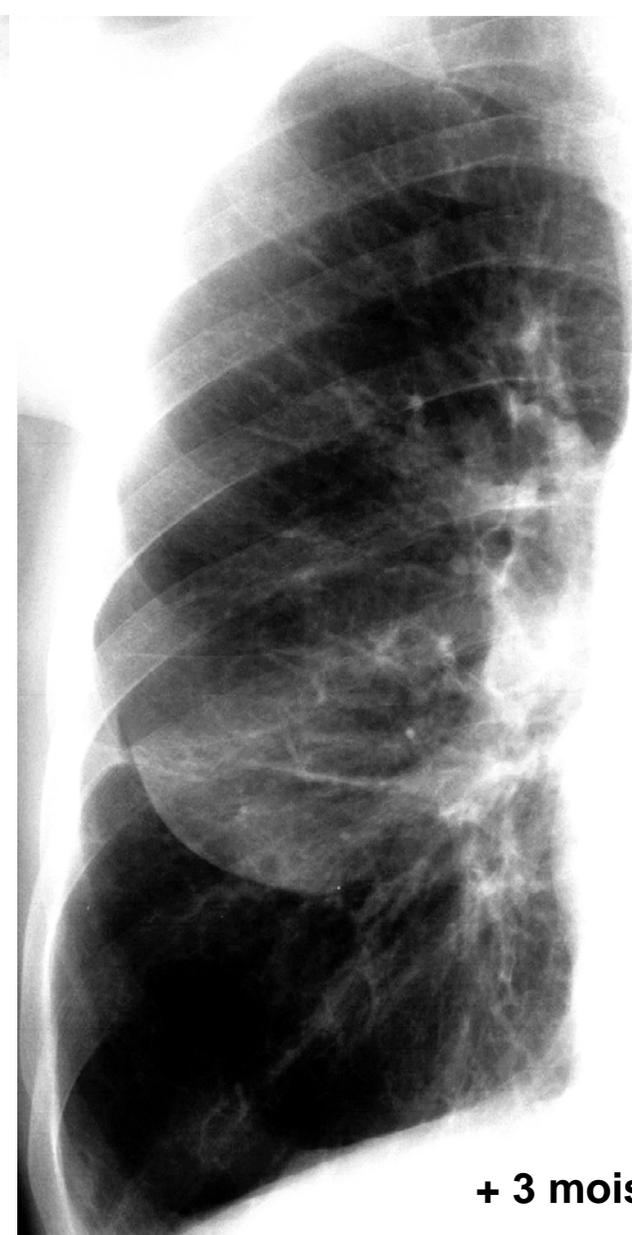


ABCES : évolution



+ 7 jours

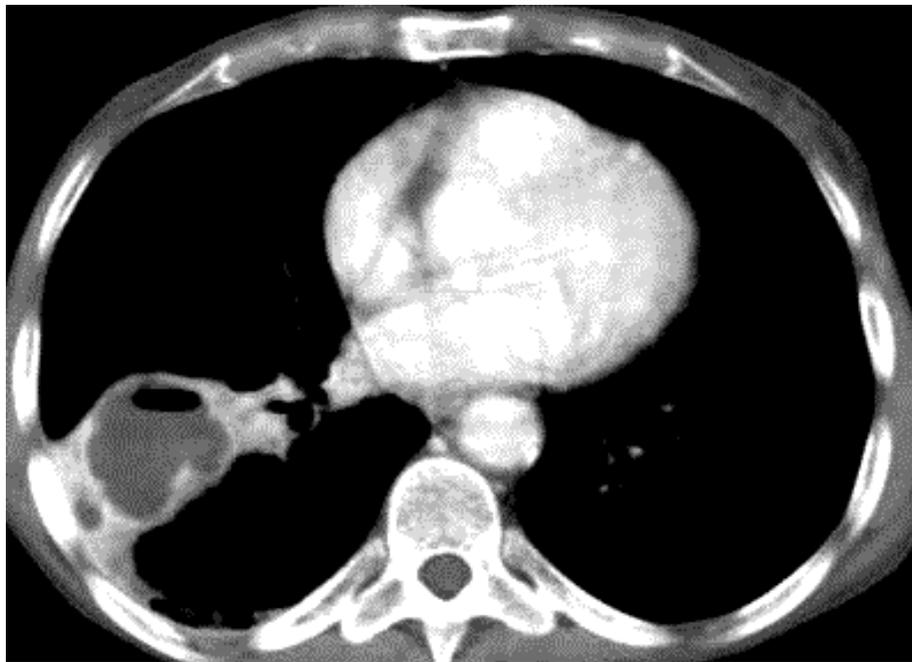
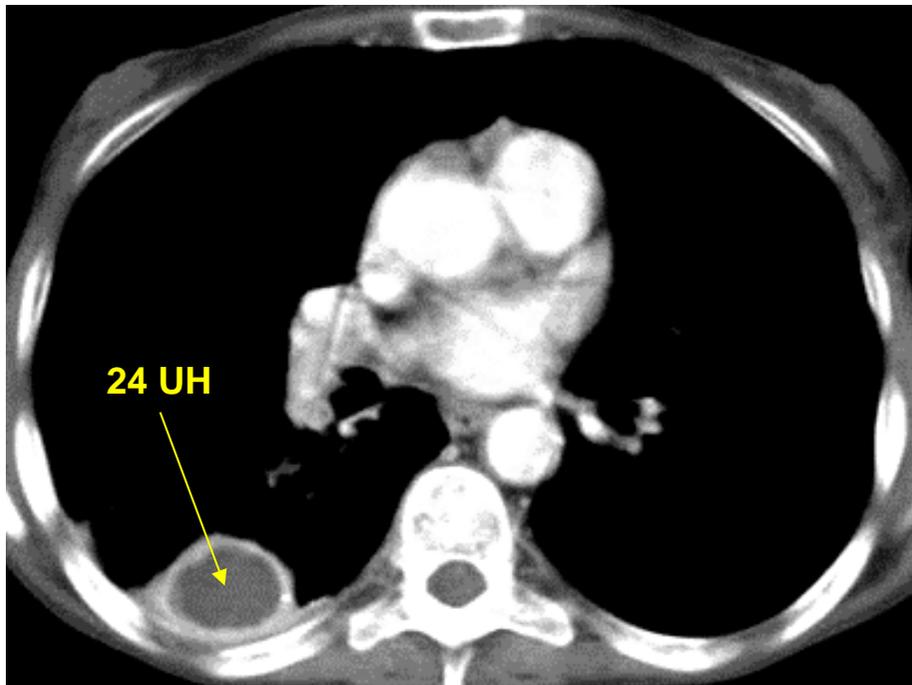
cavitation



+ 3 mois

cicatrice

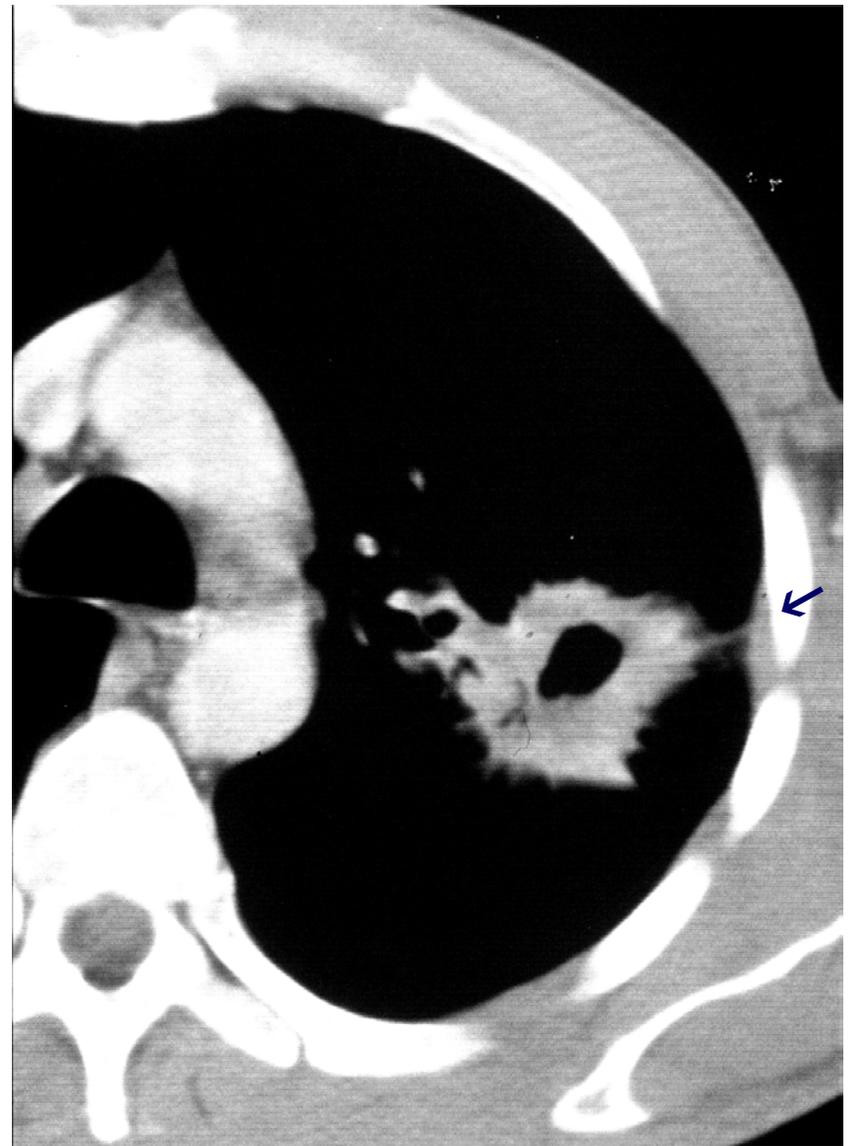
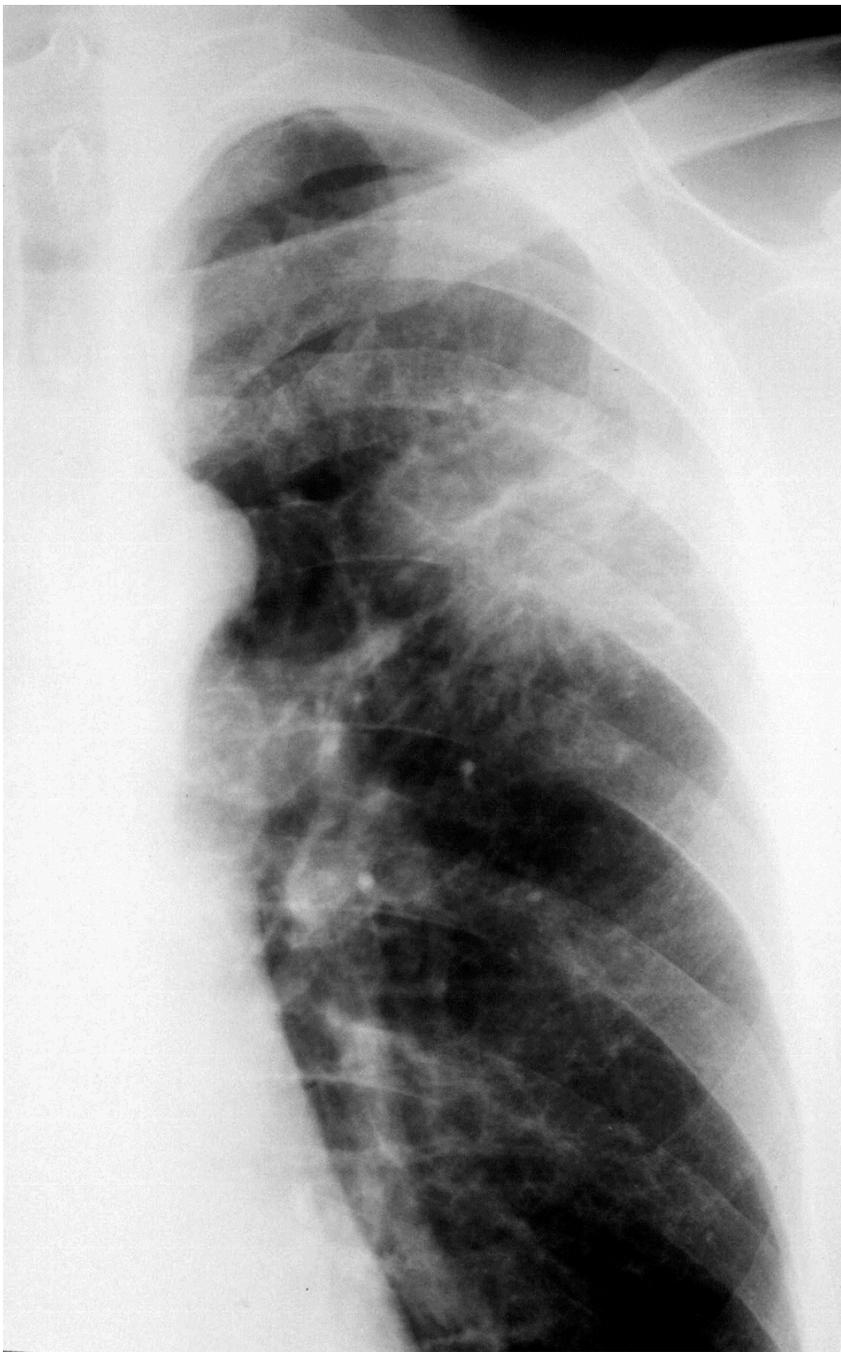




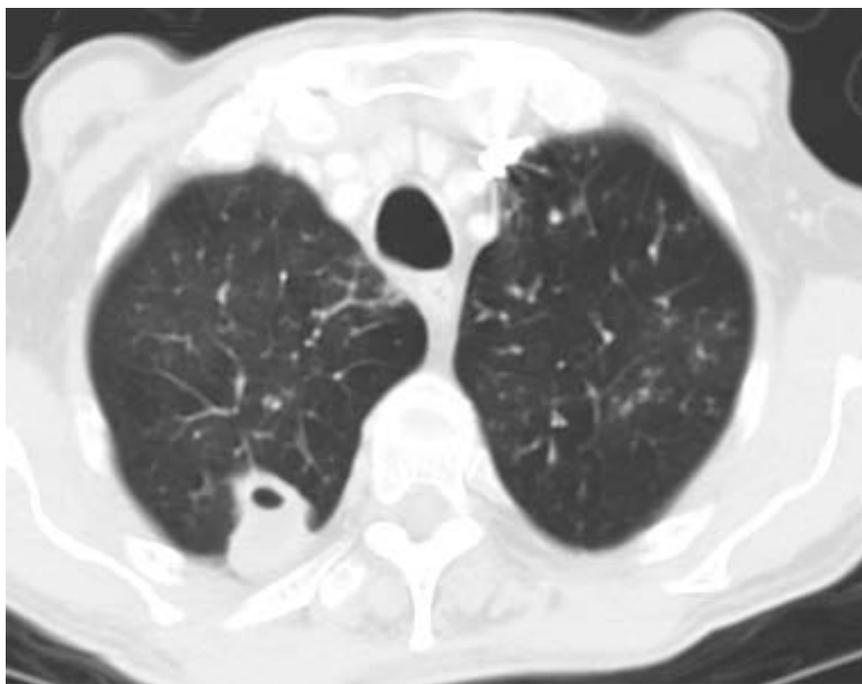
ABCES



- cavitation / nécrose
- rehaussement périphérique en couronne



CANCER BR. : cavitation , " pleural tag "

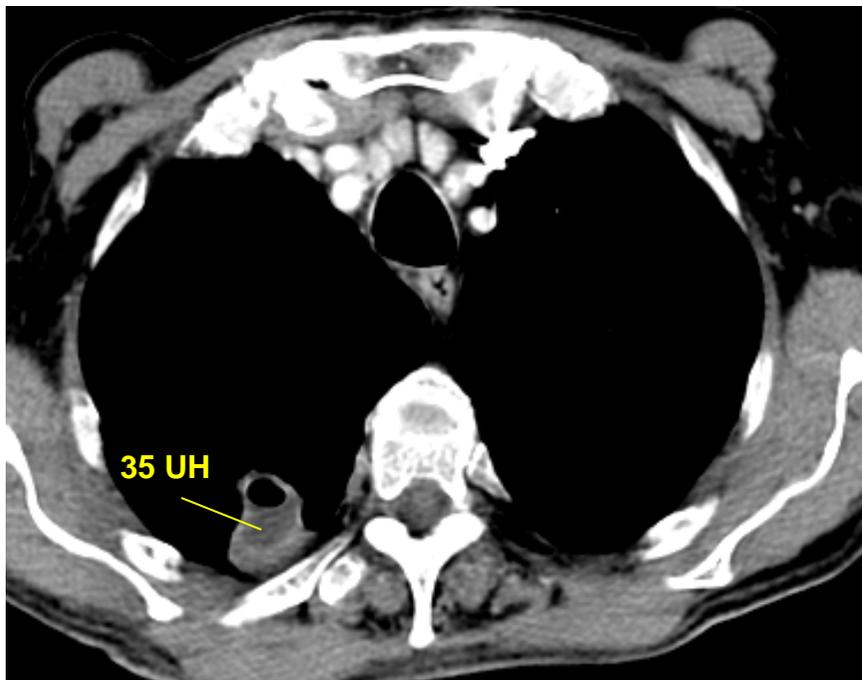


amaigrissement

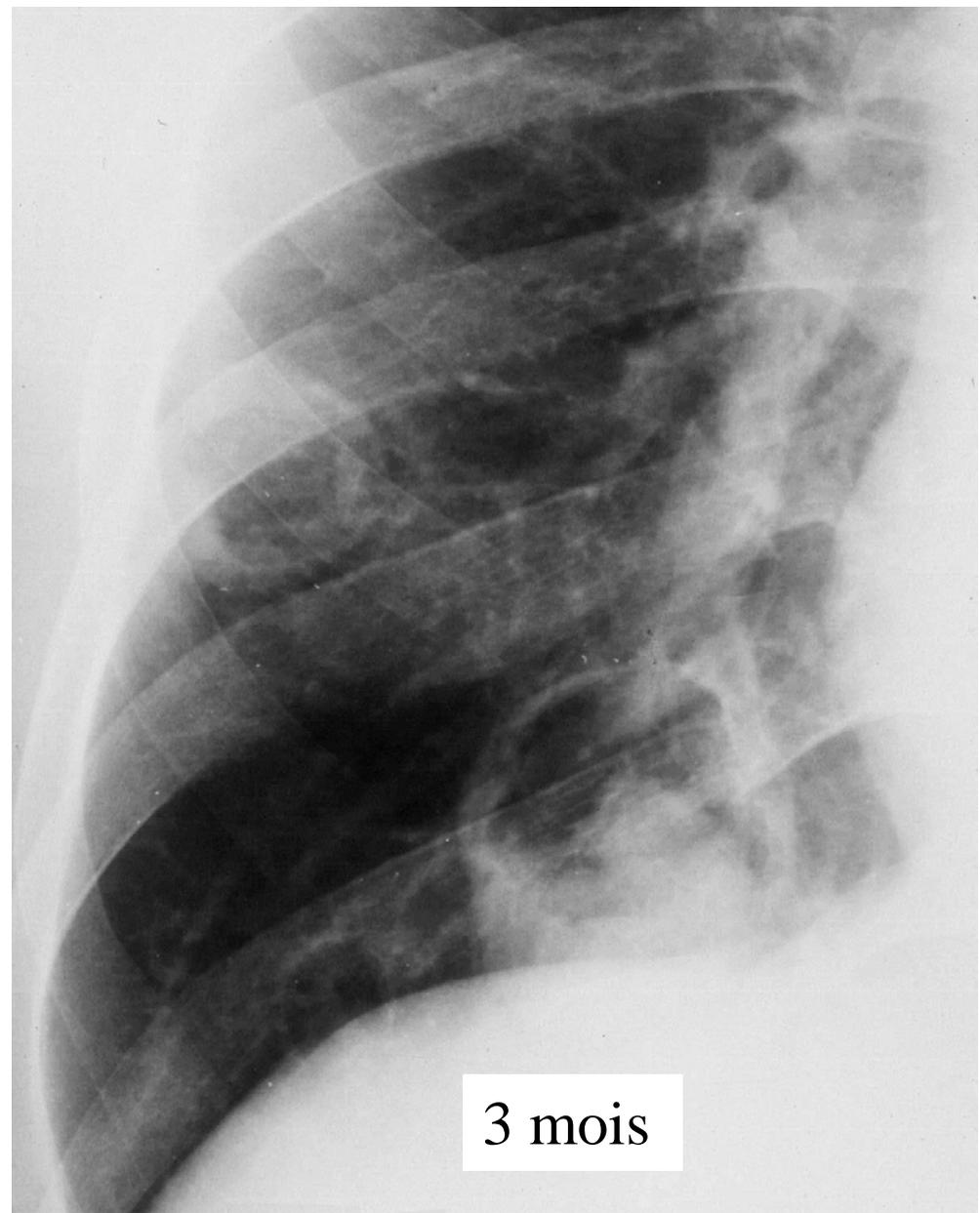
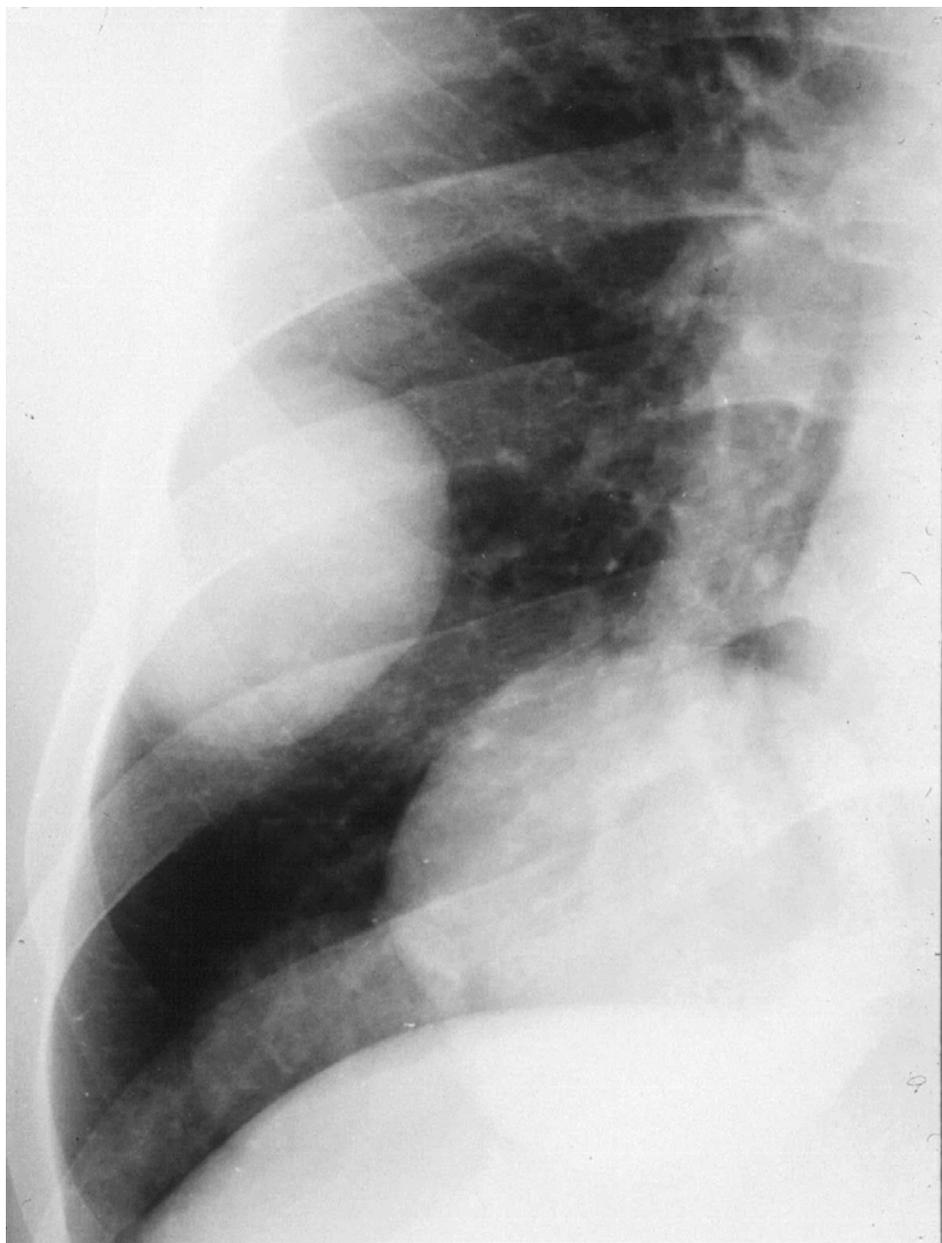
toux

sudations nocturnes

depuis 3 mois



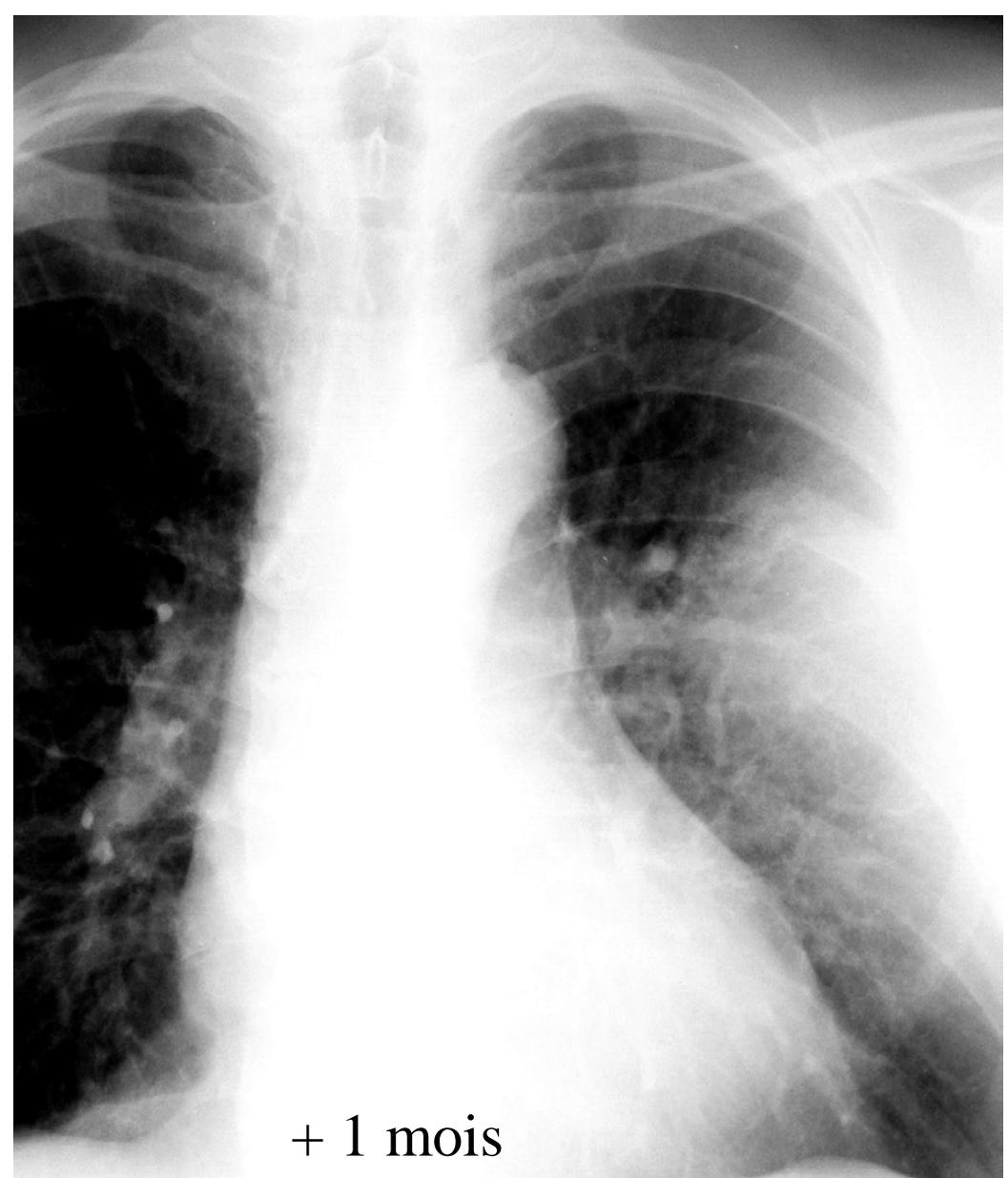
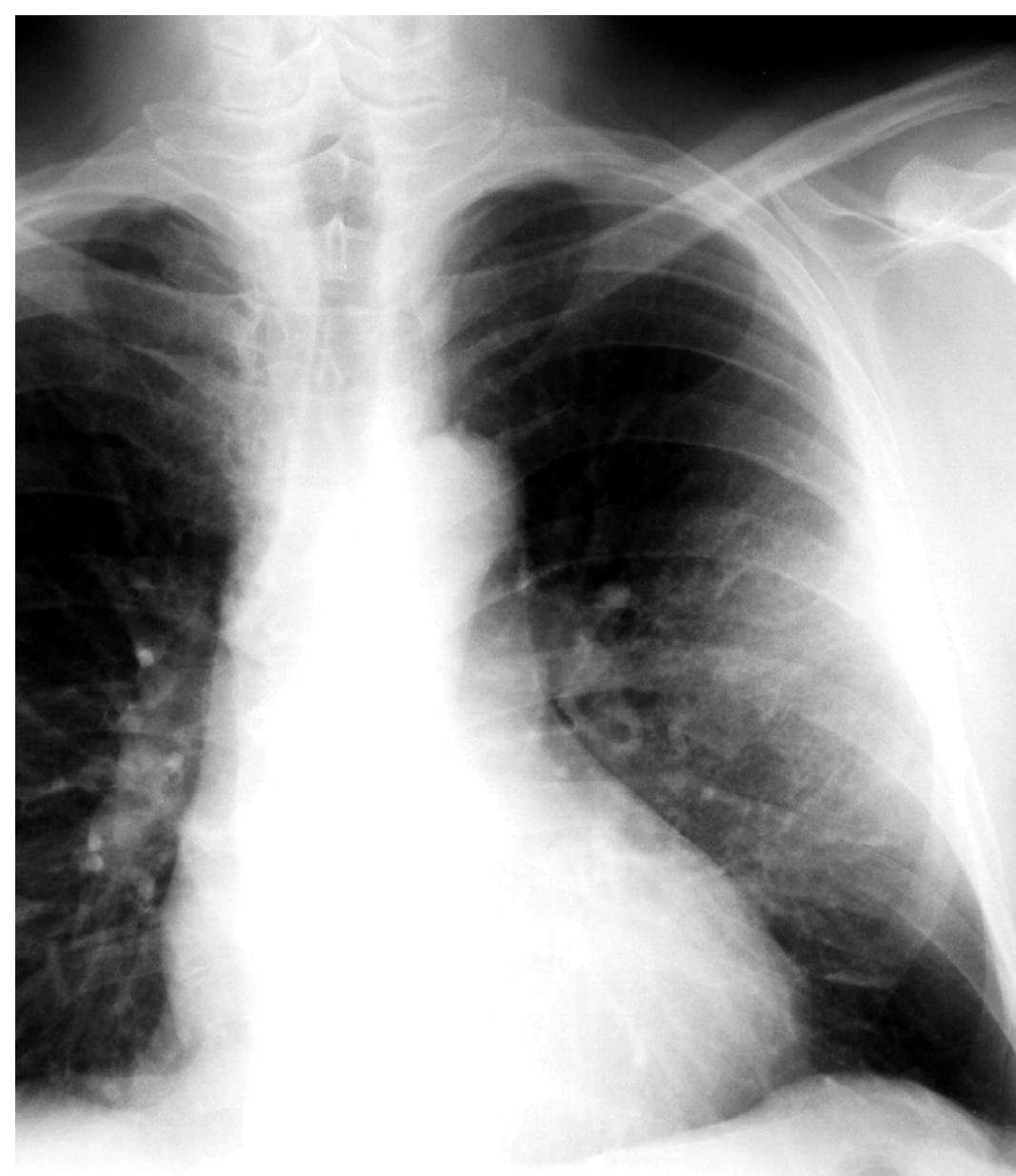
**lésion tuberculeuse
excavée**



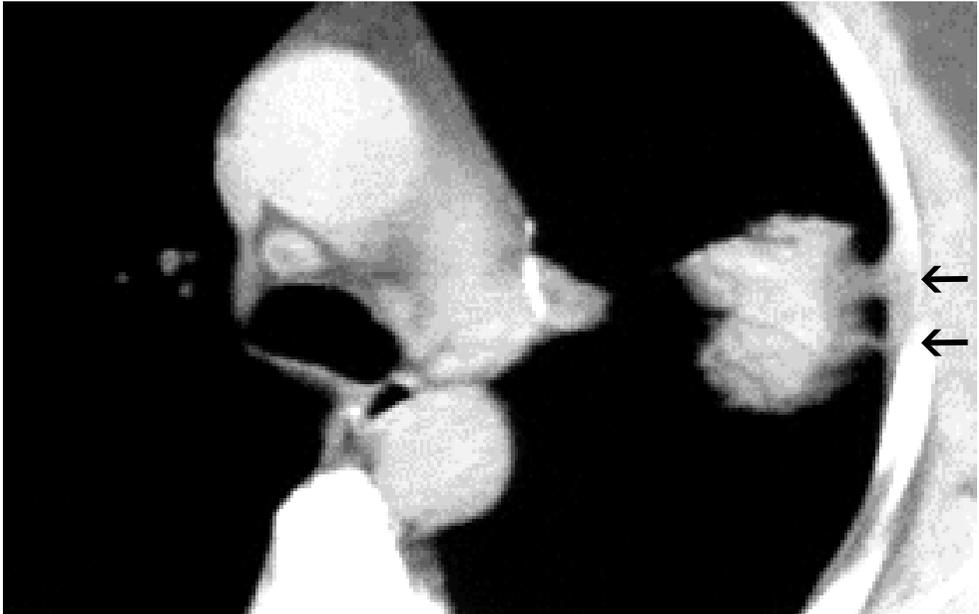
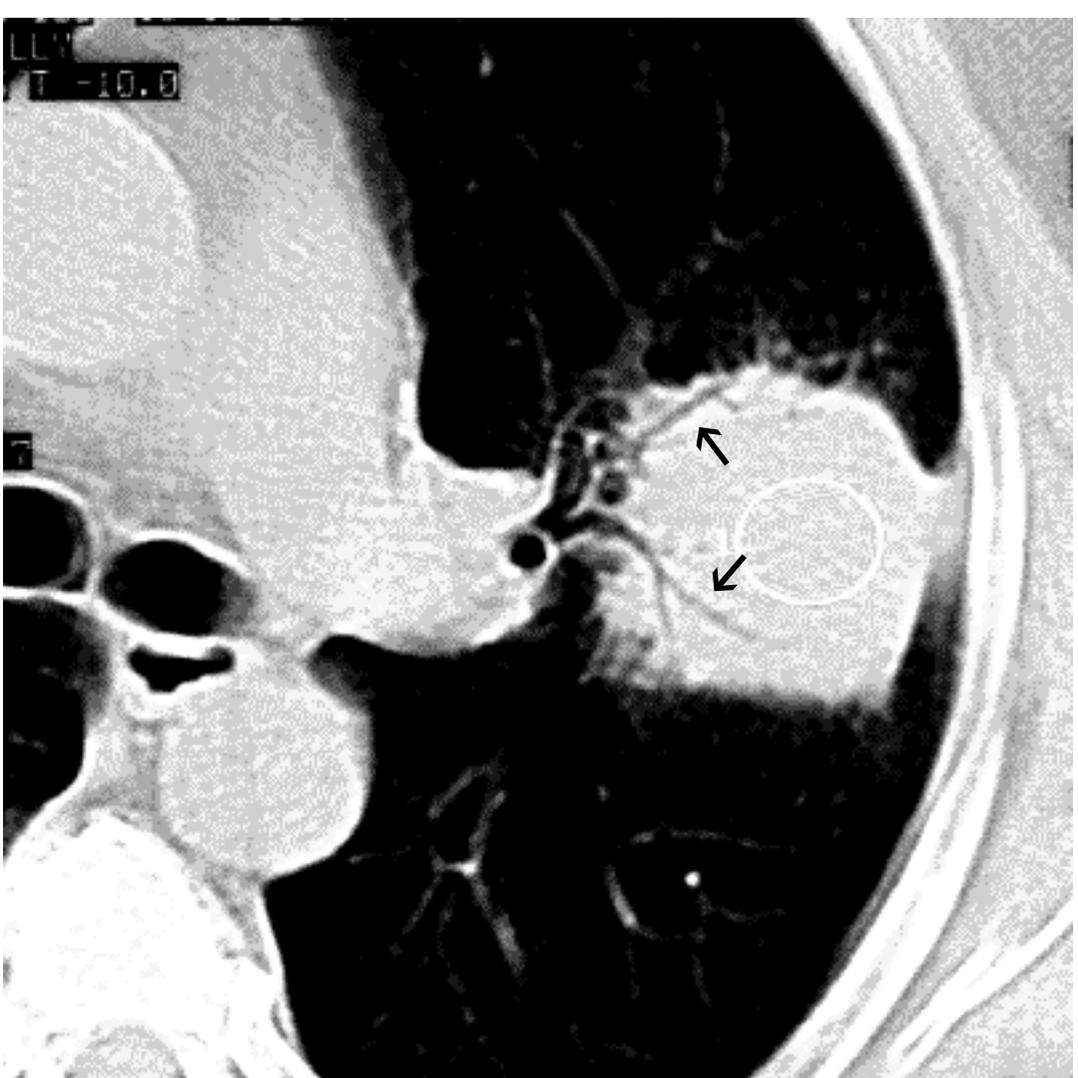
METASTASES → CAVITATION EN COURS DE CHIMIOOTHERAPIE

NP : BRONCHOGRAMME AERIQUE

- **CANCER LEPIDIQUE (CBA)**
 - **CROISSANCE LE LONG DES SEPTA**
 - **ALVEOLOGRAMME AERIQUE**
(PSEUDO-CAVITATION)
- **PNEUMONIE RONDE**
- **LYMPHOME PRIMITIF PULMONAIRE**

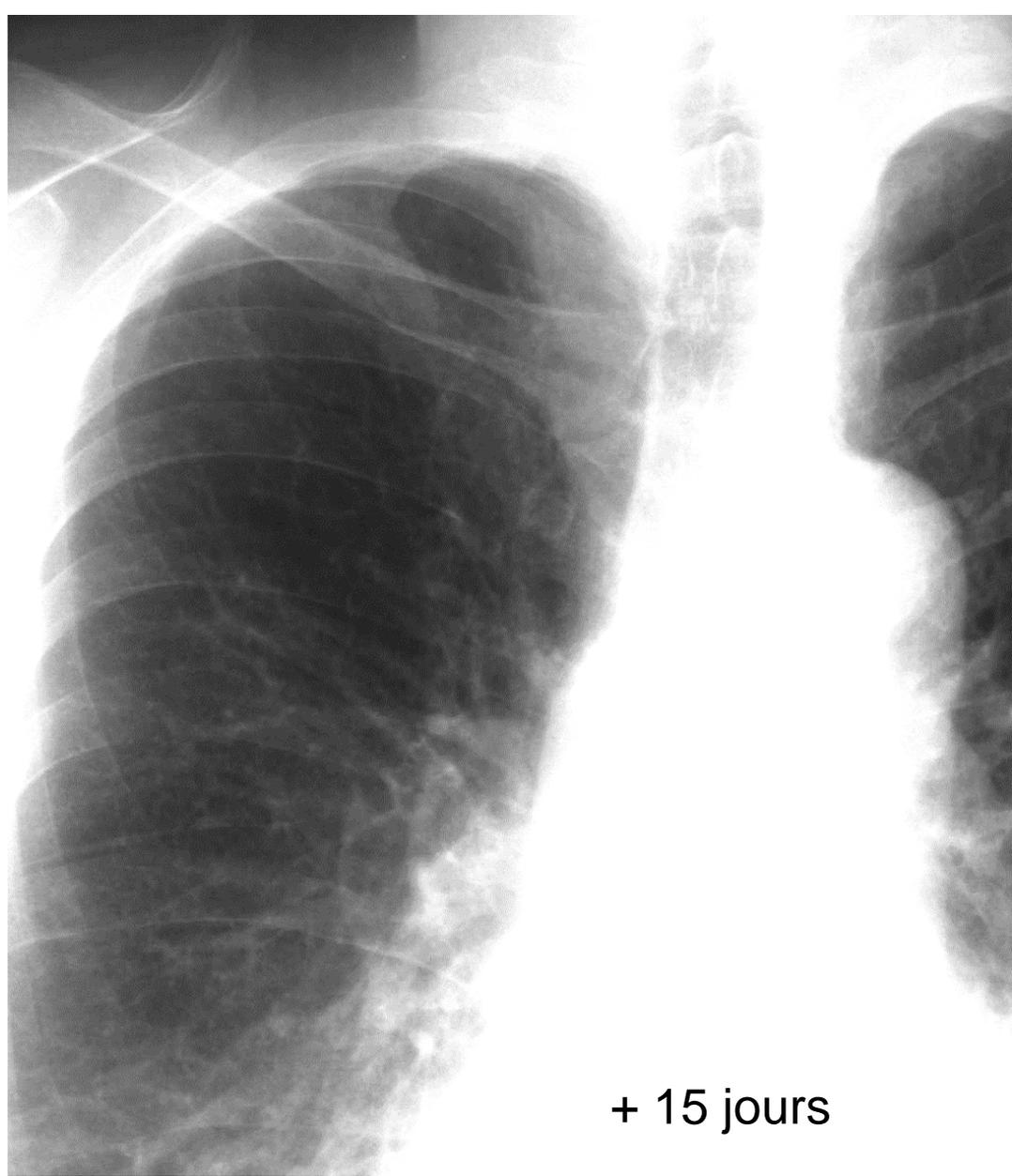


Cancer Lépidique

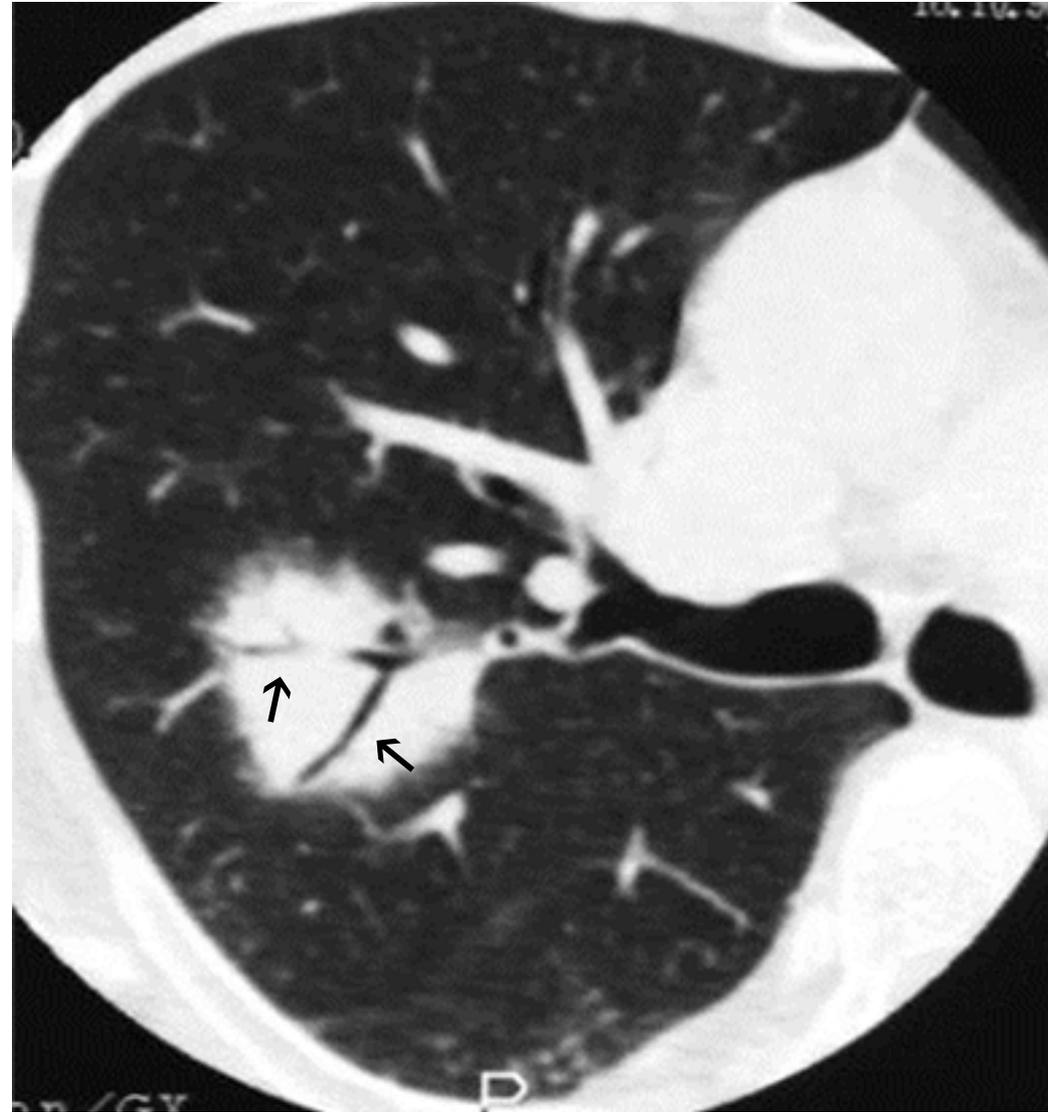
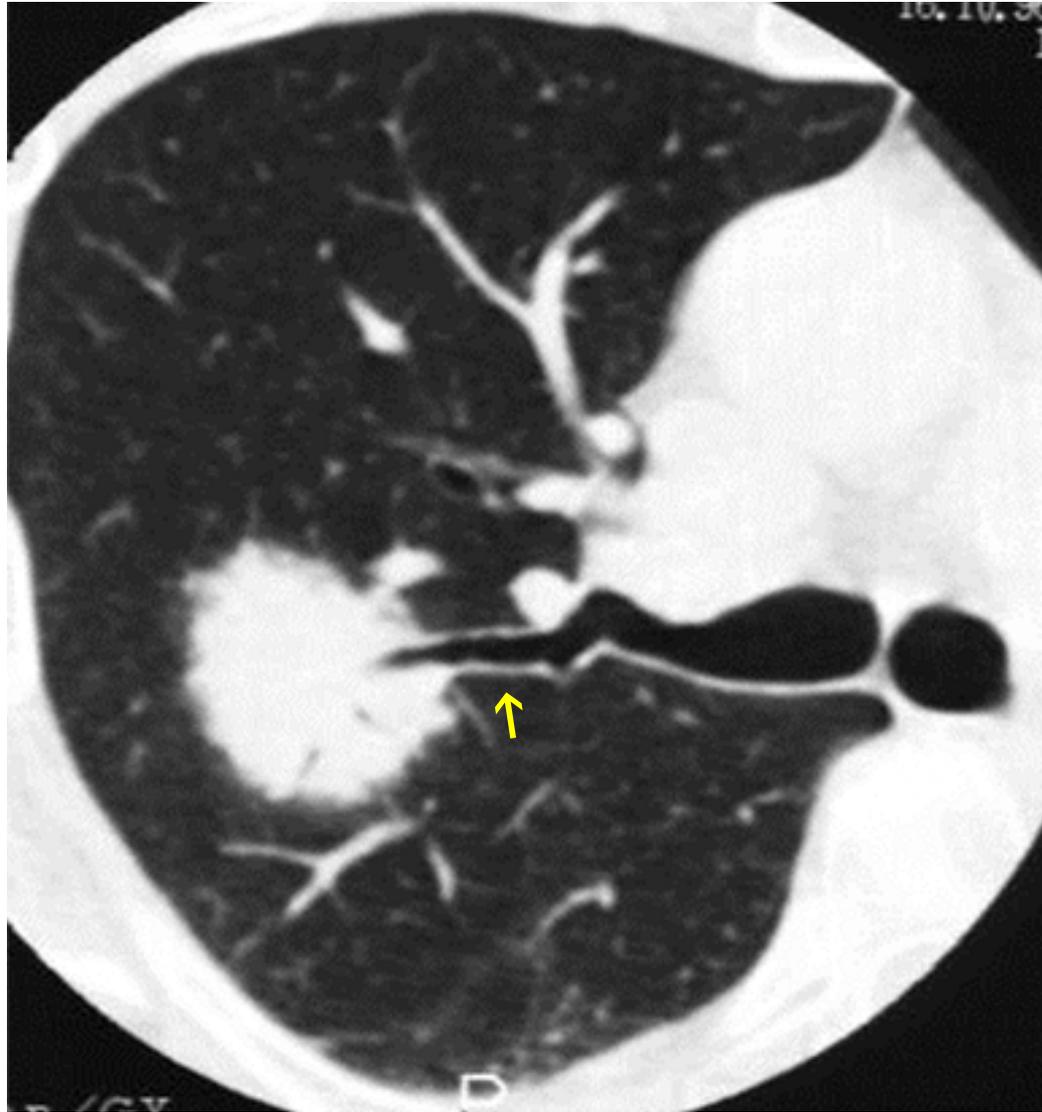


Cancer Lépidique

: BRONCHOGRAMME AERIQUE, " PLEURAL TAGS "



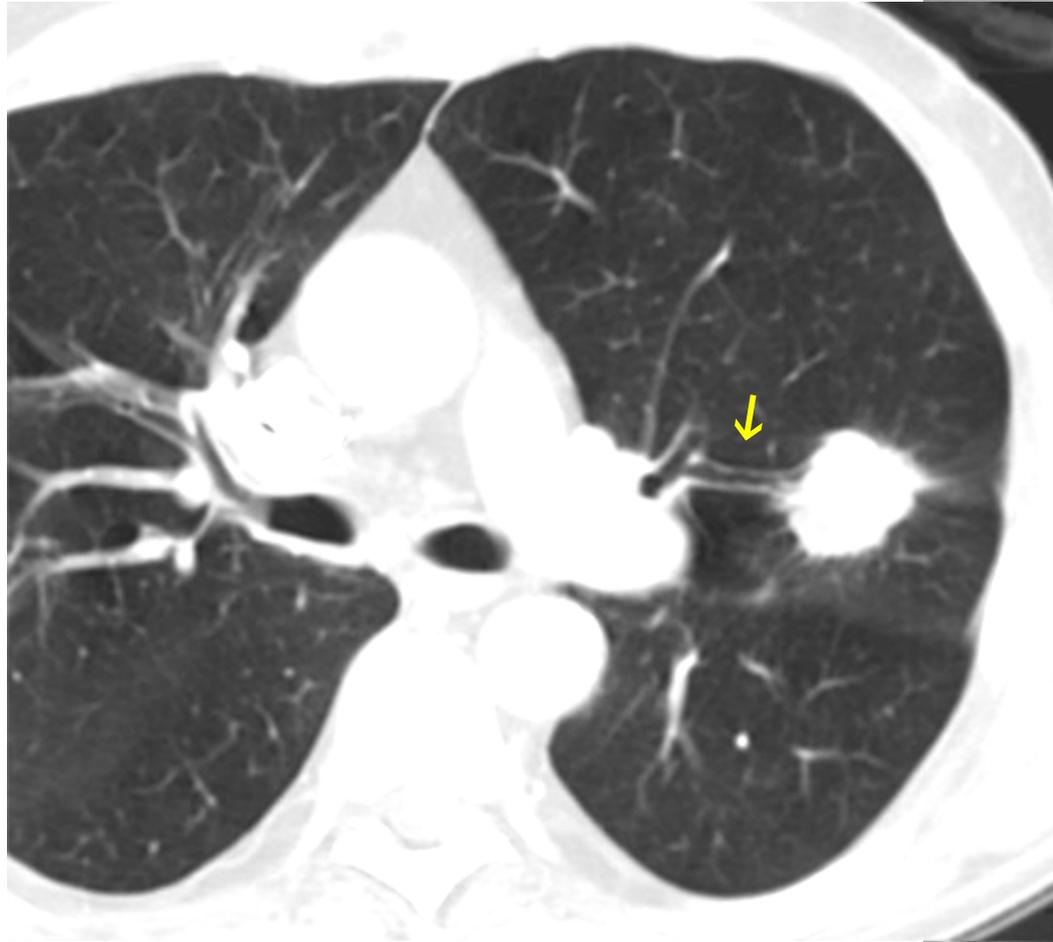
PNEUMONIE RONDE → RESOLUTION



PNEUMONIE RONDE : SIGNE DE LA BRONCHE ,
BRONCHOGRAMME AERIQUE

NP : SIGNE DE LA BRONCHE

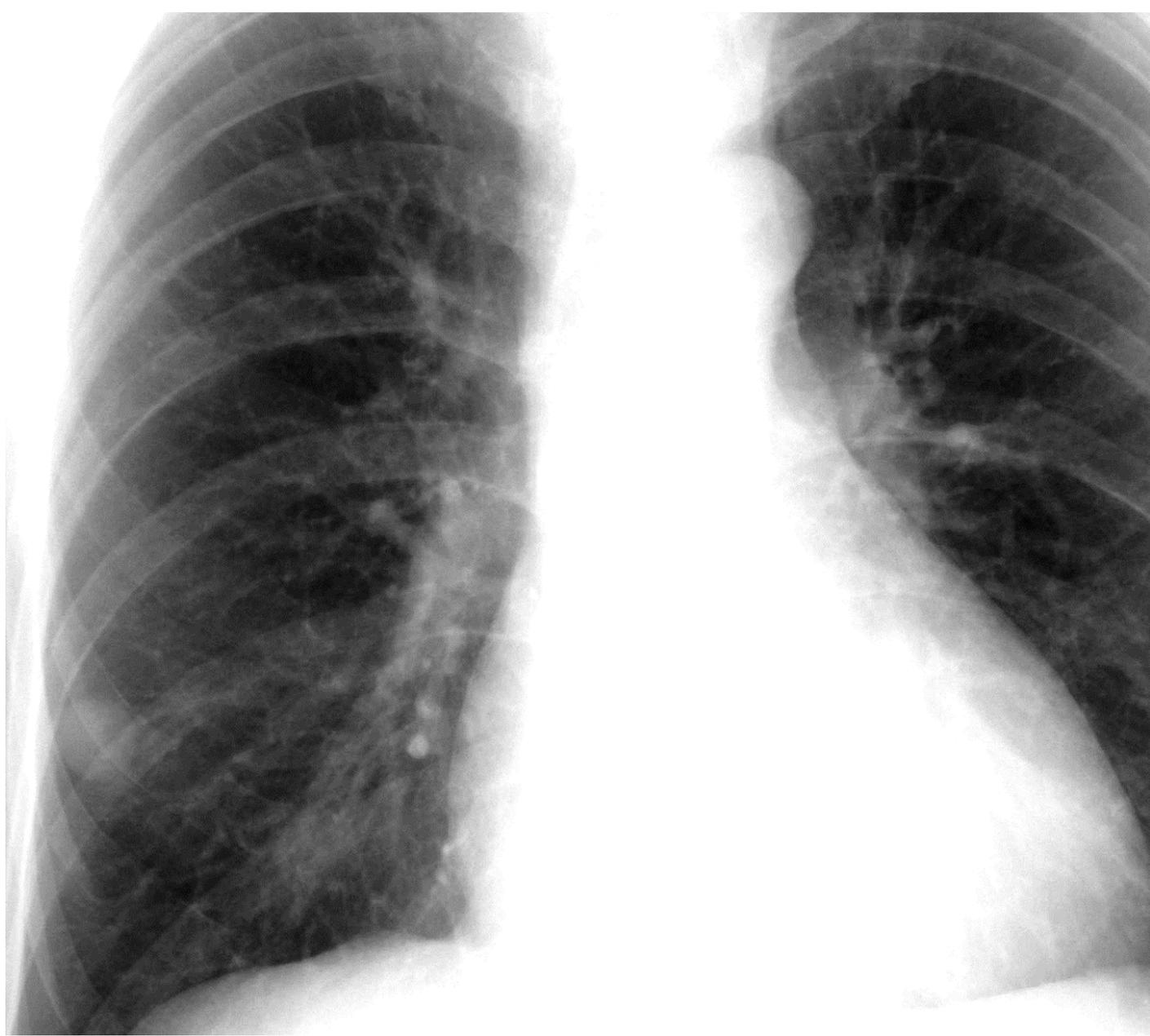
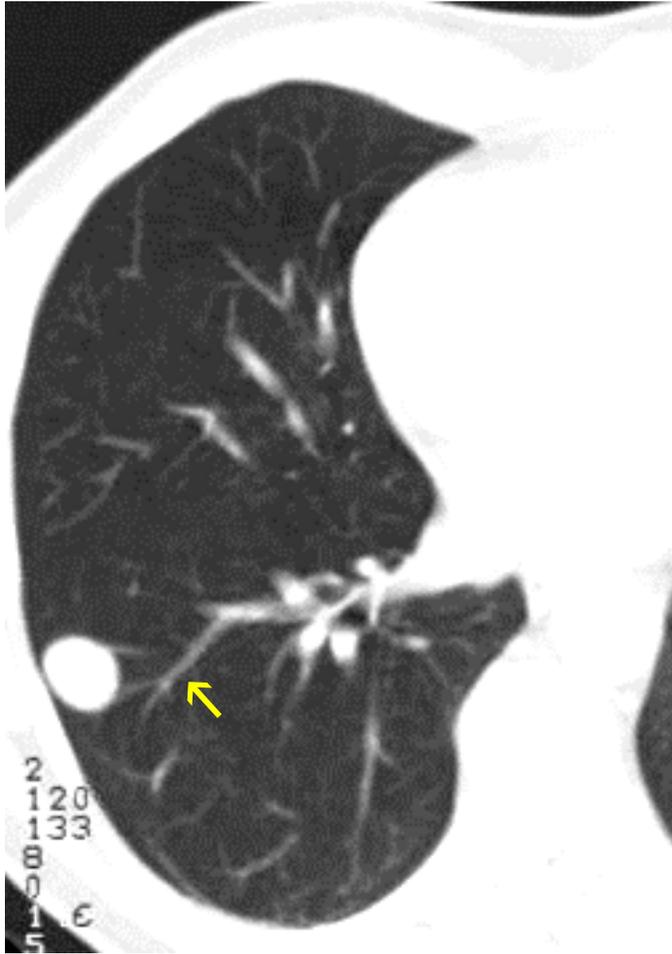
- INTERRUPTION OU PENETRATION BRONCHIQUE
- BENINS et MALINS
- ACCESSIBITE A LA BIOPSIE TRANSBRONCHIQUE



CANCER BR. : spiculé , signe de la bronche

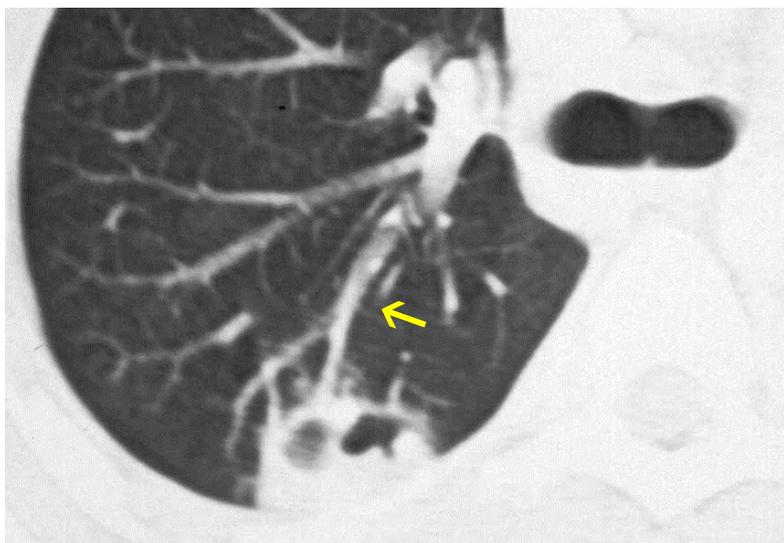
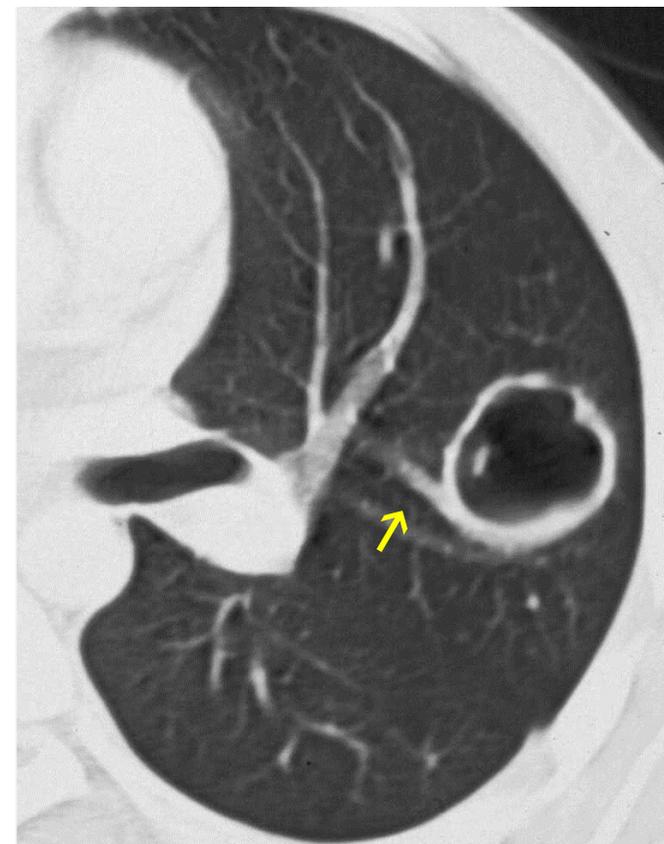
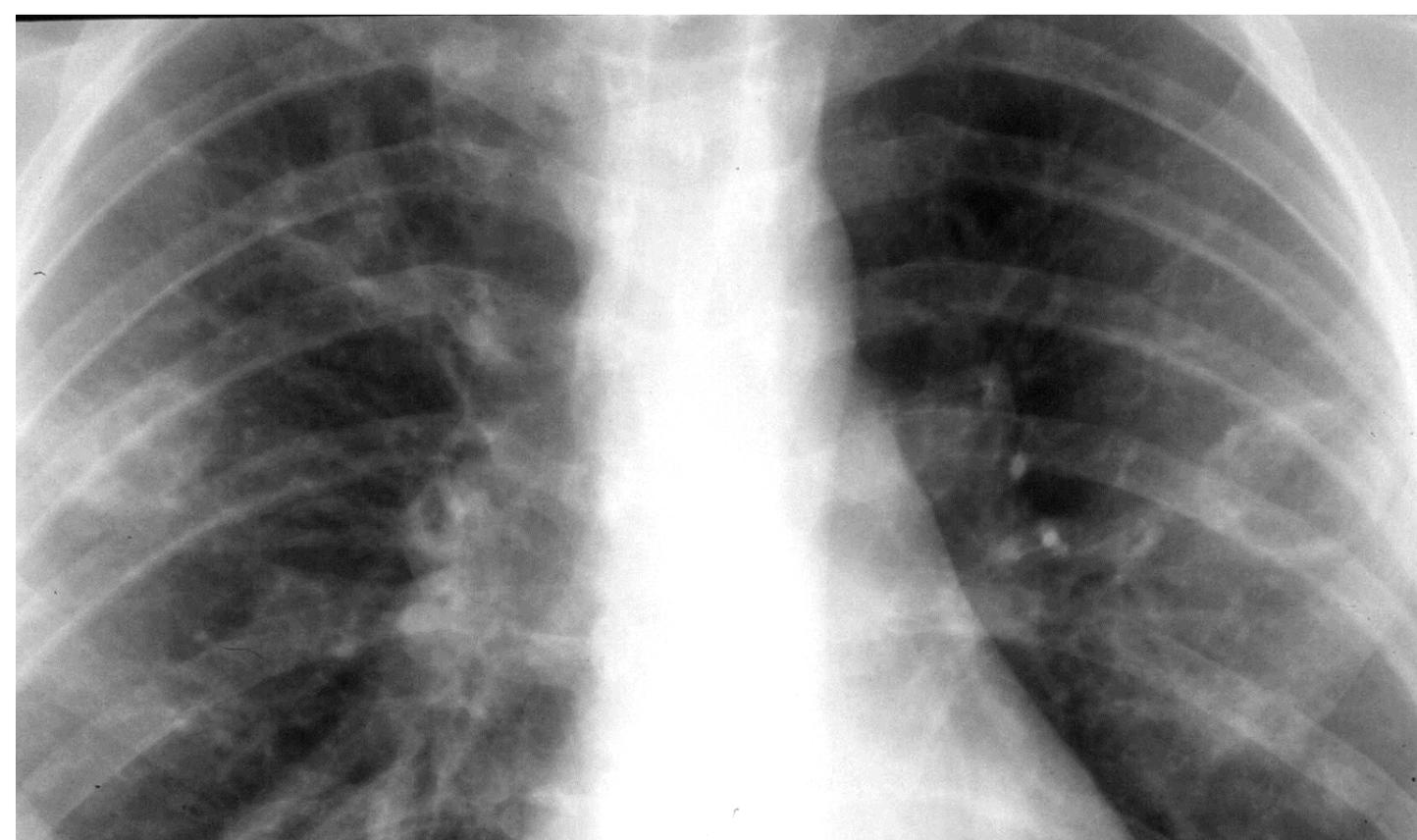
NP : SIGNE VASCULAIRE

- **CONNEXION ARTERIELLE**
- **LESIONS HEMATOGENES**
 - METASTASES
 - EMBOLIES SEPTIQUES (ABCES)
 - INFARCTUS
 - ASPERGILLOSE
- **LESION VASCULAIRE**
 - MALFORMATION ARTERIO-VEINEUSE (MAV)
(image en " comète ")

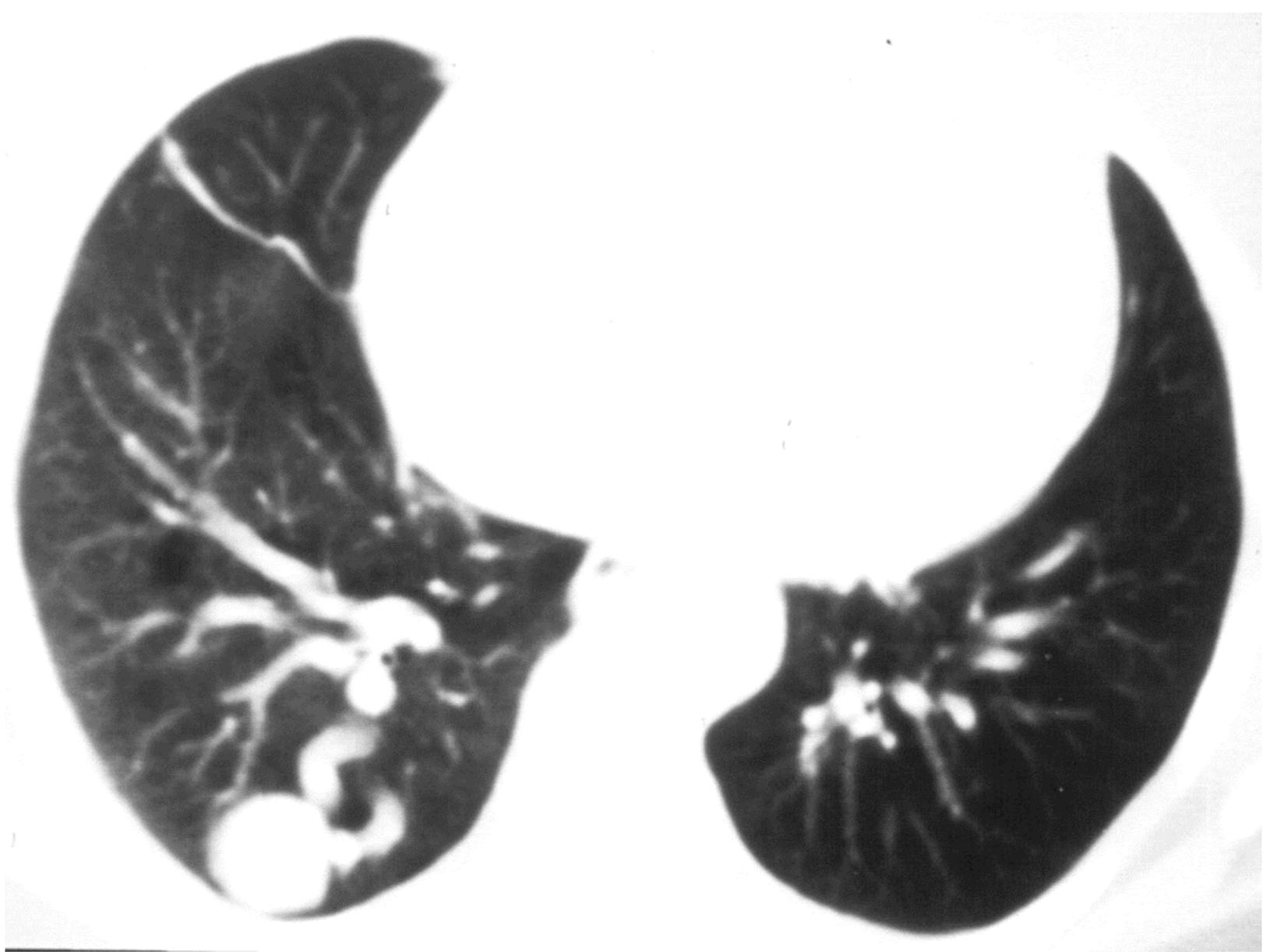


METASTASE : " feeding vessel "

(antécédent de fibrosarcome)



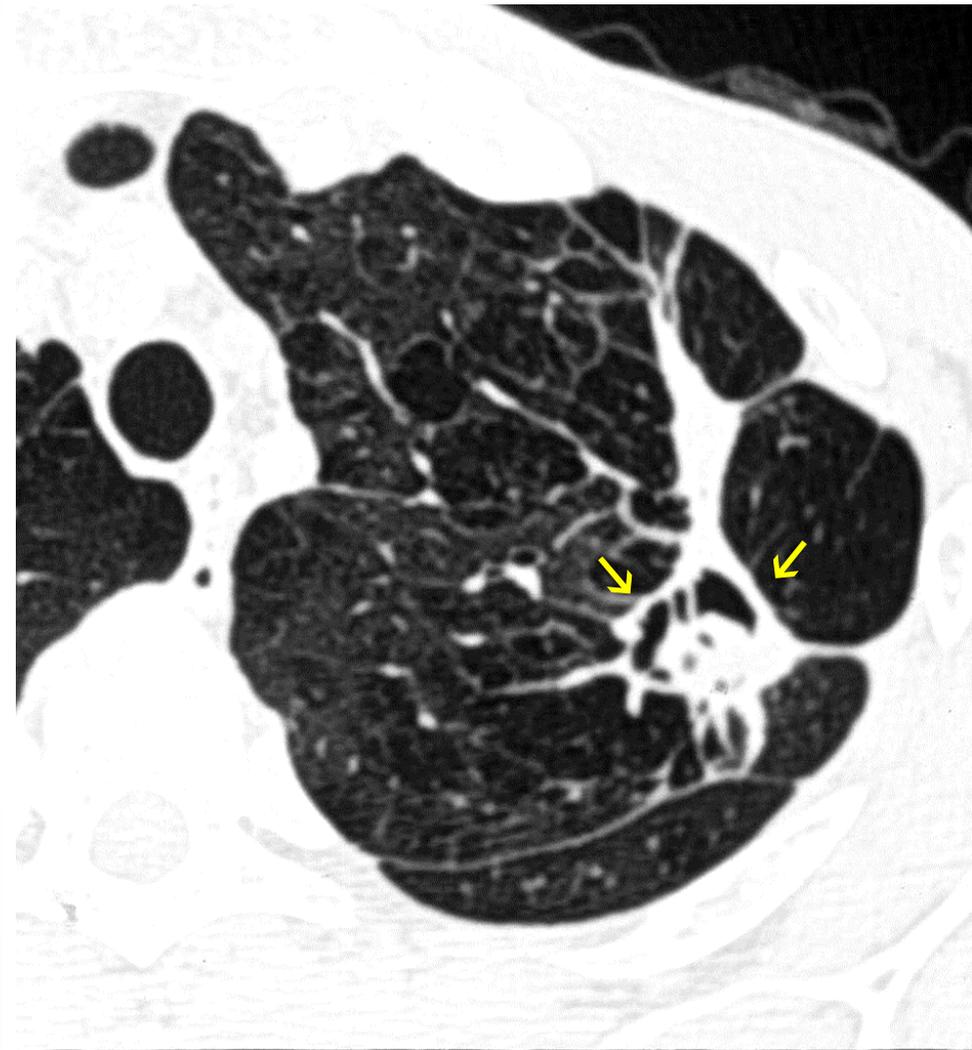
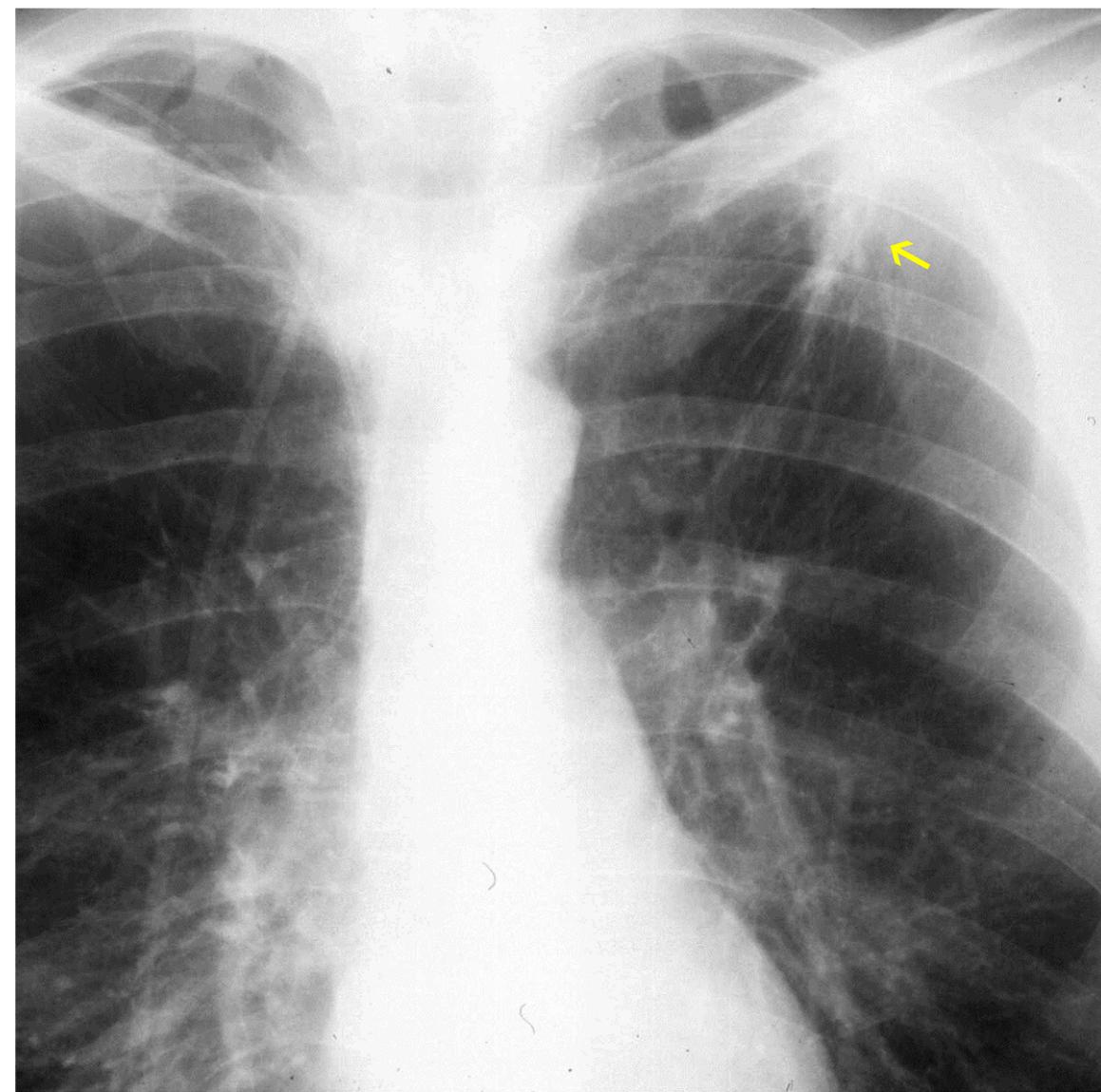
EMBOLIES SEPTIQUES (ABCES) :
cavitation , connexion vasculaire



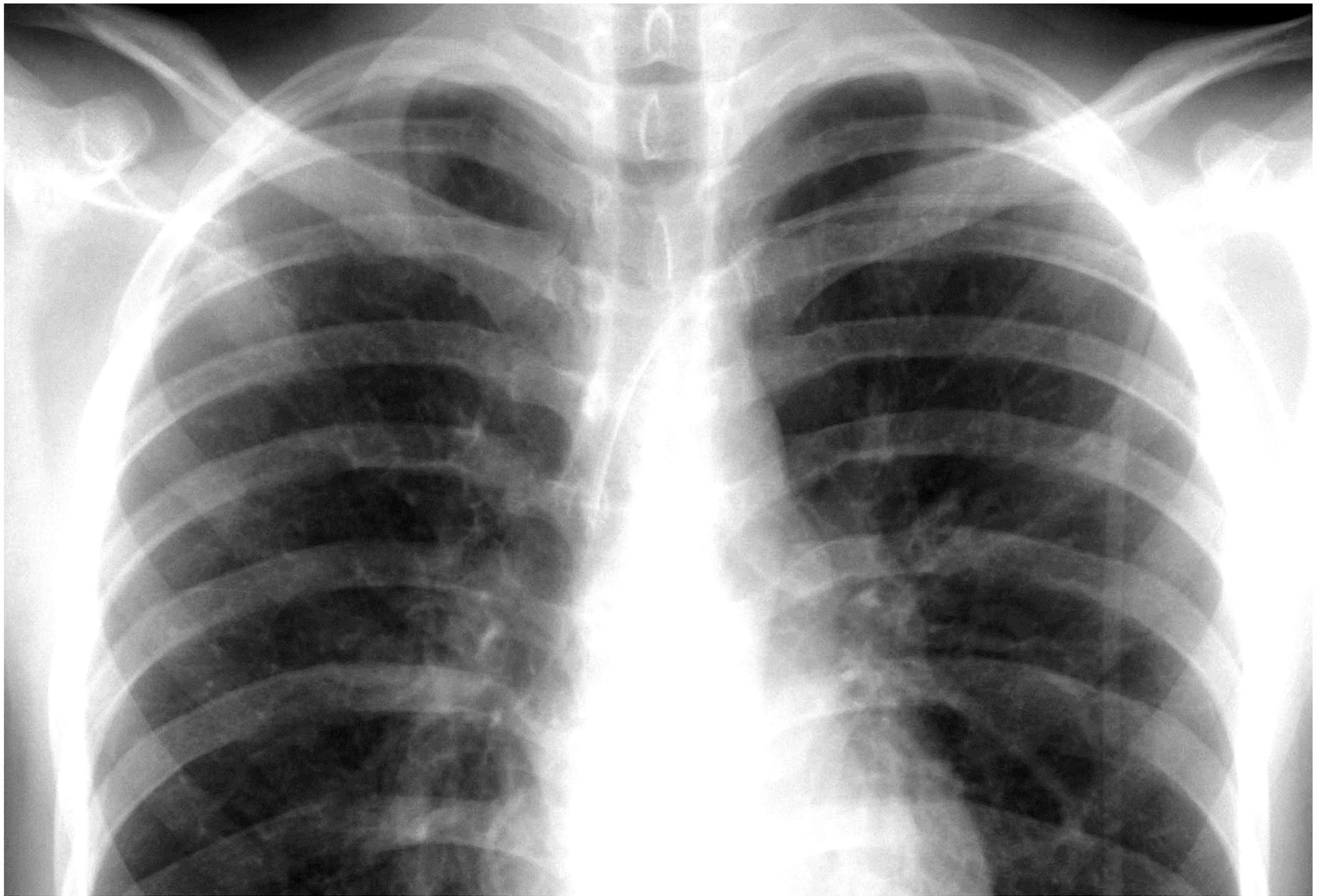
MALFORMATION A-V : image en " comète " , perfusion basale droite ➡

SIGNES PARENCHYMATEUX PERI-NP.

- **CROISSANT AERIQUE** - ASPERGILLOME
- **HALO**
 - ASPERGILLOSE
 - (METASTASE , CANCER)



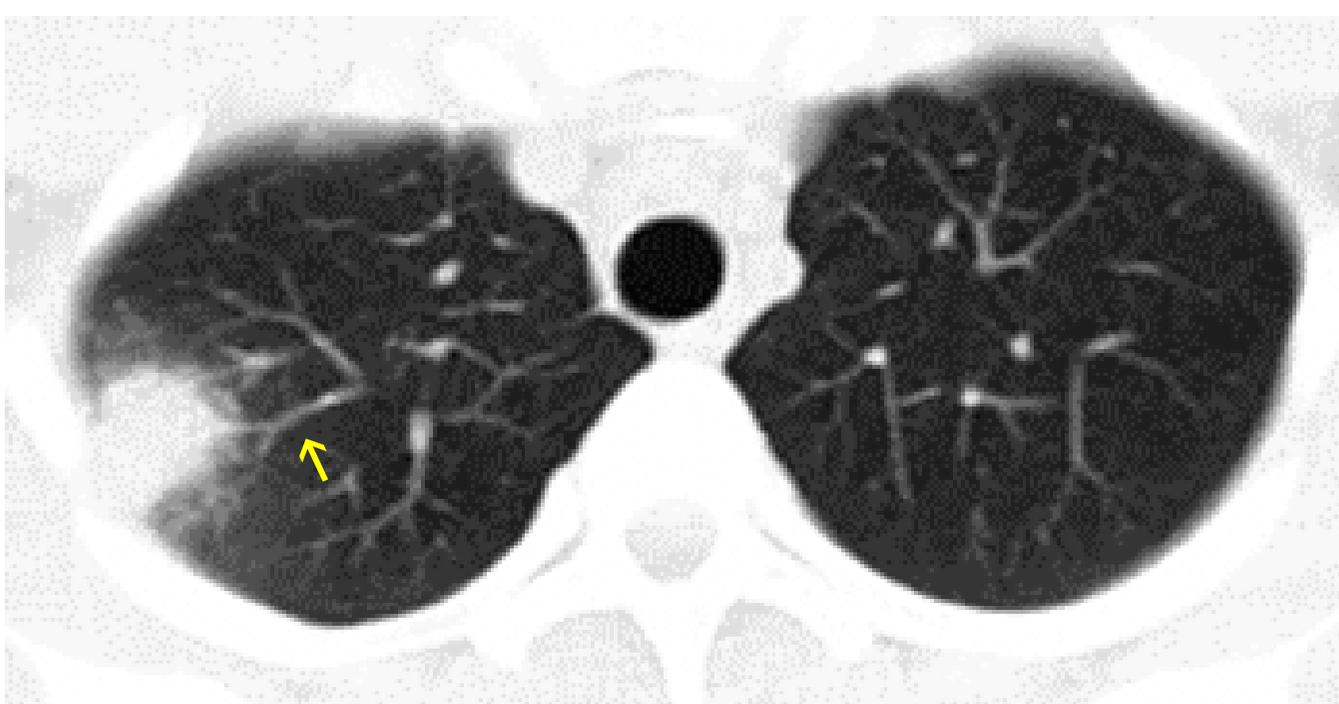
ASPERGILLOME INTRA-CAVITAIRE : signe du CROISSANT AERIQUE



NP (patient immunodéprimé , fébrile)

ASPERGILLOSE (invasive)

- Connexion
vasculaire

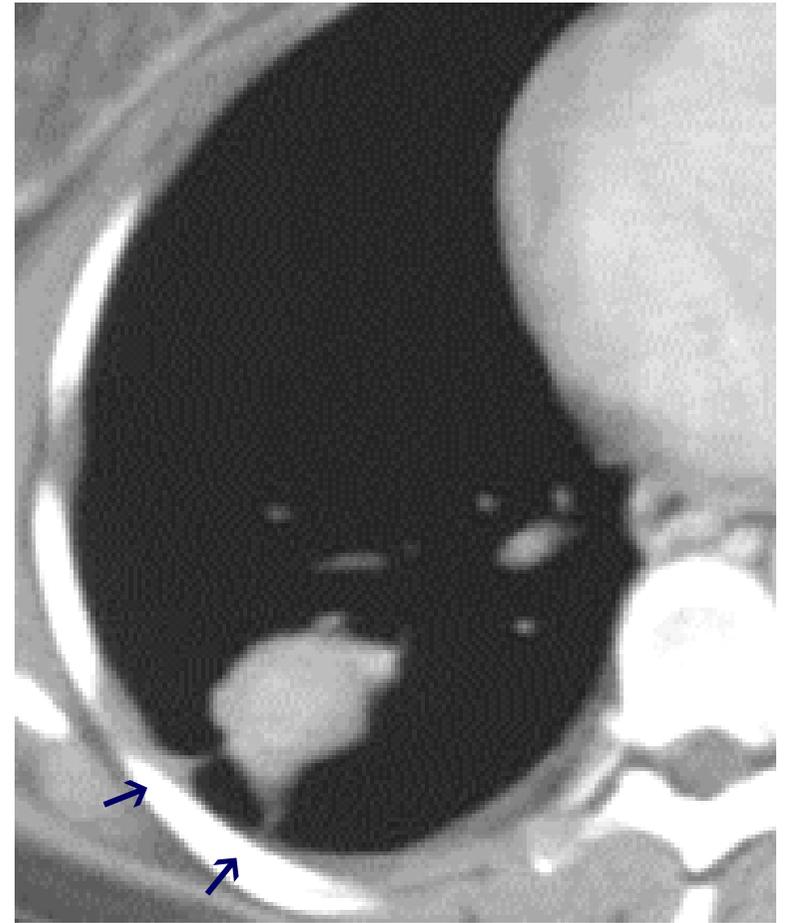
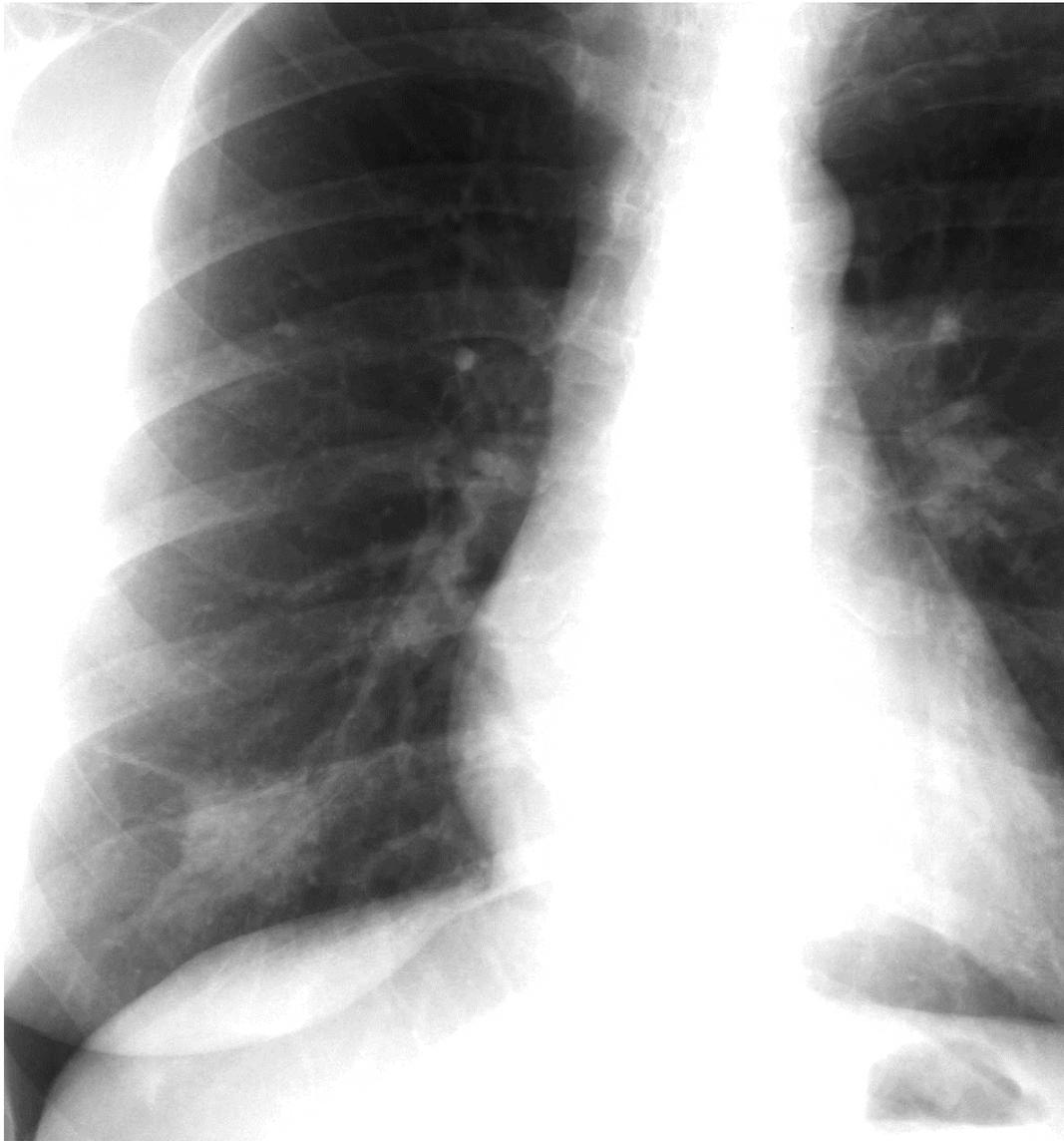


- Signe du halo
en " verre dépoli "



NP : SIGNES PLEURAUX

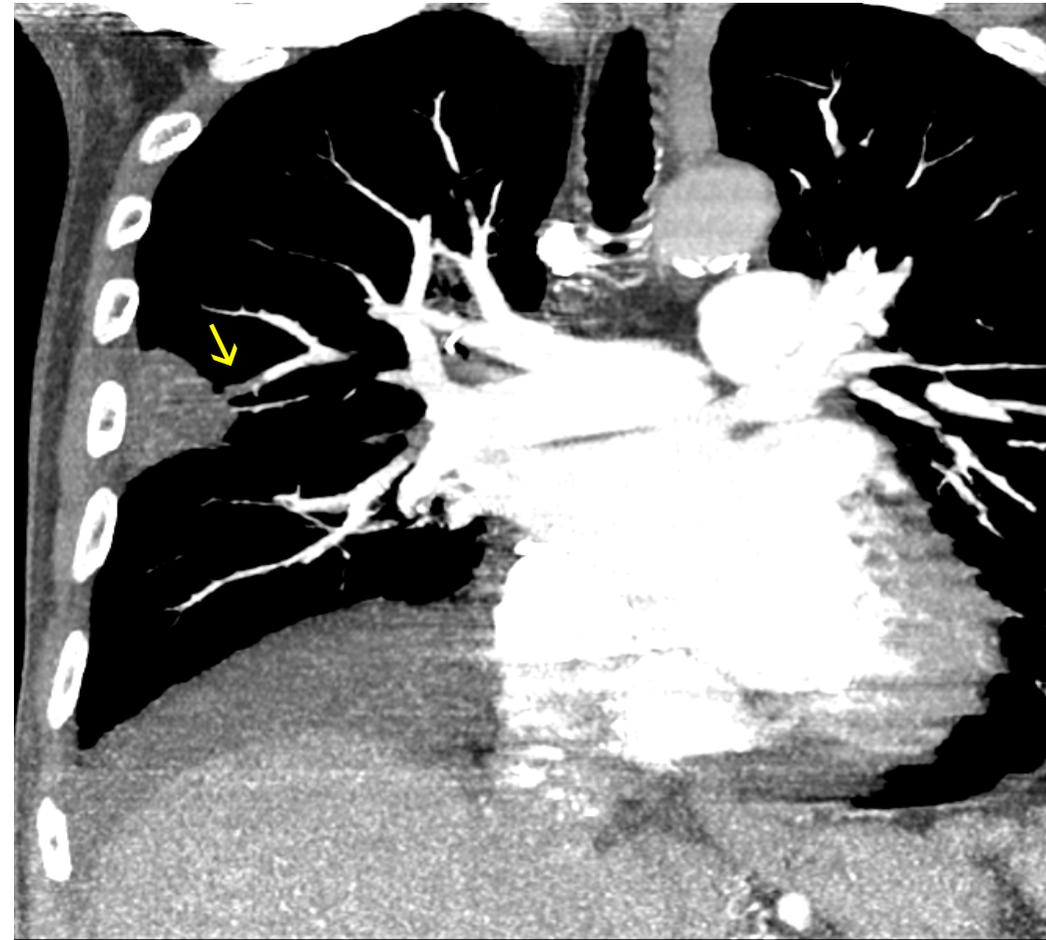
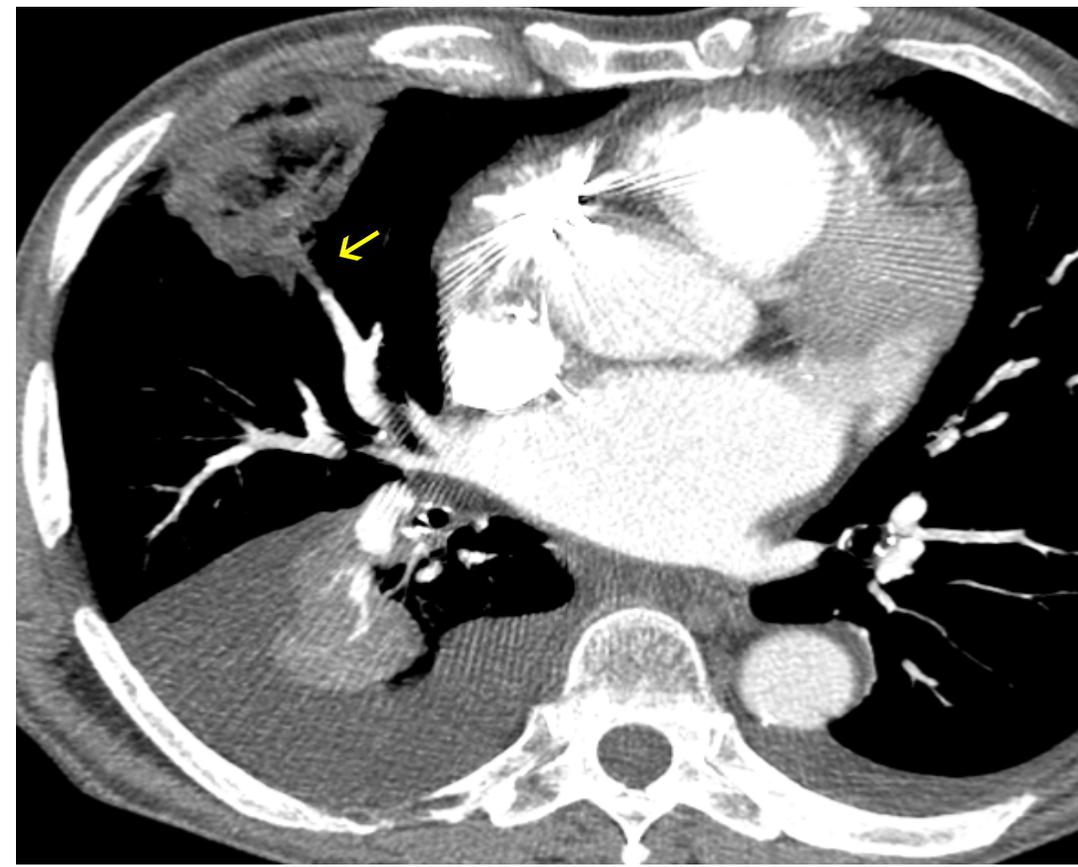
- **" PLEURAL TAGS "**
 - **CANCER BRONCHIQUE**
 - **(GRANULOME TBC.)**
- **BASE PEURALE**
 - **INFARCTUS PULM.**
 - HAMPTON'S HUMP**
 - EMBOLE : TDM AVEC CONTRASTE IV**



CANCER BRONCHIQUE → "pleural tags"



Douleur brutale basi-thoracique bilatérale la veille + dyspnée progressive



EMBOLIES PULM. → INFARCTUS

- **base pleurale ("Hampton's hump")**
- **(cavitation)**

ANGIO TDM
→ **connexion vasc. + embole**

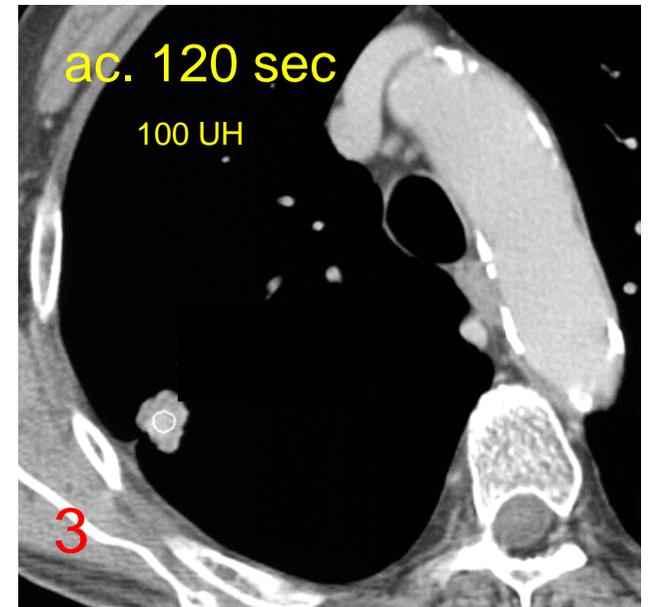
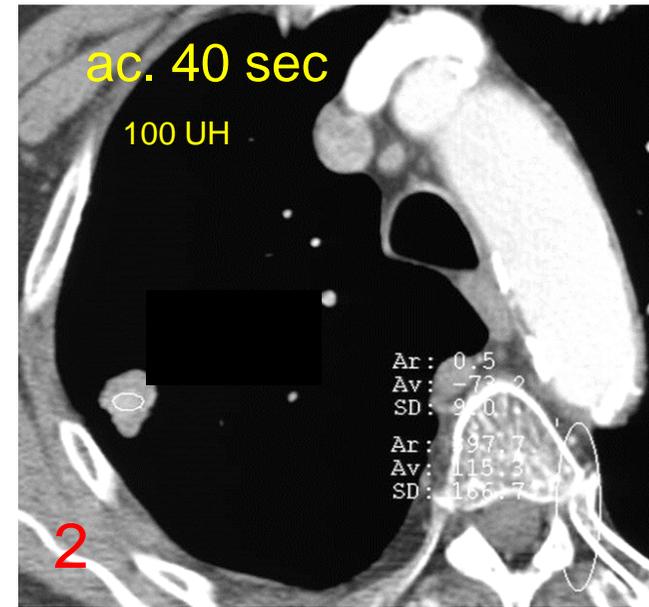
MPR frontal

NP : EVALUATION **TDM** FONCTIONNELLE

- INJECTION IV DE PRODUIT DE CONTRASTE
- NODULE INDETERMINE
 - REHAUSSEMENT - < 10 UH **BENIN** (MALIN)
 - > 40 UH **MALIN** (10% BENIN)
 - ++ MAV, TUM. CARCINOÏDE,
METASTASE (MELANOME)



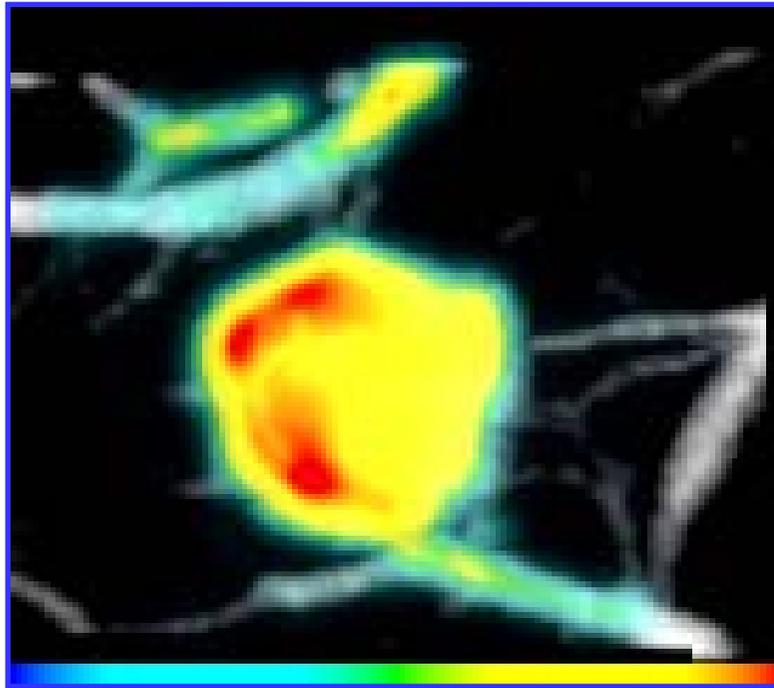
NODULE : spiculé



TDM
FONCTIONNELLE

rehaussement : 68 UH

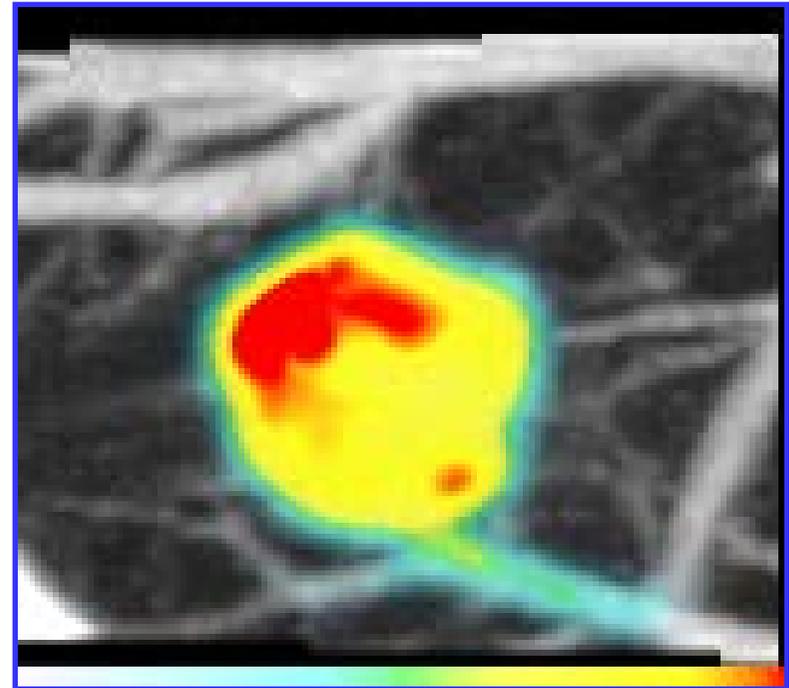
CANCER BRONCHIQUE



maximum slope

0 HU / sec

35 HU / sec



peak enhancement

0 HU

250 HU







Performance du PET-FDG

	Nodules benins	Nodules malins	Sensibilité	Spécificité
• Kubota et al	12	10	83	90
• Duhaylongsod et al	59	28	97	81
• Bury et al.	33	17	100	88
• Knight et al.	32	16	100	63
• Gupta et al.	45	16	93	88
• Lowe et al.	120	7	96	77
• Lowe et al.	60	30	92	90
• Total	361	194	95	81

CAD: Détection et quantification

Review **Analysis**

CT Viewer Lung Nodule Assessment

Archive Manager

Delete Quick Film Copy To

Sub-selection

B40 CHEST USER MEETING 2012 UCL ST.Luc
 AMET F/26Y Philips, Brilliance 40
 4 18 May, 2012 12:52:15.46
 120 kV
 FOV 343.0 mm
 SW 5.00 mm
 Z 118

10 cm

MIP
 C -442
 W 1969

1. Detection

Show Lesions
 Rotation center

Detection Tools

Show CAD Results

Edit Nodules:

Window: Modified

Max Diameter (mm)	
Effective Diameter (mm)	
Volume ± Error (mm ³)	
Max Area (mm ²)	
HU (Mean/Max/Min)	

Outils de segmentation

B40 CHEST USER MEETING 2012
 AMET F/26Y
 4

UCL ST.Luc
 Philips, Brilliance 40
 18 May, 2012 12:52:15.46
 120 kV
 FOV 343.0 mm
 SW 5.00 mm
 Z :18

10 cm

MIP
 C -442
 W 1969

Lesion 1

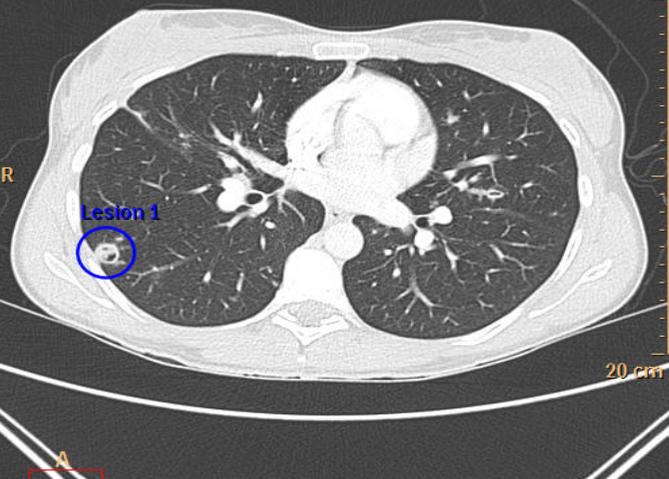
Lesion 1	
Max Diameter (mm)	19.6
Effective Diameter (mm)	12.8
Volume ± Error (mm ³)	1106.1 ± 111.9
Max Area (mm ²)	130.6
HU (Mean/Max/Min)	-63 / 597 / -1024

Volume (mm³) 1106.1
 Angle Z: 22, 99 deg
 Vol. Rend.

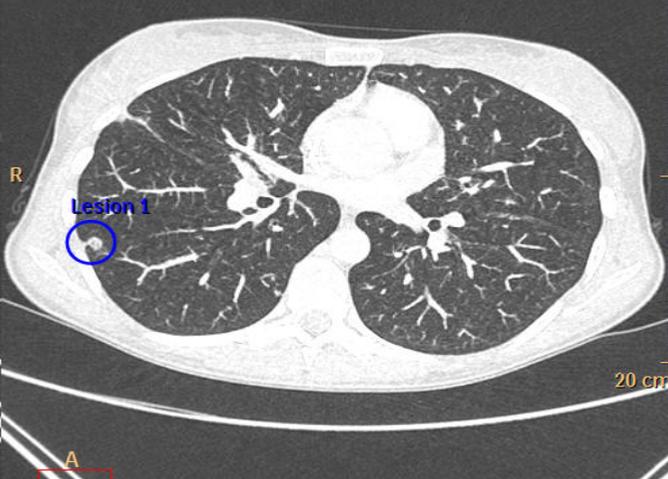
Comparaison de nodules

Lower Lung
Original
Lower Lung
Follow Up

18 mai 2012



31 juillet 2012



Detection Tools

Original	Follow Up
Lesion 1	Lesion 1
CAD 1	CAD 1
CAD 2	CAD 2
CAD 3	CAD 3

Show Lesions

Rotation center

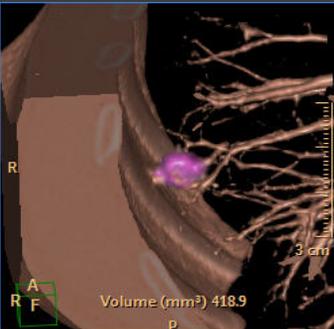
Show CAD Results

Edit Nodules:

Lesion 1		Lesion 1	
Max Diameter (mm)	18.0	Max Diameter (mm)	12.8
Effective Diameter (mm)	12.5	Effective Diameter (mm)	9.3
Volume ± Error (mm ³)	1015.2 ± 202.3	Volume ± Error (mm ³)	418.9 ± 70.0
Max Area (mm ²)	120.3	Max Area (mm ²)	57.1
HU (Mean/Max/Min)	-195 / 88 / -520	HU (Mean/Max/Min)	-254 / 448 / -1024

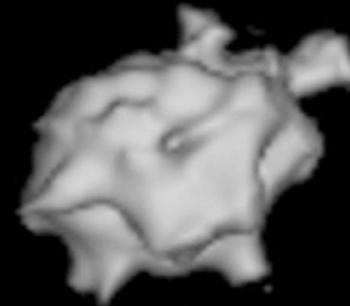
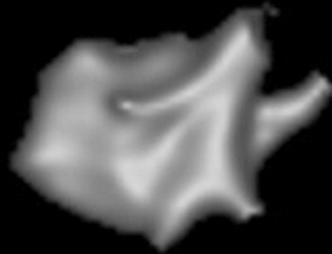


Volume (mm³) 1015.2

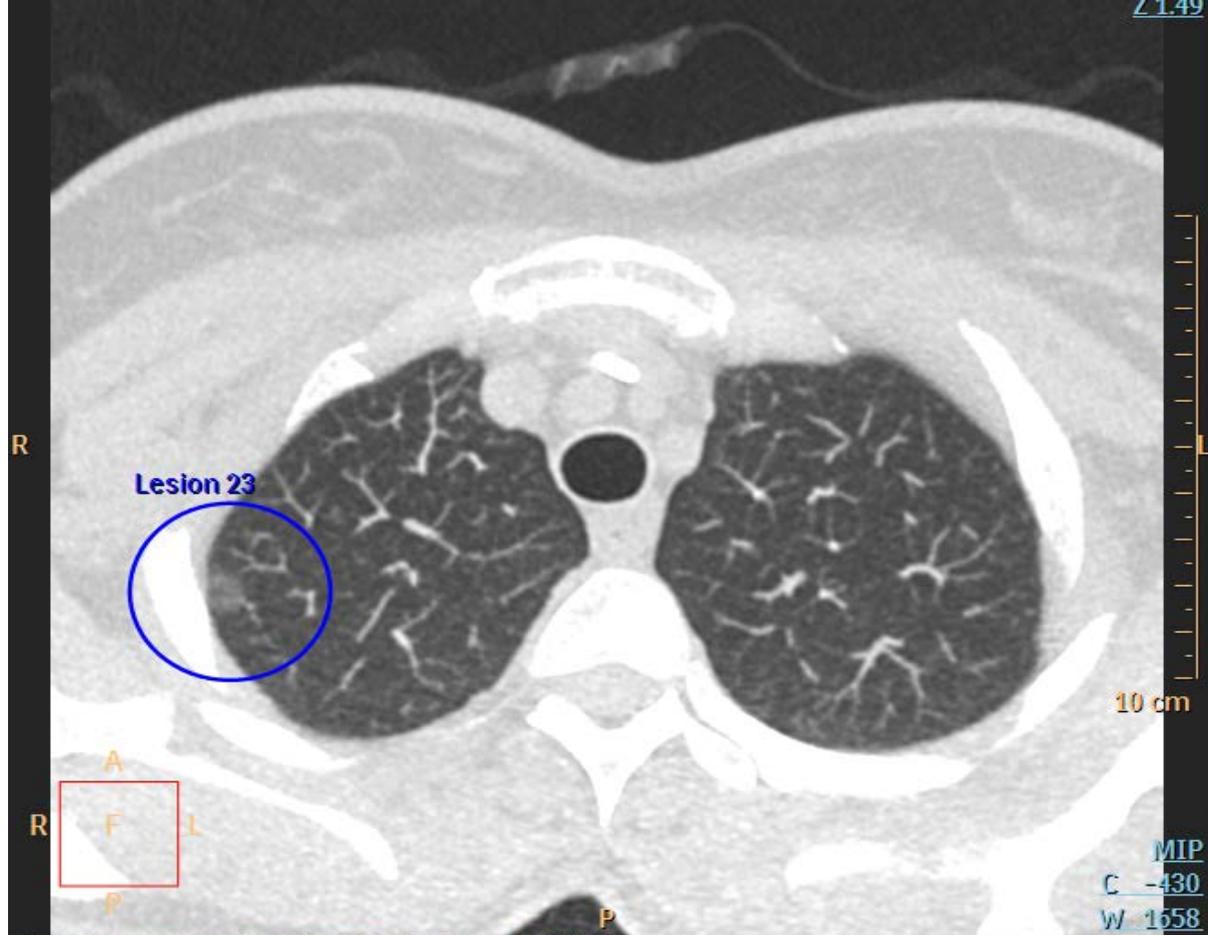


Volume (mm³) 418.9

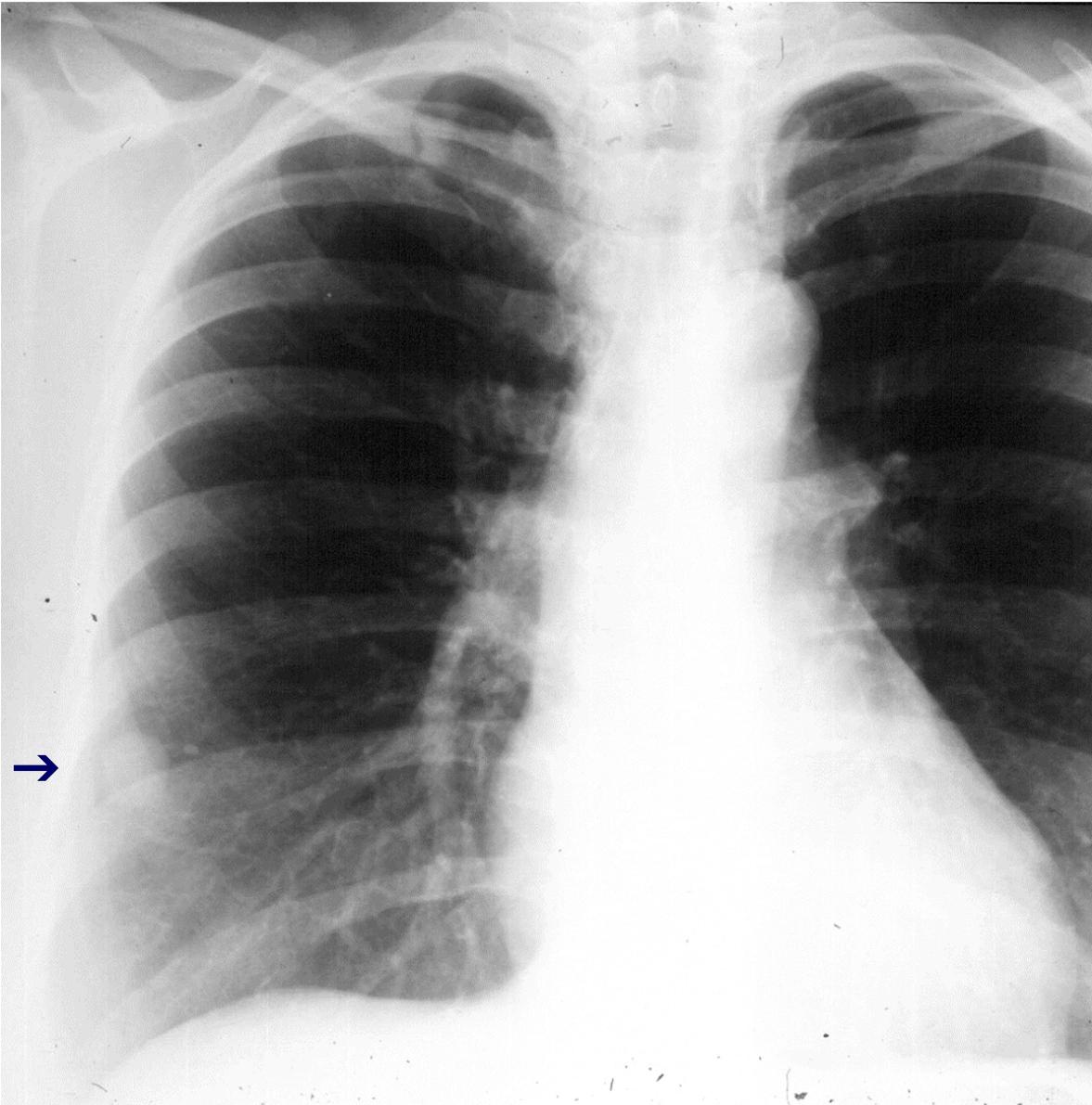
Exit
Reset all



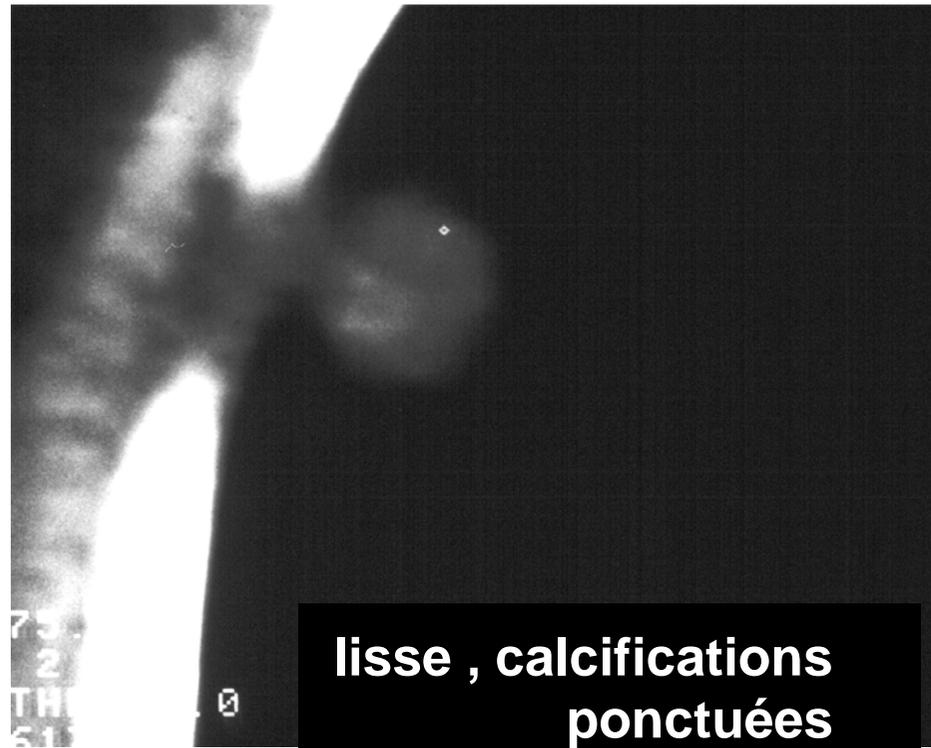
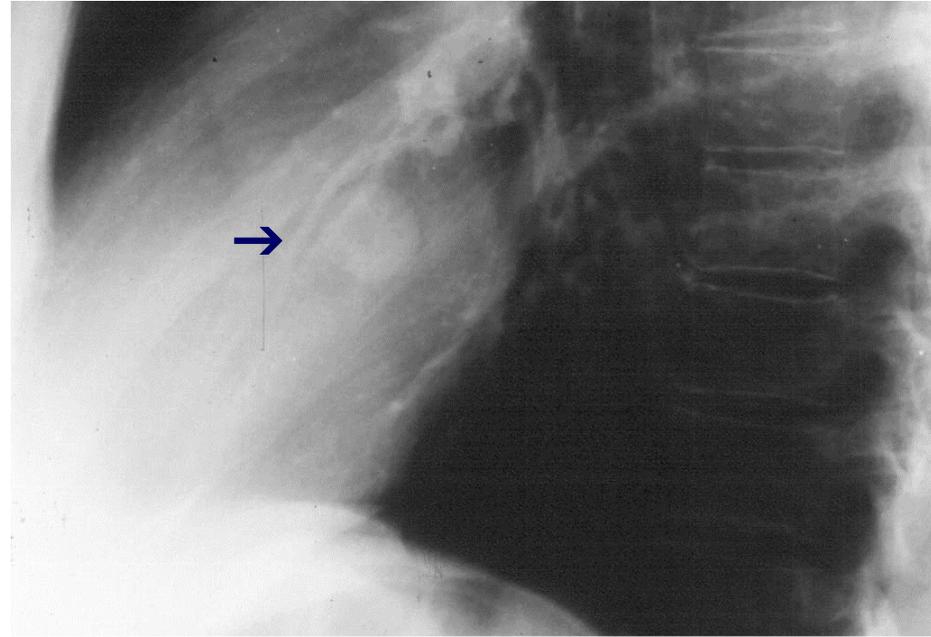
Temps de doublement estimé à 154 jours



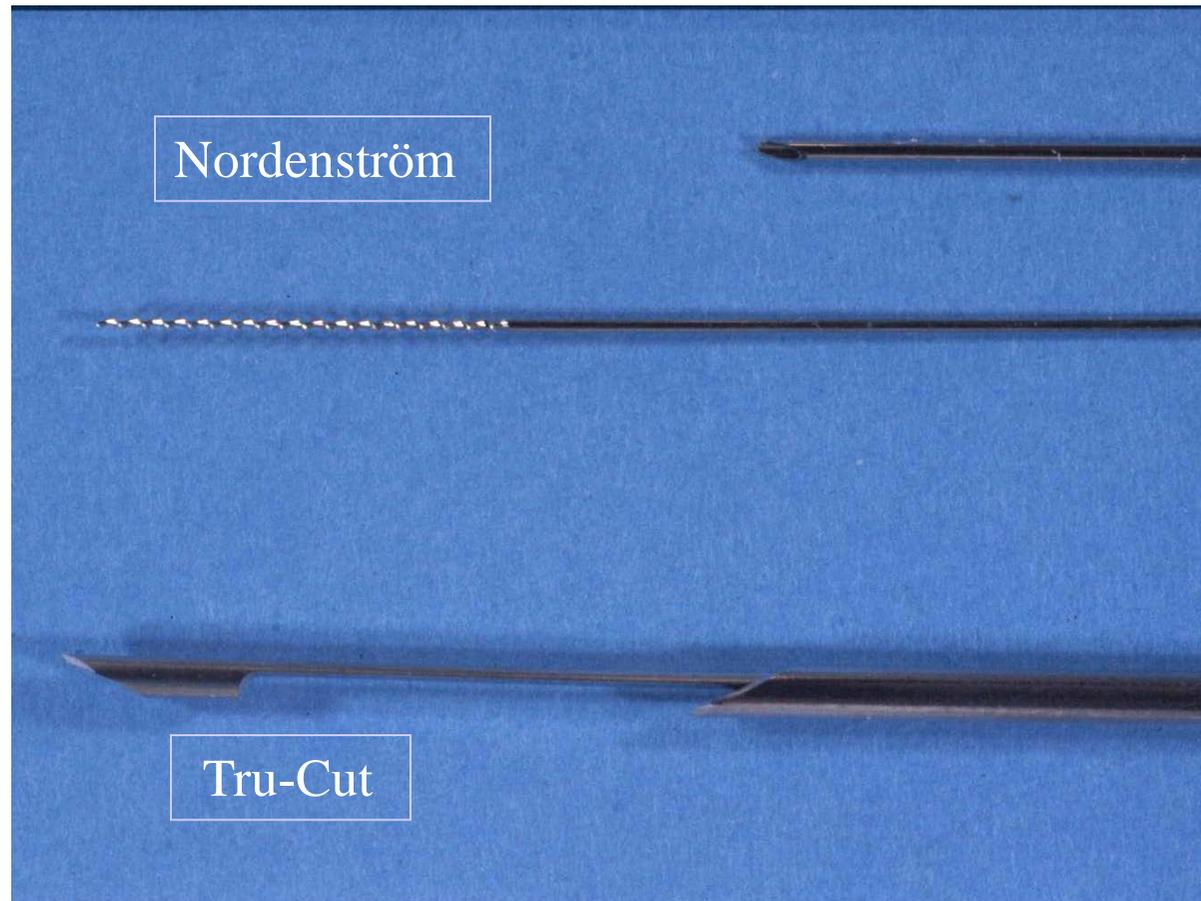
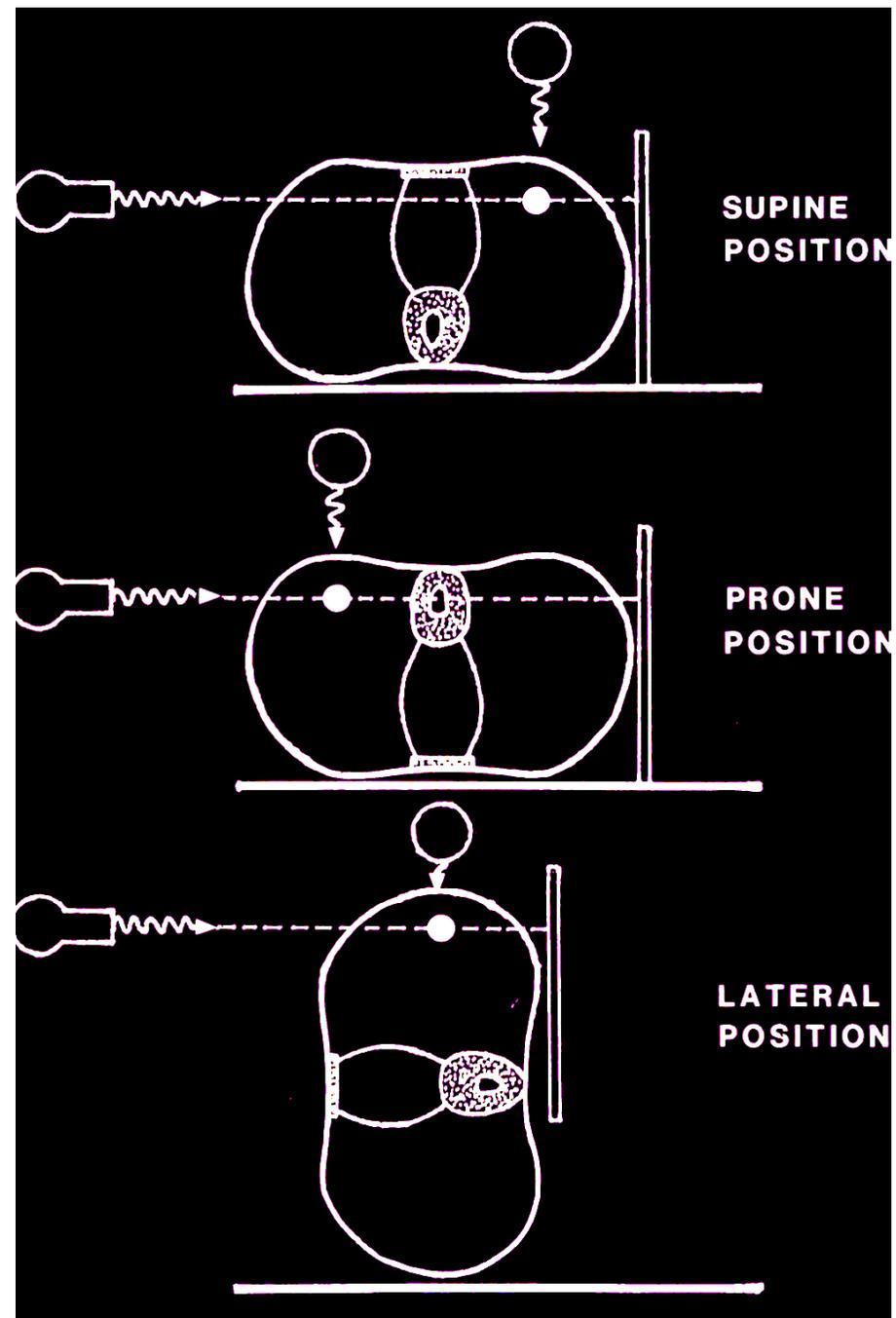
Lesion 23	
Max Diameter (mm)	14.5
Effective Diameter (mm)	10.2
Volume ± Error (mm ³)	554.0 ± 51.0
Max Area (mm ²)	104.0
HU (Mean/Max/Min)	-575 / 31 / -1024



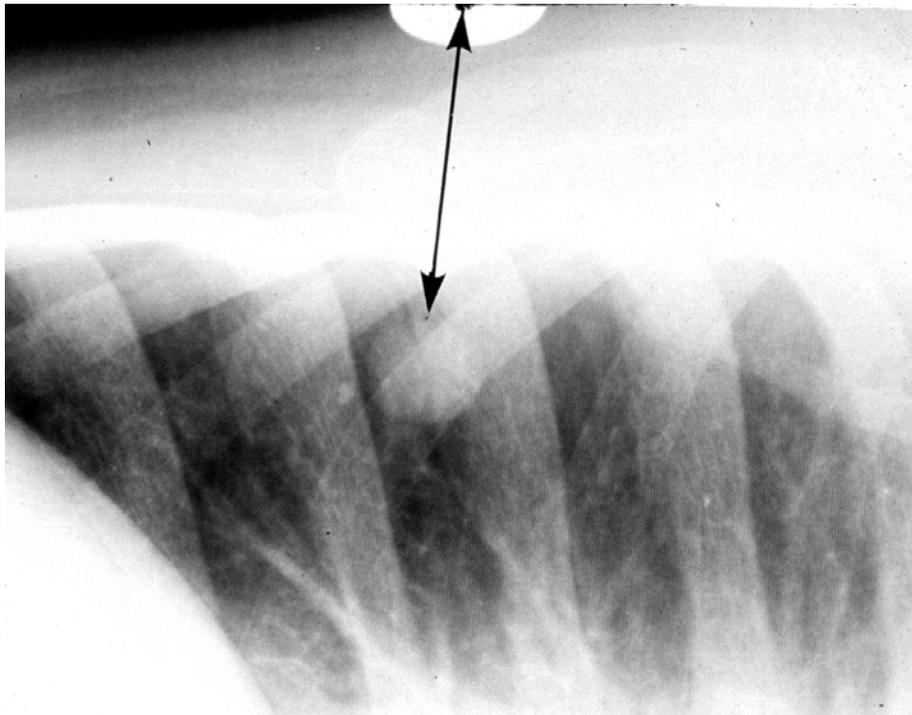
**CANCER BRONCHIQUE ?
TUMEUR CARCINOÏDE ?
HAMARTOME ?**



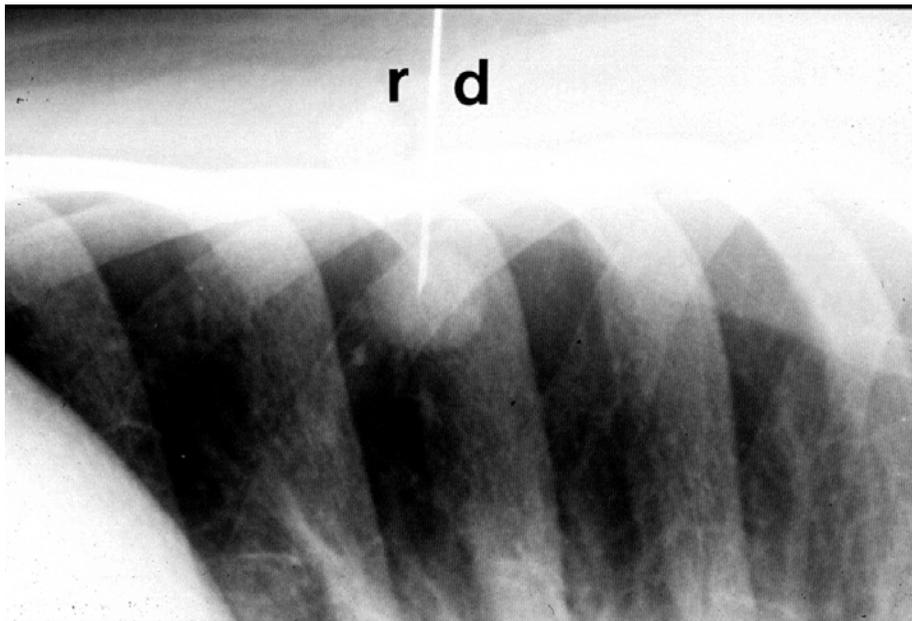
**lisse , calcifications
ponctuées**



PONCTION-BIOPSIE
TRANSTHORACIQUE
(PBTTH)



PBTTH : guidance fluoroscopique
(radioscopique)

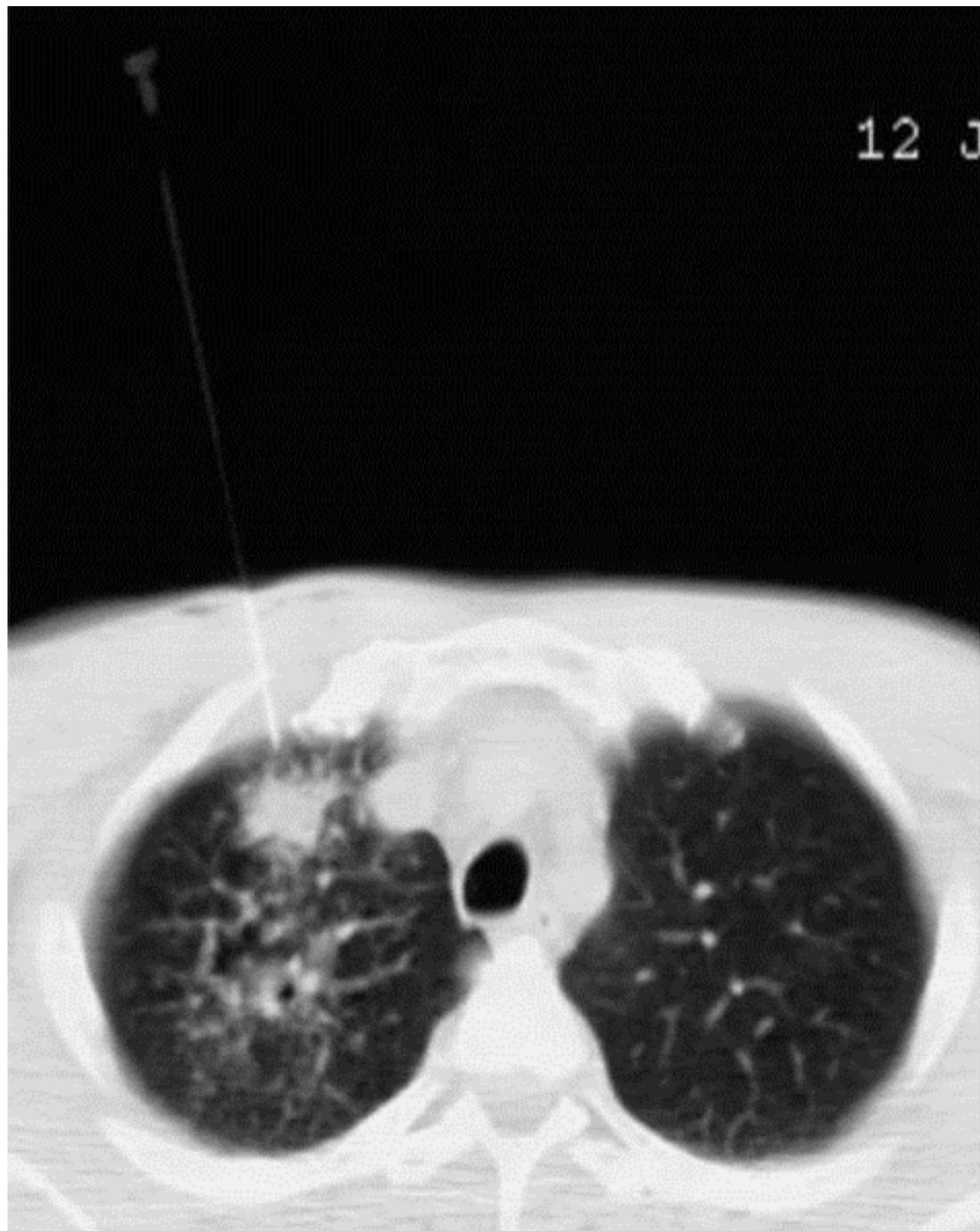


cytologie

➔ **HAMARTOME**

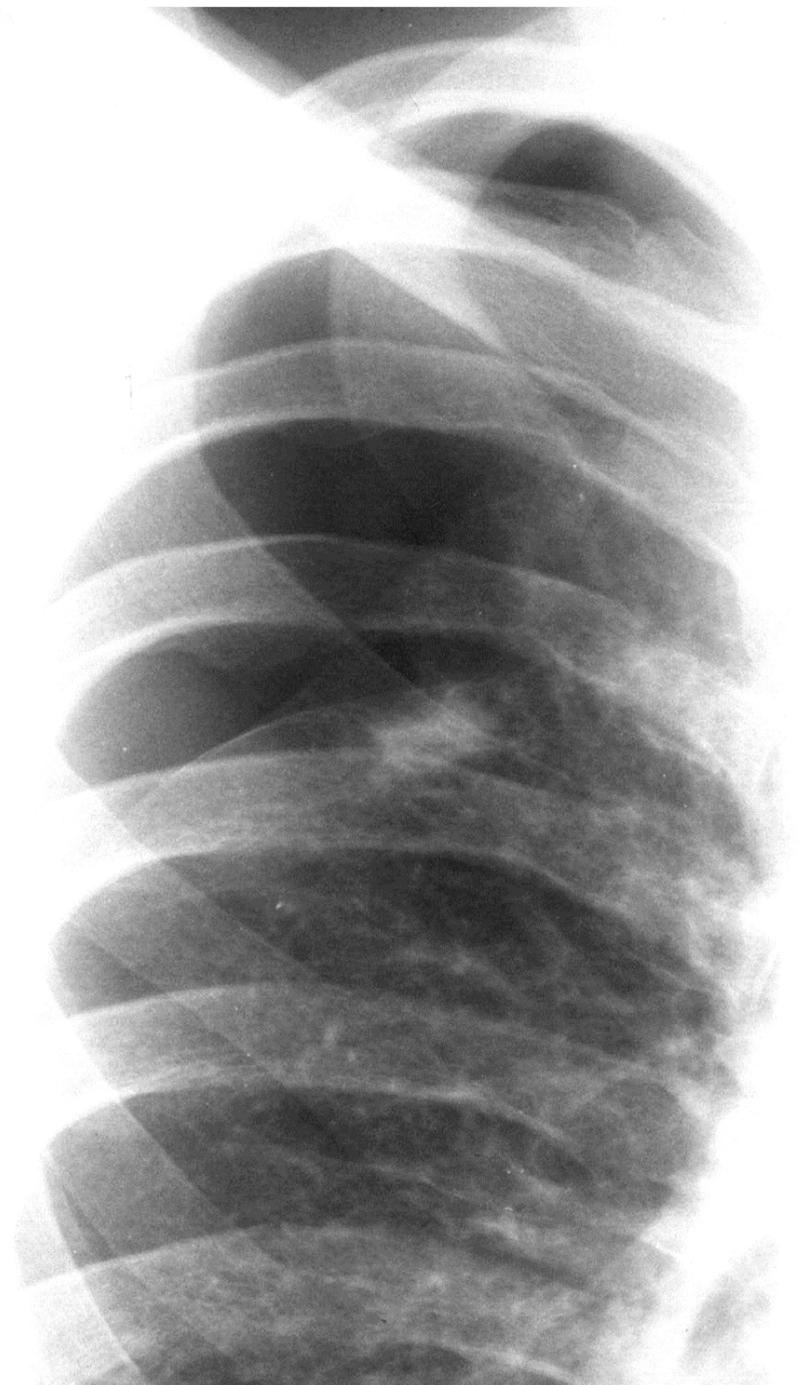
PONCTION-BIOPSIE
TRANSTHORACIQUE

GUIDANCE TDM



après PBTTH

pneumothorax (10-20 %)



PONCTION-BIOPSIE TRANSTHORACIQUE (PBTTH)

- INDICATIONS
 - NODULE INDETERMINE
(NON ACCESSIBLE PAR VOIE TRANSBRONCHIQUE)
 - CANCER ← TYPE HISTOLOGIQUE
 - TYPAGE GENETIQUE: MUTATION EGFR
- PROCEDURE
 - GUIDANCE : FLUOROSCOPIE / TDM
 - AIGUILLE : VRILLE (NORDENSTRÖM)
COUPERET (TRU-CUT)
- COMPLICATIONS
 - PNO (10-20%) ← RT EN EXPIRATION
 - HEMOPTYSIE (1-10%)
 - (EMBOLIE GAZEUSE)
 - (ESSAIMAGE DU PRELEVEMENT)

CONCLUSION

- **NODULE** ← **RADIOSCOPIE** → **PSEUDO-NODULE** → **STOP**
- **NP : BENIN (60%)** ← **TDM** → **MALIN (40%)**
- **EVOLUTIF** ← **COMPARAISON** (ANCIENNES RT) → **STABLE**
STOP ET SURVEILLANCE (SCAR CARC.) ↙
- **CORRELATION** RT-CLIN. EVOQUANT NP **BENIN** → **STOP**
- **TDM** : DIAGNOSTIC PROBANT **BENIN** → **STOP**
- **BIOPSIE** TRANSBRONCHIQUE / **PBTTH**
 - NODULE INDETERMINE
 - CANCER (TYPE HISTO.)
- PLUSIEURS VOIES DIAGNOSTIQUES