SPIF
La société de Pneumologie d'Île-de-France

GROUPE HOSPITALIER PARIS SAINT JOSEPH

# Cryobiopsie ganglionnaire et minisonde avec electronavigation

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Pneumologue interventionnel
Hôpital Marie Lannelongue - Paris
28.09.2024

# Conflits d’intérêt

OLYMPUS

erbe

SENSOME
Sensitive Medical Devices

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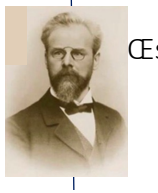
# La PI de l'évolution à la révolution

Innovation

Laryngoscope
1897

(Kilian)

Œsophagoscope
1904

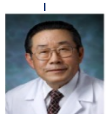
(Jackson)

FOB
1966

(Ikeda)

Laser
1982

(Dumon)

TBNA
1983

(Wang)

Cryotherapy
1986

Airway Stent
1990

(Dumon)

RP-EBUS
2002

ENB
2004

CP-EBUS
LVR
2006

Combined
EBUS / EUS
2010

CBCT in IP
2015

Robot
2018

MWA
2021

Cryobiopsy
2022

1890 — 1960 — 1980 — 1990 — 2000 — 2010 — 2022

Education

1978

1980

2001

GETIF
Groupe d'Endoscopie Thoracique et Interventionnel Francophone

BRONCHOSCOPY INTERNATIONAL™

2007
PI Fellowship USA

2010

2016
ERS EBUS certification

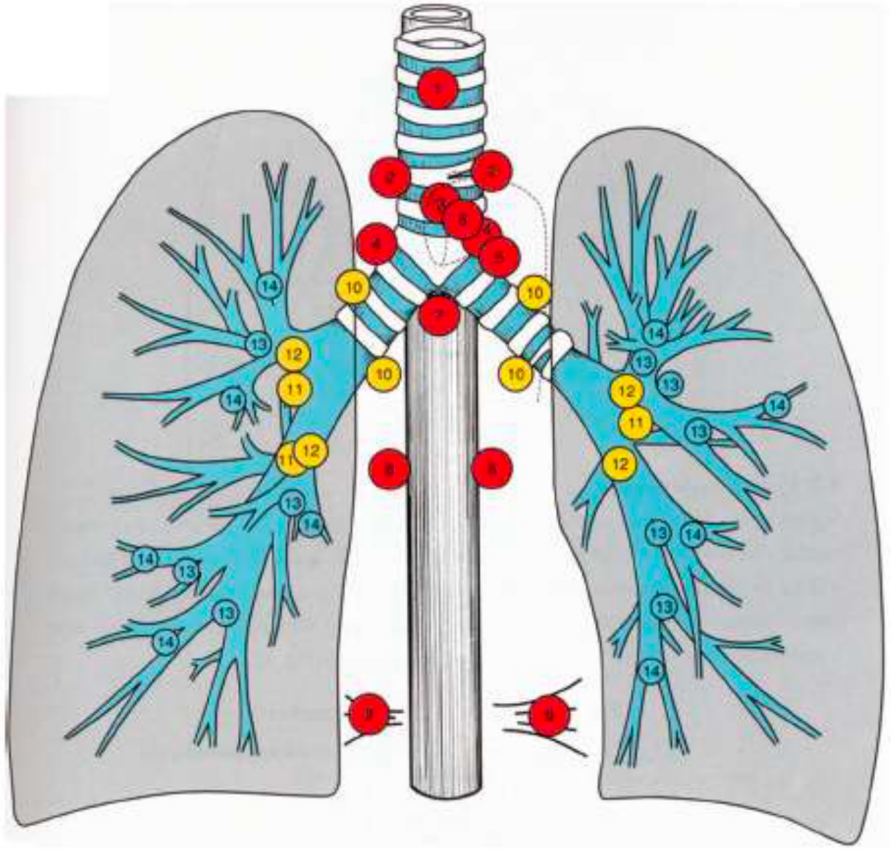
2018
Master IP Italy

(Gompelmann)

2020
1st IP Prof Vienne

# PI = Boîte à outils

1. Lésion endobronchique
   - Fibroscopie bronchique
2. Adenopathies mediastinales et hilaires
   - EBUS - Axiale
3. Nodules pulmonaires peripheriques
   - EBUS – Radiale
   - Navigation électromagnétique
   - CBCT
   - Robot
4. Désobstruction endobronchique
   - Bronchoscopie rigide



# PI = Boîte à outils

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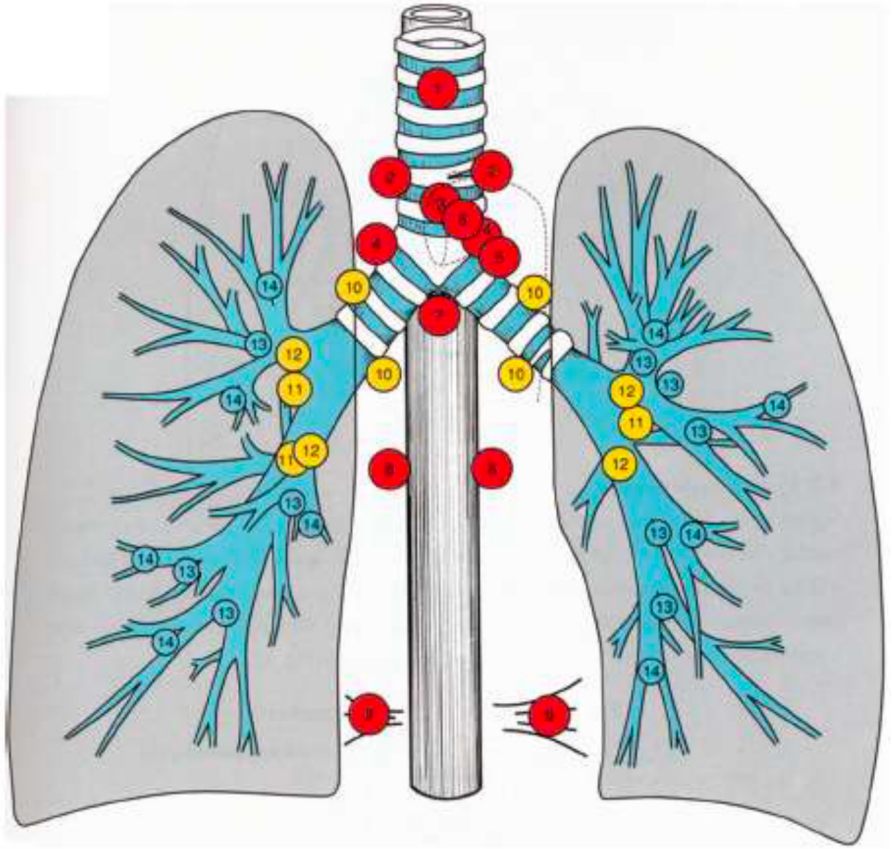
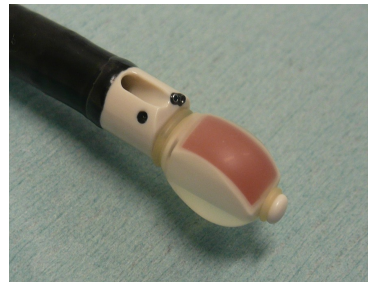


# Echoendoscopie bronchique axiale:

- Adénopathies médiastinales ou hilaires.



- 2 approches pour réaliser une biopsie médiastinale:
  - Chirurgicale: Mediastinoscopie, mediastinotomie et thoracoscopie
  - Endoscopique bronchique CP-EBUS

- EBUS axiale:
  - Gold standard (Guidelines ERS, ATS, ACCP)
  - Moins invasive, sensible, bien toléré

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# Outils de prélèvement:

A. EBUS – TBNA (Needle Aspiration)
B. EBUS – TBFB (Forceps Biopsy)
C. EBUS – TBCB (Cryo Biopsy)

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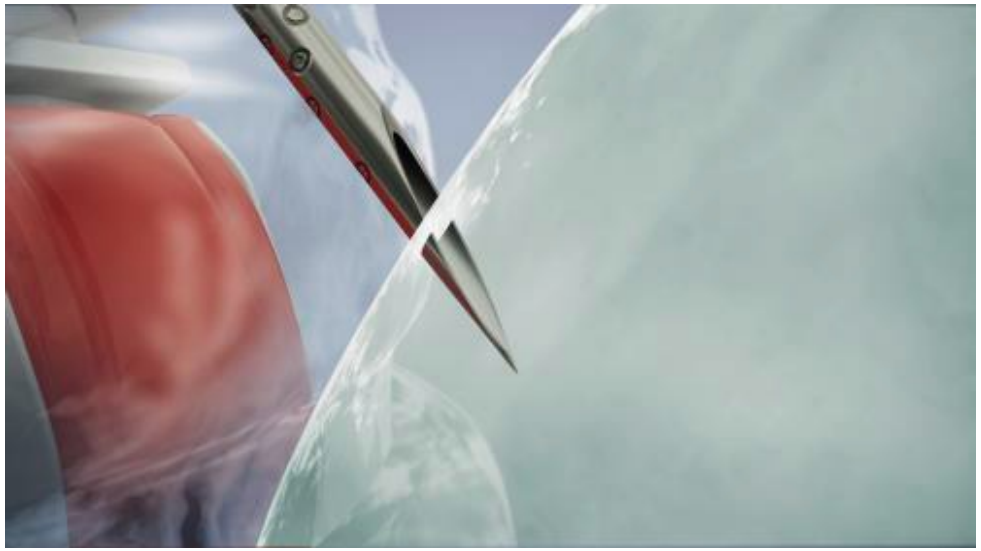
# A. EBUS – TBNA (Needle aspiration) :



# Sarcoïdose

## Efficacy and safety of convex probe EBUS-TBNA in sarcoidosis: a systematic review and meta-analysis

Ritesh Agarwal [1], Arjun Srinivasan, Ashutosh N Aggarwal, Dheeraj Gupta

Affiliations + expand

PMID: 22417738 DOI: 10.1016/j.rmed.2012.02.014

- Meta analyse 2004-2011
- 15 études, 553 patients
- Diagnostic yield from 54 to 93% with the pooled diagnostic accuracy being 79% (95% CI, 71-86%)

2012 Jun;106(6):883-92. doi: 10.1016/j.rmed.2012.02.014.Epub 2012 Mar 13.

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# Tuberculose

## Diagnostic Value of Convex Probe Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration in Mediastinal Tuberculous Lymphadenitis: A Systematic Review and Meta-Analysis

Wei Li [1], Ting Zhang [1], Yuqing Chen [1], Chao Liu [1], Wenjia Peng [2]

Affiliations + expand

PMID: 26177653 PMCID: PMC4510950 DOI: 10.12659/MSM.894526

- 14 études
- 684 patients
- Diagnostic yield of EBUS-TBNA for mediastinal TBLA was 80% (95% CI: 74-86%).

2015 Jul 16;21:2064-72. doi: 10.12659/MSM.894526.

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# Lymphome

## Diagnostic Accuracy of Endobronchial Ultrasound Transbronchial Needle Aspiration in Lymphoma. A Systematic Review and Meta-Analysis

Gonzalo Labarca [1], Melibea Sierra-Ruiz [2], Fayez Kheir [3], Erik Folch [4], Adnan Majid [2], Hiren J Mehta [5], Michael A Jantz [5], Sebastian Fernandez-Bussy [6]

- 14 études, 425 patients
- Sensibilité: 66.2% (confidence interval [CI], 55-75.8%; $I^2$ = 76.2%), spécificité: 99.3% (CI, 98.2-99.7%; $I^2$ = 40%).

A. Nouveau diagnostic:

13 études, 243 patients

Sensibilité of 67.1% (CI, 54.2-77.9%; $I^2$ = 66.8%)

Spécificité of 99.6% (CI, 99.1-99.8%; $I^2$ = 0%)

B. Récidive:

11 études, 166 patients

Sensibilité of 77.8% (CI, 68.1-85.2%; $I^2$ = 20.2%)

Spécificité of 99.5% (CI, 98.9-99.8%; $I^2$ = 0%)

Ann Am Thorac Soc. 2019 Nov;16(11):1432-1439. doi: 10.1513/AnnalsATS.201902175OC.

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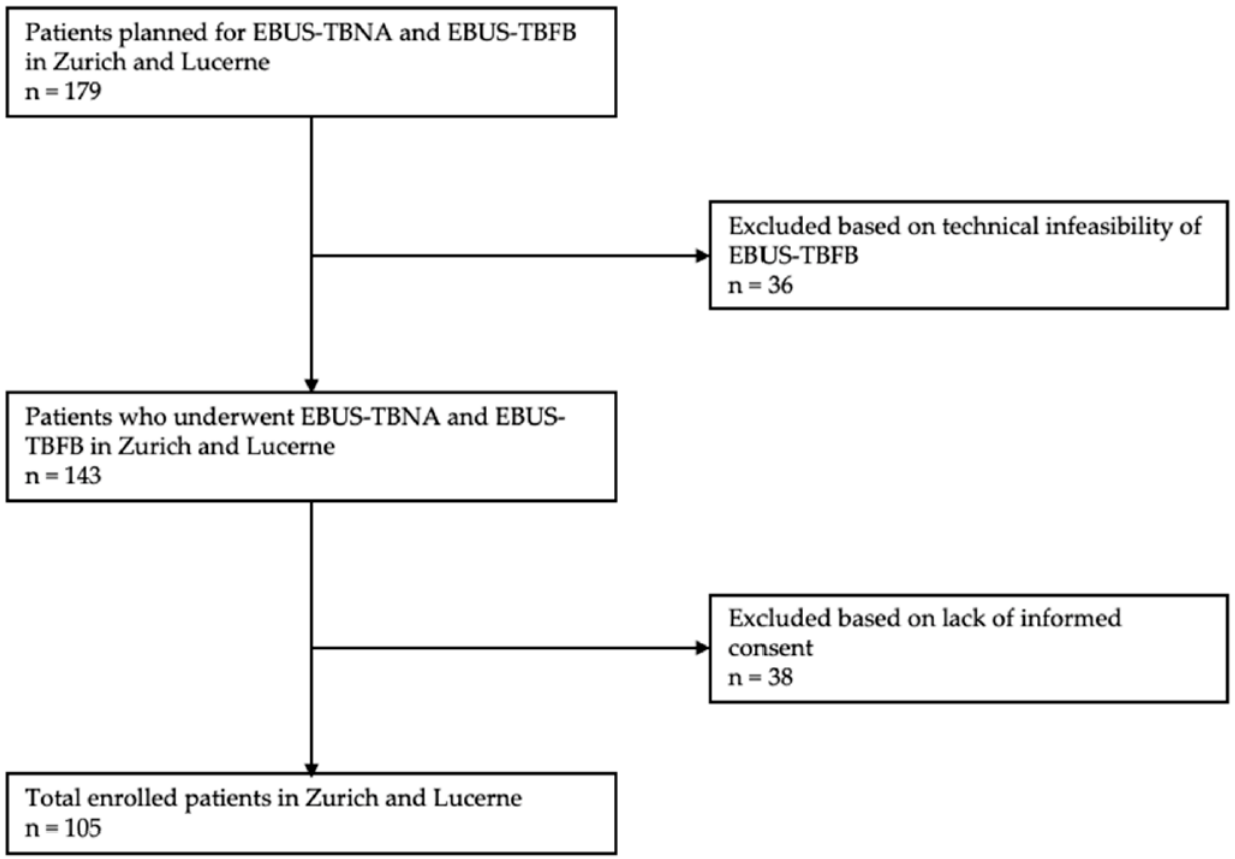
# B. EBUS – TBFB (Foceps biopsy):

# Endobronchial Ultrasound-Guided Transbronchial Forceps Biopsy: A Retrospective Bicentric Study Using the Olympus 1.5 mm Mini-Forceps

**Fabienne Rüber [1], Gilles Wiederkehr [2], Carolin Steinack [1], Sylvia Höller [3,4], Peter Karl Bode [4,5], Fabian Kölbener [6] and Daniel Peter Franzen [1,7,*]**




Journal of *Clinical Medicine*

**Citation:** Rüber, F.; Wiederkehr, G.; Steinack, C.; Höller, S.; Bode, P.K.; Kölbener, F.; Franzen, D.P. Endobronchial Ultrasound-Guided Transbronchial Forceps Biopsy: A Retrospective Bicentric Study Using the Olympus 1.5 mm Mini-Forceps. *J. Clin. Med.* **2022**, *11*, 4700. https://doi.org/10.3390/jcm11164700

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**Table 4.** Diagnostic yield of TBNA and TBNA plus TBFB overall and divided into the final diagnosis.

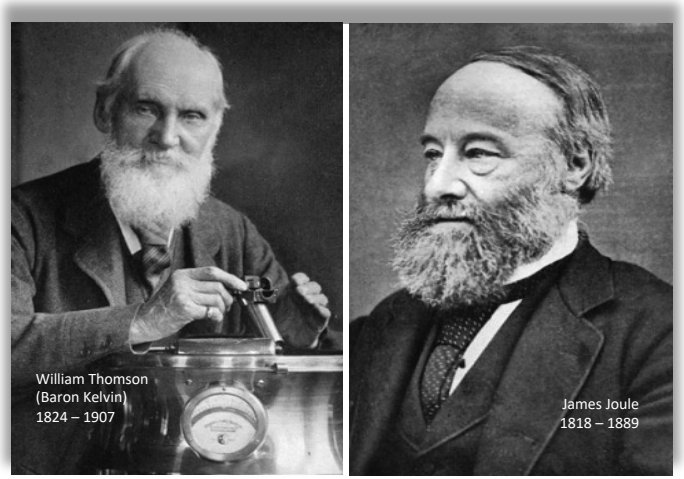
| | Total | TBNA | TBNA plus TBFB | *p*-Value |
|---|---|---|---|---|
| Overall | 105 | 65/105 (61.9) | 90/105 (85.7) | <0.001 |
| Final diagnosis | | | | |
| Lung cancer | 34 | 26/34 (76.5) | 33/34 (97.1) | 0.016 |
| Lung cancer staging | 11 | 7/11 (63.6) | 7/11 (63.6) | >0.05 |
| Other malignancies * | 7 | 3/7 (42.9) | 4/7 (57.1) | >0.05 |
| Lymphoma | 8 | 5/8 (62.5) | 6/8 (75) | >0.05 |
| Sarcoidosis | 27 | 12/27 (44.4) | 23/27 (85.2) | 0.001 |
| Other | 18 | 12/18 (66.7) | 17/18 (94.4) | >0.05 |

# C. EBUS – TBCB (Cryobiopsie):

- Joule–Thompson:
  - Compression d'un gaz, a haut débit, qui se dilate rapidement et crée des températures bases en qq sec a l'extrémité distale de la sonde.

- L'Equipment:
  - Console (Pression, T◦C −70 ◦C to −89 ◦C, durée d'application)
  - Cryogènes (CO2 ou protoxyde d'azote)
  - Cryo sonde (1.1 , 1.7 , 2.4 mm)

- Cryotechniques:
  - Cryo-biopsie
  - Cryothérapie
  - Cryo-recanalization

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# Cryobiopsie:

La nouvelle gamme comprend trois sondes à usage unique de diamètre 1,1 et 1,7 ainsi que 2,4 mm pour des possibilités d'application étendues. Plusieurs éléments clés brevetés permettent d'obtenir un design affiné, léger et ergonomique.[1,2]

Les sondes miniaturisées de 1,1 mm et 1,7 mm permettent une amélioration du bénéfice clinique et de la compatibilité, par ex. avec des cathéters de navigation.[3]

La sonde de 2,4 mm permet diverses applications par le design optimisé de son extrémité et ses capacités de congélation maximales.[3]

1.1 mm

Cryosonde flexible, ø 1,1 mm, longueur 1,15 m (avec tube d'extraction, ø 2,6 mm, longueur 817 mm)
N° 20402-401

Cryosonde flexible, ø 1,1 mm, longueur 1,15 m (avec tube d'extraction, ø 2,6 mm, longueur 757 mm)
N° 20402-402

1.7 mm

Cryosonde flexible, ø 1,7 mm, longueur 1,15 m
N° 20402-410

2.4 mm

Cryosonde flexible, ø 2,4 mm, longueur 1,15 m
N° 20402-411

EUROPEAN RESPIRATORY journal
FLAGSHIP SCIENTIFIC JOURNAL OF ERS

# European Respiratory Society guidelines on transbronchial lung cryobiopsy in the diagnosis of interstitial lung diseases

**PICO question 1: In patients with undiagnosed ILD considered eligible to undergo SLB, is TBLC a valid replacement test?**

*Recommendation*

For patients with undiagnosed ILD considered eligible to undergo SLB, the task force suggests performing TBLC if obtaining histopathological data is indicated (conditional recommendation for the intervention, 'very low' certainty of evidence). Remark: this recommendation applies to centers experienced in performing TBLC.

**PICO question 2: In patients with undiagnosed ILD not considered eligible to undergo SLB, does TBLC increase the diagnostic confidence of the multidisciplinary team discussion?**

*Recommendation*

For patients with undiagnosed ILD not considered eligible to undergo SLB, the task force suggests TBLC if obtaining histopathological data is indicated (conditional recommendation, 'very low' certainty of evidence). Remark: this recommendation applies to centers experienced in performing TBLC; the advantages of potentially increasing diagnostic certainty by performing TBLC against the disadvantages of potential serious adverse events should be weighed in each individual patient.

Please cite this article as: Korevaar DA, Colella S, Fally M, *et al*. European Respiratory Society guidelines on transbronchial lung cryobiopsy in the diagnosis of interstitial lung diseases. *Eur Respir J* 2022; in press (https://doi.org/10.1183/13993003.00425-2022).

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# Transbronchial mediastinal cryobiopsy in the diagnosis of mediastinal lesions: a randomised trial

**Jing Zhang[1], Jie-Ru Guo[1], Zan-Sheng Huang[1], Wan-Lei Fu[2], Xian-Li Wu[1], Na Wu[3], Wolfgang M. Kuebler[4], Felix J.F. Herth [5,6,7] and Ye Fan[1,7]**

[1]Dept of Respiratory Disease, Xinqiao Hospital, Third Military Medical University, Chongqing, China. [2]Dept of Pathology, Xinqiao Hospital, Third Military Medical University, Chongqing, China. [3]Dept of Epidemiology, College of Preventive Medicine, Third Military Medical University, Chongqing, China. [4]Institute of Physiology, Charité Universitätsmedizin, Berlin, Germany. [5]Dept of Pneumology and Critical Care Medicine, Thoraxklinik, University of Heidelberg, Heidelberg, Germany. [6]Translational Lung Research Center Heidelberg, University of Heidelberg, Heidelberg, Germany. [7]Felix J.F. Herth and Ye Fan contributed equally to this article as lead authors and supervised the work.

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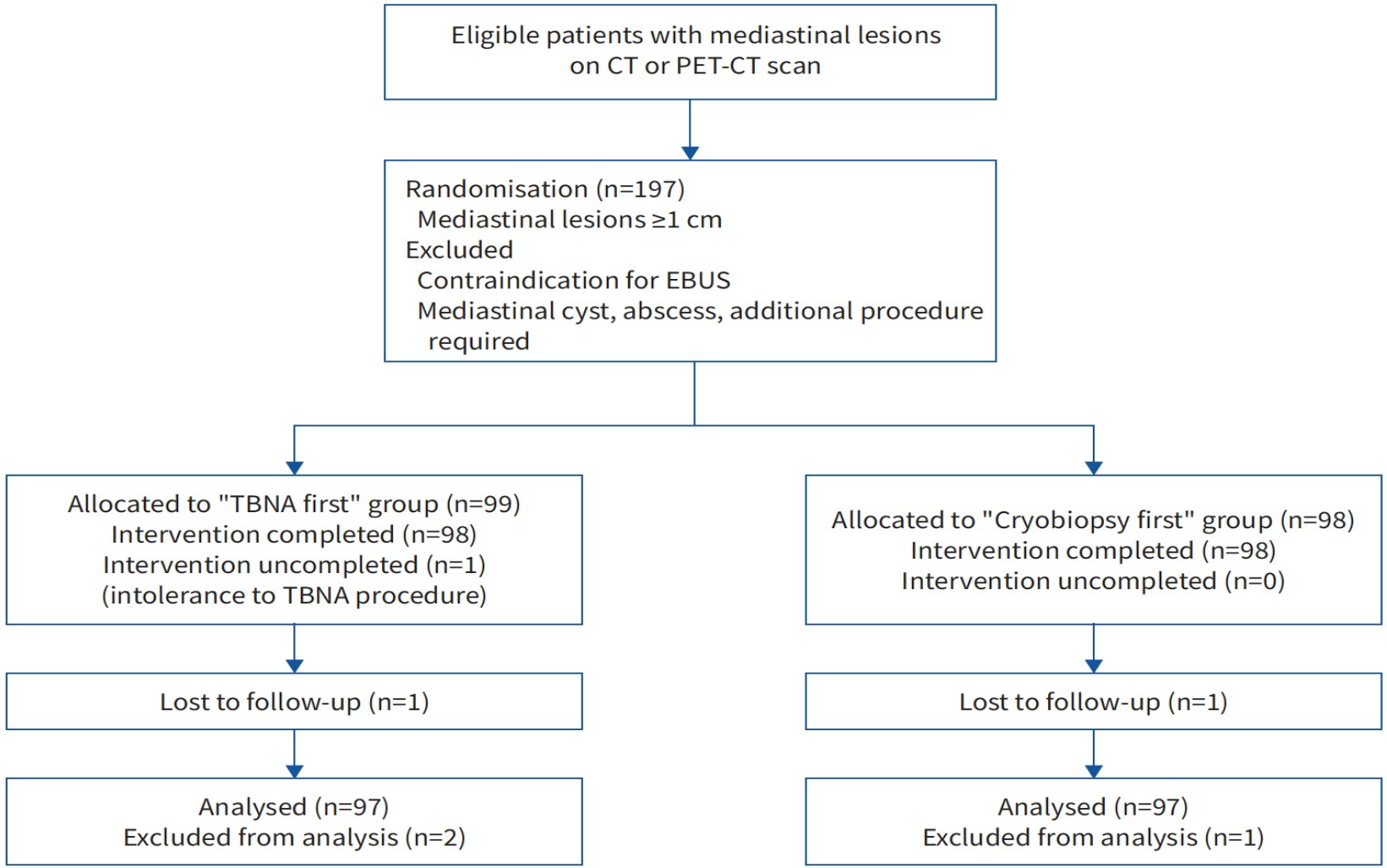


**FIGURE 1** Patient flow. CT: computed tomography; PET: positron emission tomography; EBUS: endobronchial ultrasound; TBNA: transbronchial needle aspiration.

**TABLE 2** Diagnostic yields of TBNA and transbronchial mediastinal cryobiopsy

| | Total | TBNA | Cryobiopsy | p-value |
|---|---|---|---|---|
| **Subjects n** | 194 | 194 | 194 | |
| **Diagnostic yield n (%)** | | | | 0.001 |
| No | 13 (6.7%) | 39 (20.1%) | 16 (8.2%) | |
| Yes | 181 (93.3%) | 155 (79.9%) | 178 (91.8%) | |
| **Common tumour n** | | | | |
| Lung, adenocarcinoma | 75 | 68 | 72 | |
| Lung, squamous cell | 24 | 24 | 23 | |
| Lung, large cell | 3 | 3 | 3 | |
| Lung, NSCLC (NOS) | 7 | 6 | 5 | |
| Lung, small cell | 26 | 26 | 26 | |
| Total n (%) | 135 (69.6%) | 127 (65.5%) | 129 (66.5%) | 0.58 |
| **Uncommon tumour n** | | | | |
| Lung, carcinoid | 1 | 0 | 1 | |
| Lung, sarcomatoid | 1 | 1 | 1 | |
| Lymphoma | 8 | 1 | 7 | |
| Seminoma | 1 | 0 | 1 | |
| Thymic carcinoma | 1 | 1 | 1 | |
| Total n (%) | 12 (6.2%) | 3 (1.5%) | 11 (5.7%) | 0.001 |
| **Benign disorder n** | | | | |
| Sarcoidosis | 15 | 10 | 15 | |
| Tuberculosis | 16 | 8 | 16 | |
| Pneumoconiosis | 7 | 7 | 7 | |
| Total n (%) | 47 (24.2%) | 25 (12.9%) | 38 (19.6%) | 0.004 |

TBNA: transbronchial needle aspiration; NSCLC: non-small cell lung cancer; NOS: not otherwise specified.

# Diagnostic yield:

Oveall: 79.9% Vs 91.8%

- Common tumors: 94% Vs 95.5%
- Uncommon tumors: 25% Vs 91.6%
  - Lymphoma: 12.5% Vs 87.5%
- Benign disorders: 53% Vs 81%

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# Complications

**TABLE 4** Procedure-related adverse events

| | "TBNA first" group | "Cryobiopsy first" group | p-value |
|---|---|---|---|
| **Subjects n** | 98 | 98 | |
| **Bleeding n** | | | |
| Grade 2 | 9 | 9 | |
| Grade 3 | 0 | 2 | |
| Grade 4 | 0 | 0 | |
| Total n (%) | 83 (84.7%) | 86 (87.8%) | 0.53 |
| **Pneumothorax n (%)** | 1 (1.0%) | 1 (1.0%) | 1 |
| **Pneumomediastinum n (%)** | 0 (0%) | 1 (1.0%) | 1 |
| **Death n (%)** | 0 (0%) | 0 (0%) | - |

TBNA: transbronchial needle aspiration.

# PI = Boîte à outils

1. Lésion endobronchique
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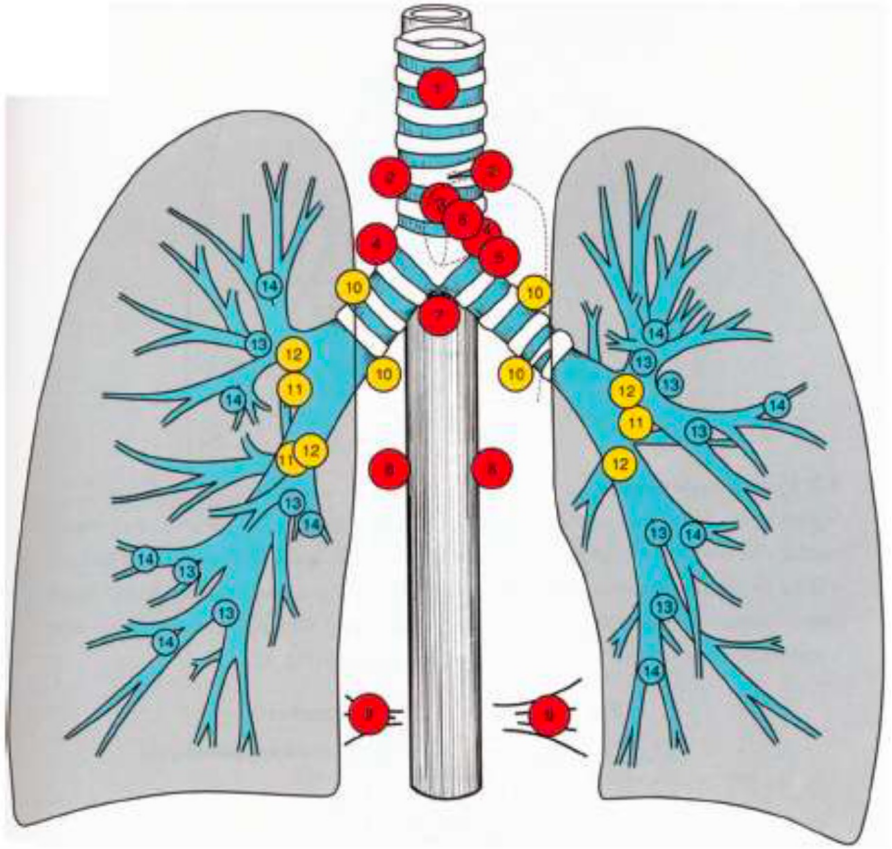
   - Navigation électromagnétique
   - CBCT
   - Robot
4. Désobstruction endobronchique
   - Bronchoscopie rigide



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# Nodules pulmonaires périphériques

- Augmentation de la découverte fortuite des nodules pulmonaires:
  - Dépistage du cancer du poumon
  - Amélioration de la qualité d'imagerie
- Défi pour les pneumologues interventionnels.
- 3 approches pour réaliser une biopsie pulmonaire:
  - Chirurgicale
  - Ponction trans-thoracique guidée sous scanner
  - Endoscopique bronchique RP-EBUS
    1. EBUS radiale - minisonde
    2. Electronavigation
    3. Cone Beam - CT
    4. Bronchoscopie robotique

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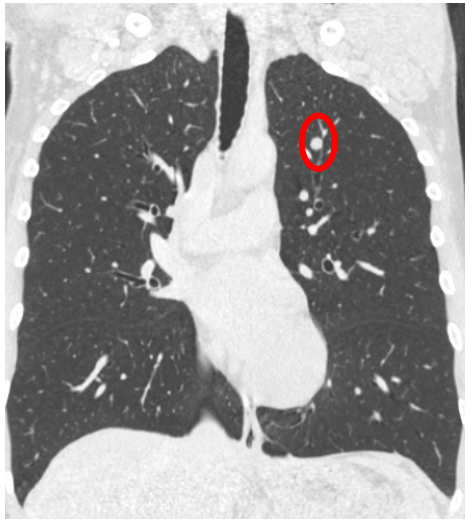
# 1. Echoendoscopie bronchique radiale:

- Avantages:
  - Simple, accessible
  - Sous AL
  - Cout

- RP-EBUS - RD: 70,6 %✦

- Complications sont rares✦
  - Pneumothorax 1,08 %
  - Saignements 2,8 %



✦ Ali, M.S.; Trick, W.; Mba, B.I.; Mohananey, D.; Sethi, J.; Musani, A.I. Radial endobronchial ultrasound for the diagnosis of peripheral pulmonary lesions: A systematic review and meta-analysis. Respirology 2017, 22, 443–453.

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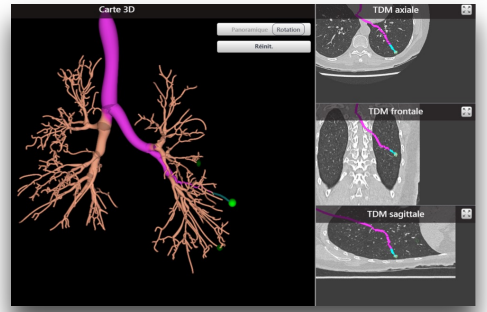
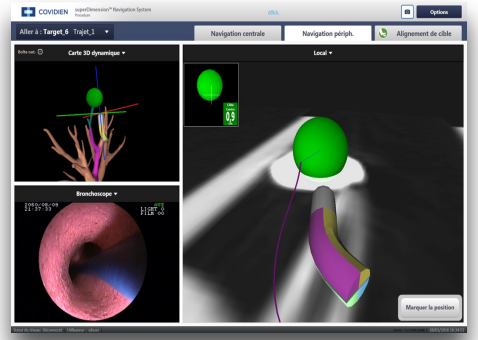
# 2. Electronavigation ENB:

- TDM de phase pour créer une image bronchoscopique virtuelle.
- Champ magnétique autour du patient pour détecter un dispositif suivi afin d'obtenir la position superposée sur la carte bronchoscopique virtuelle.
- Chevauchement de l'imagerie avec le champ électromagnétique via des points sélectionnés et fournir un itinéraire jusqu'à la lésion.
- Rendement diagnostique : L'étude NAVIGATE✦
  - 1 157 biopsies guidées par ENB
  - 94 % (ont réussi la navigation et obtenu des échantillons de tissu)
  - 73 % à 12 mois
  - Complications: PNO 4.3%, Saignement 2.5%




✦ J Thorac Oncol. 2019 Mar;14(3):445-458. PMID: 30476574

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# Electromagnetic navigation ENB:

## Sensitivity and Safety of Electromagnetic Navigation Bronchoscopy for Lung Cancer Diagnosis

### Systematic Review and Meta-analysis

CHEST

*Erik E. Folch, MD; Gonzalo Labarca, MD; Daniel Ospina-Delgado, MD; Fayez Kheir, MD; Adnan Majid, MD; Sandeep J. Khandhar, MD; Hiren J. Mehta, MD; Michael A. Jantz, MD; and Sebastian Fernandez-Bussy, MD*

- 40 études, 3356 nodules
- Taille : 23.2 mm
- Durée médiane de procédure: 46.3 min
- Navigation réussie: 98%
- RD: 77%
- Complications: PNO 2.0%

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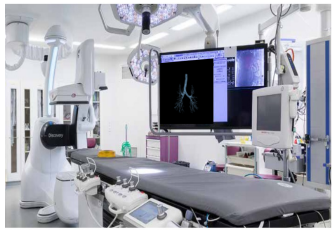
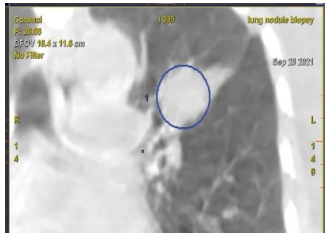
# 3. Cone Beam CT

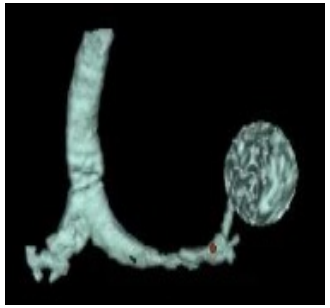
Step 1:
GA



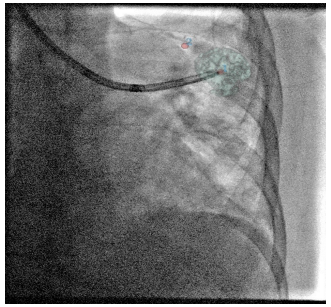
Step 2:
CBCT



Step 3:
Create a masque



Step 4:
Fusion and
Navigation



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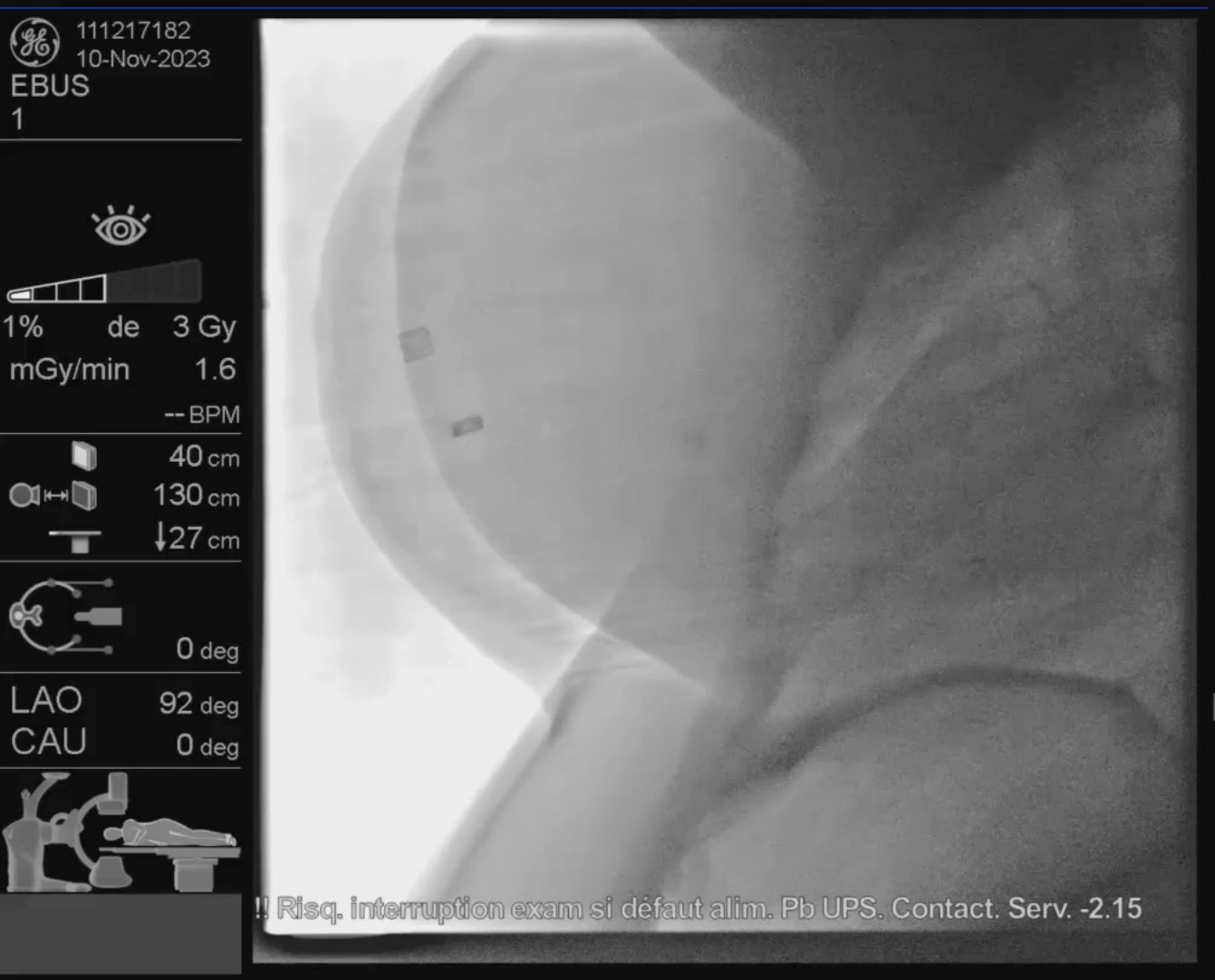
111217182
10-Nov-2023
EBUS
1
1% de 3 Gy
mGy/min 1.6
-- BPM
40 cm
130 cm
27 cm
0 deg
LAO 92 deg
CAU 0 deg
!! Risq. interruption exam si défaut alim. Pb UPS. Contact. Serv. -2.15

No Signal

080187
CBCT
Hop. Marie Lannelongue
10/11/2023 11:27:30
20MHz
G : 7
C : 5
0
1
2
3
4
MEDIA
DF: 0
CV: 1
1/ 12

# 4. Bronchoscopie robotique

## Monarch™ platform

(Images courtesy of Auris Health, Inc., Redwood Ci)

## Ion Robotic System

(Images courtesy of Intuitive Surgical©, Sunnyvale, CA,USA)

## Galaxy System™

(Images courtesy of Noah Medical, San Carlos, CA, USA)

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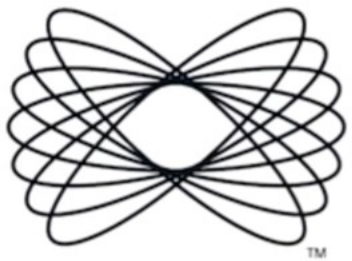

# MONARCH™

# Bronchoscopie robotique

**Diagnostic Performance and Safety Profile of Robotic-assisted Bronchoscopy: A Systematic Review and Meta-Analysis**

**Muhammad Sajawal Ali** , **Uzair Khan Ghori** , **Max Theodore Wayne** , **Eugene Shostak** , and **Jose De Cardenas**
https://doi-org.proxy.insermbiblio.inist.fr/10.1513/AnnalsATS.202301-075OC **PubMed:** 37769170

ATS Journals

- 20 études, 1779 lésions
- Rendement diagnostique 84.3%
- Meilleur rendement:
  - Lésion > 20 mm
  - Signe de la bronche
- Complications:
  - PNO 2.3%
  - PNO drainé 1.2%
  - Saignement important 0.5%

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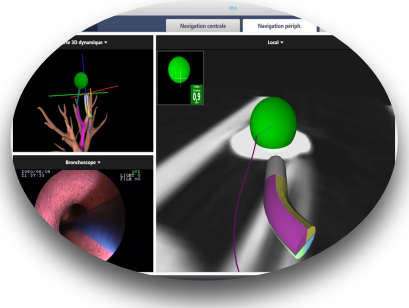
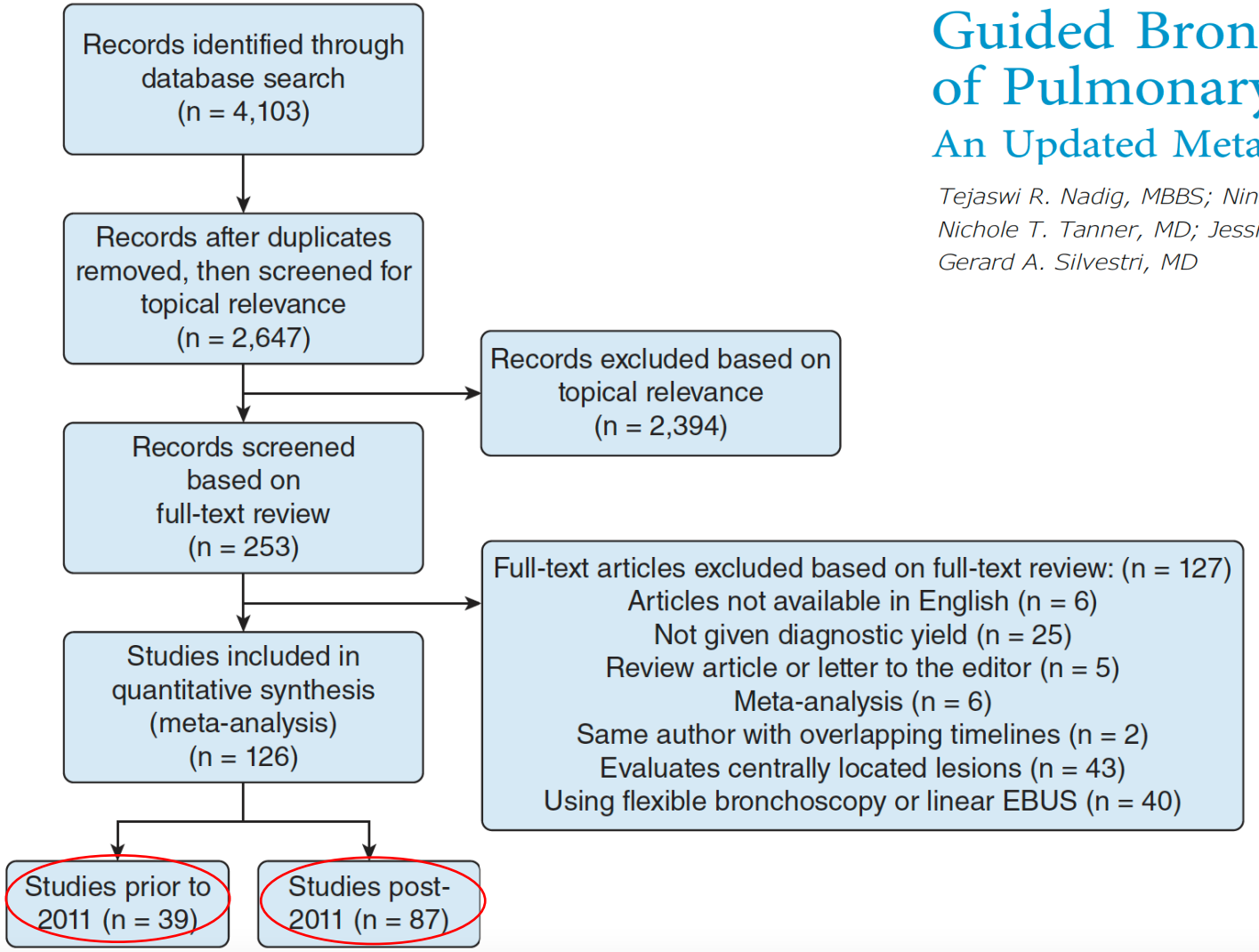
| | |  | | |
|---|---|---|---|---|
| Machine cost | 100k | 200k | 900k | 1.2M |
| Cost/procedure | 500 euros | 1500 euros | 2600 euros | 1000 euros |
| Diagnostic Yield | 70%[1] | 77%[2] | 84%[3] | Aiding tool |


1. Ali, M.S.; Trick, W.; Mba, B.I.; Mohananey, D.; Sethi, J.; Musani, A.I. Radial endobronchial ultrasound for the diagnosis of peripheral pulmonary lesions: A systematic review and meta-analysis. Respirology 2017, 22, 443–453.
2. J Thorac Oncol. 2019 Mar;14(3):445-458. PMID: 30476574
3. Pubmed: 37669170

# Est-ce qu'on a amélioré le RD?




## Guided Bronchoscopy for the Evaluation of Pulmonary Lesions

### An Updated Meta-analysis

CHEST

*Tejaswi R. Nadig, MBBS; Nina Thomas, MD; Paul J. Nietert, PhD; Jessica Lozier, MD; Nichole T. Tanner, MD; Jessica S. Wang Memoli, MD; Nicholas J. Pastis, MD; and Gerard A. Silvestri, MD*

CHEST 2023; 163(6):1589-1598

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# Est-ce qu'on a amélioré le RD?

**TABLE 4** ] Study Characteristics and Diagnostic Yield, Summarized Across Types of Technology Used

| Technology Used | No. of Study Arms | Proportion of Study Arms With High Bias, % | Total No. of Nodules Included | No. of Nodules Per Study, Median (range) | Diagnostic Yield, Mean (95% CI) |
|---|---|---|---|---|---|
| R-EBUS ± GS | 51 | 78.4 | 5,494 | 83 (11-760) | 70.9% (67.9%-73.9%) |
| ENB | 24 | 75.0 | 1,952 | 53.5 (13-279) | 74.0% (68.6%-79.4%) |
| ENB + R-EBUS | 15 | 73.3 | 2,913 | 56 (26-1,329) | 66.5% (59.8%-73.3%) |
| VB + R-EBUS | 13 | 76.9 | 1,048 | 55 (12-334) | 76.4% (72.7%-80.1%) |
| Ultrathin or thin + VB | 10 | 80.0 | 795 | 63 (25-167) | 69.9% (62.4%-77.3%) |
| Ultrathin or thin + R-EBUS | 7 | 42.9 | 1,133 | 101 (20-467) | 62.6% (55.3%-70.0%) |
| Other combination | 7 | 57.1 | 771 | 63 (31-245) | 64.4% (49.0%-79.9%) |
| Ultrathin or thin | 6 | 50.0 | 770 | 104 (20-340) | 50.2% (37.3%-63.2%) |
| Ultrathin + VB + R-EBUS | 6 | 16.7 | 737 | 152.5 (32-179) | 67.3% (58.4%-76.2%) |
| Robotic | 6 | 66.7 | 483 | 56.5 (15-167) | 77.6% (70.4%-84.8%) |
| VB | 4 | 100.0 | 293 | 60.5 (50-122) | 72.4% (55.1%-89.7%) |

ENB = electromagnetic navigational bronchoscopy; GS = guide sheath; R-EBUS = radial endobronchial ultrasound; VB = virtual bronchoscopy.

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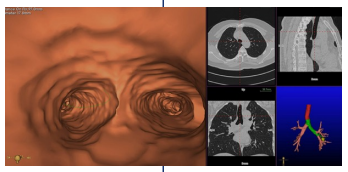
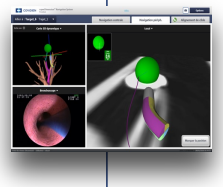
# Est-ce qu'on a amélioré le RD?

VB
2000

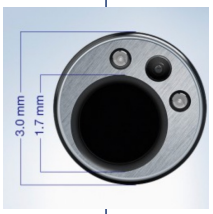


RP-EBUS
2002

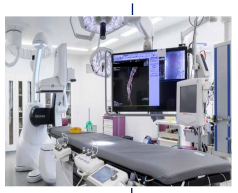
ENB
2004



Thin / Ultra thin FOB
2015




CBCT
2017



Robot
2018

2011

39 études
3,052 lésions
RD: ?

70.5%

NON

87 études
13,535 lésions
RD: ?

69.2%

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# Pourquoi ???

- Amélioration des techniques de navigation mais pas le RD
- Différence entre une navigation réussie et un diagnostic positif
- Pourquoi ?

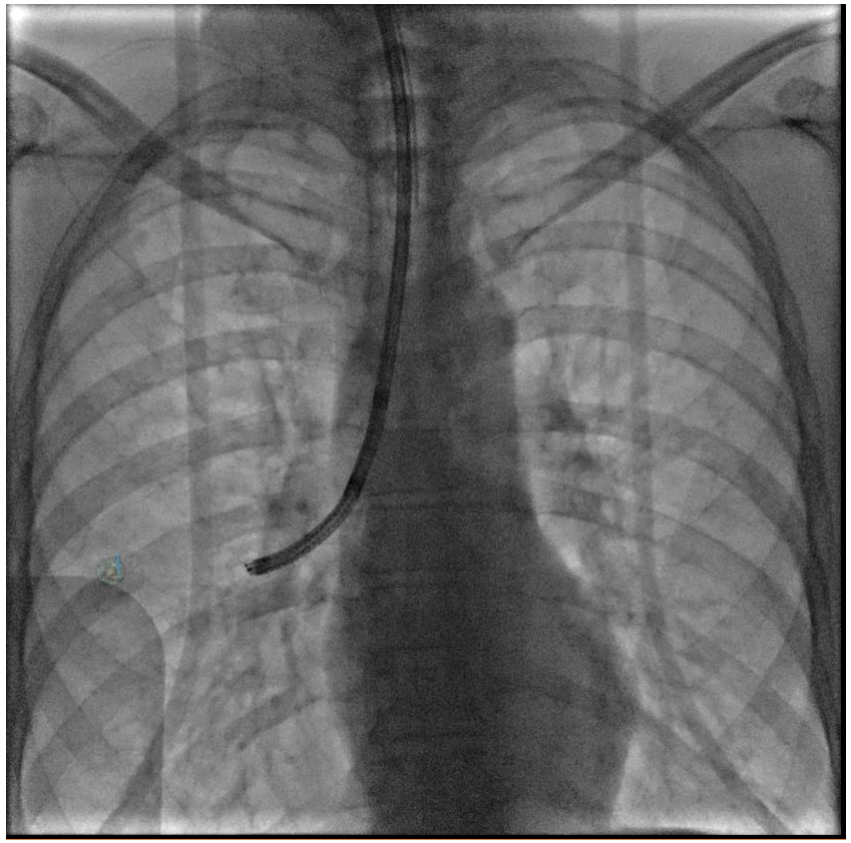
L'anapath !!!!

A. Absence de vision directe
B. Atélectasie
C. CT to body divergence
D. Techniques de biopsie

# A. Pas de vision directe

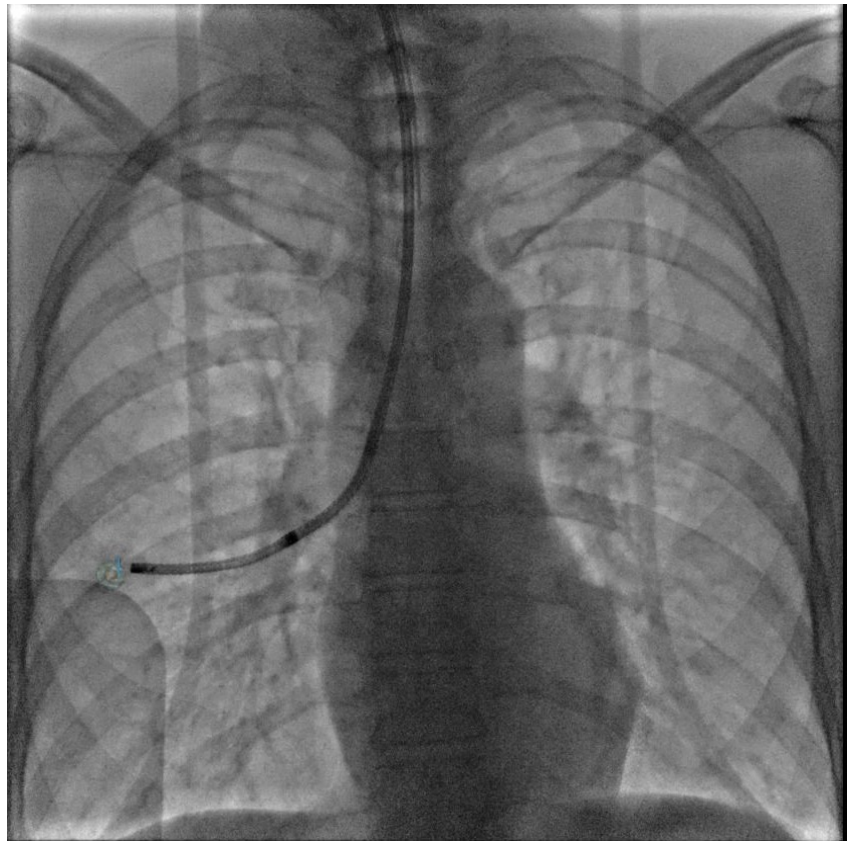
Fibroscope standard

4.9 mm



Fibroscope Ultra-fin

3 mm

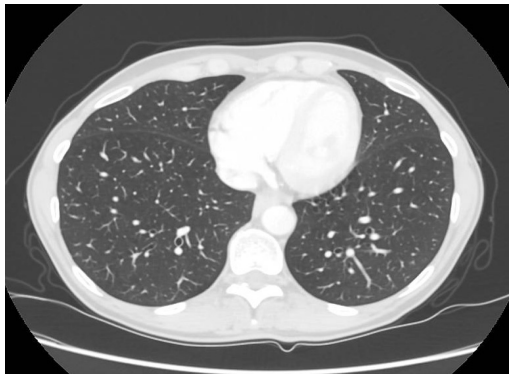


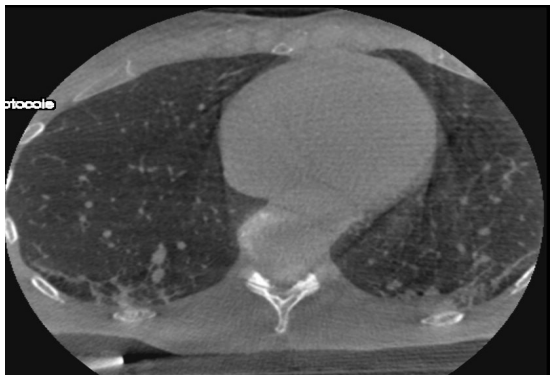
# B. Atélectasie

Scanner Pre-procédure

Ventilation non-optimisée

Ventilation optimisée



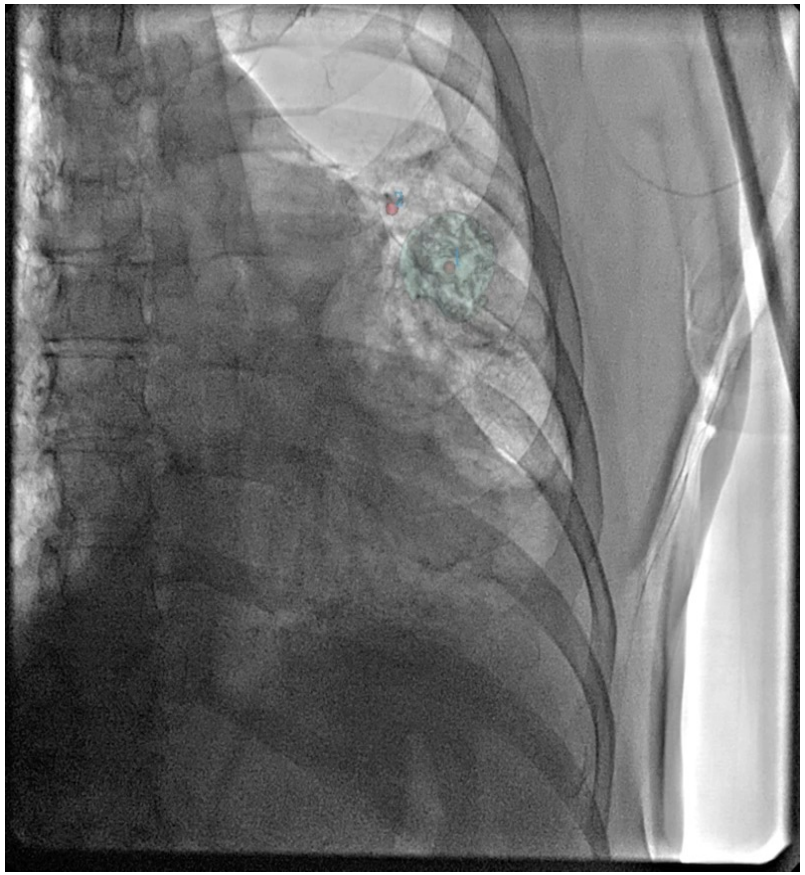


# C. CT to body divergence

- Mouvements respiratoires changent
  - Le volume pulmonaire
  - L'orientation des VA et des instruments

- La superposition de l'emplacement réel de la lésion et de la cible ne se produit qu'en un seul point du cycle respiratoire (fin de l'expiration).

- Distance de mismatch : 17.6 mm et 25.3 mm



# D. Techniques de prélèvement

# Cryobiopsie pour NPP: ML data

**Table 1. :** Results of endoscopic pulmonary cryobiopsy for PPN's.

| | Pulmonary lesions n=39 |
|---|---|
| Age, mean±SD | 68±10 |
| Sex, F/M | 18/21 |
| Lesion size (mm), mean±SD | 20±9 |
| Localization | |
| Right Upper Lobe, n (%) | 8 (21) |
| Middle Lobe | 6 (15) |
| Right Inferior Lobe | 5 (13) |
| Left Upper Lobe | 13 (33) |
| Left Inferior Lobe | 7 (18) |
| Bleeding, n (%) | 12 (31) |
| Diagnose, n (%) | 33 (85) |

Bronchoscopie robotique

RD : 84.3%

Unpublished data

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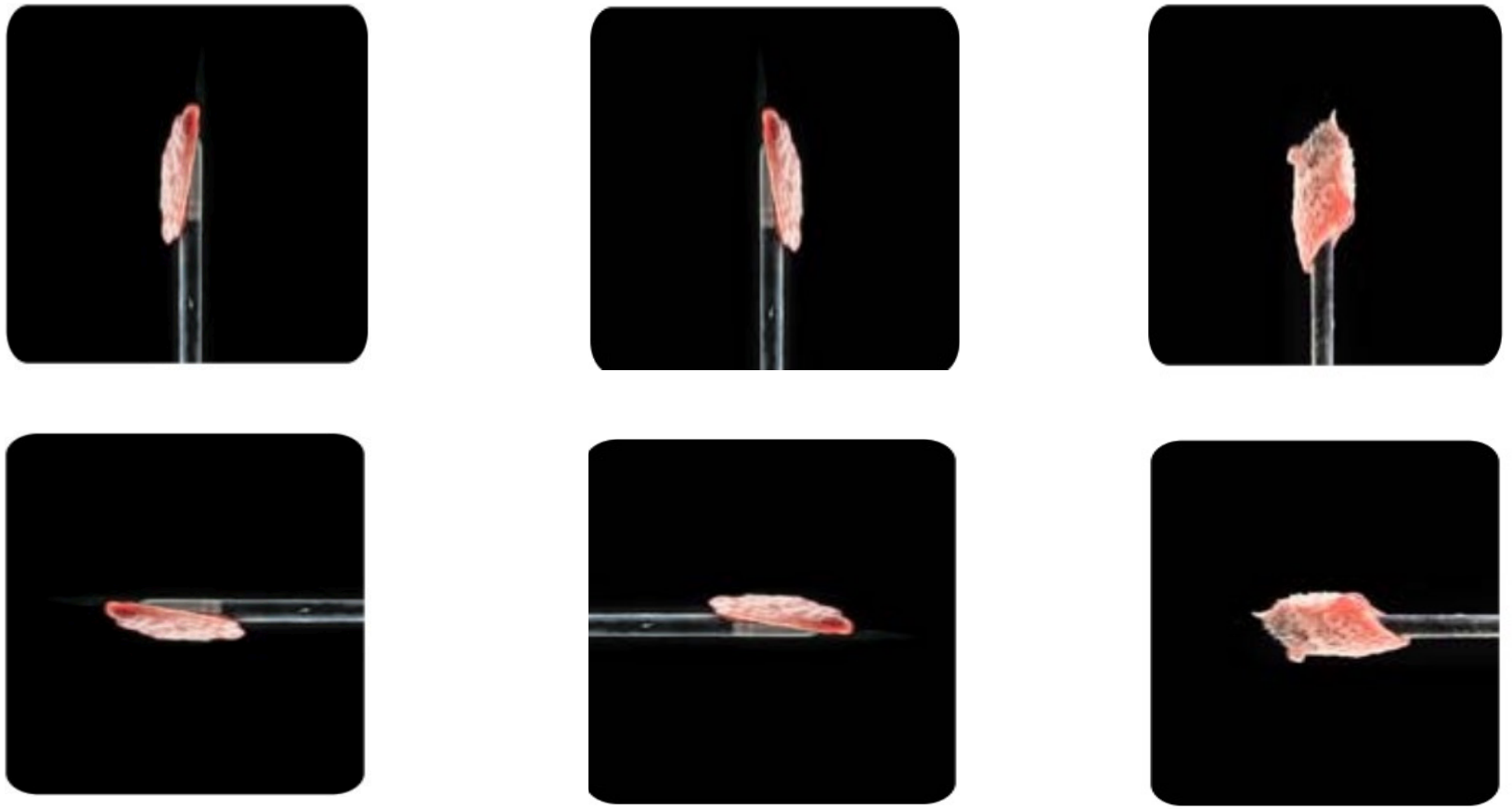
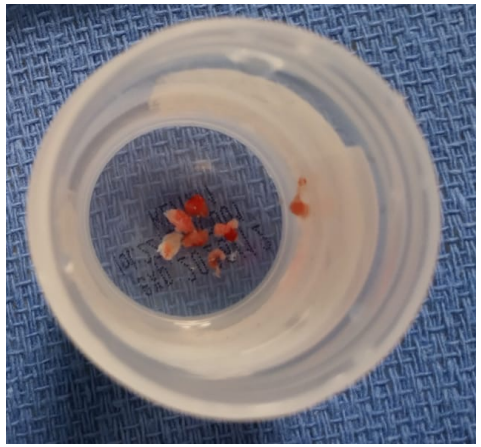
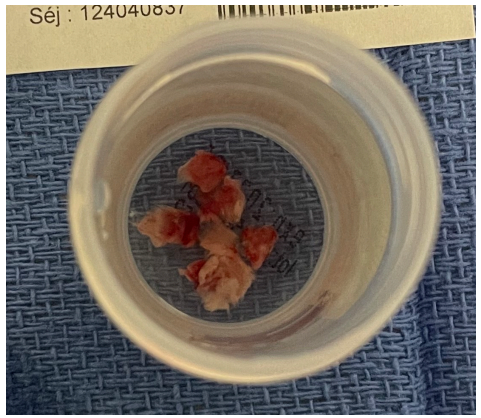
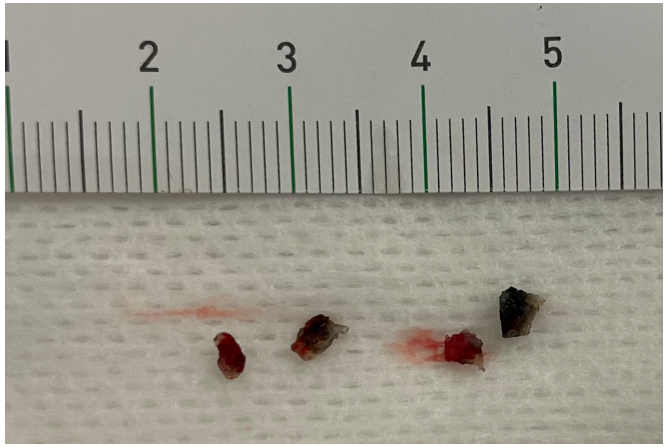
# Cryobiopsie NPP



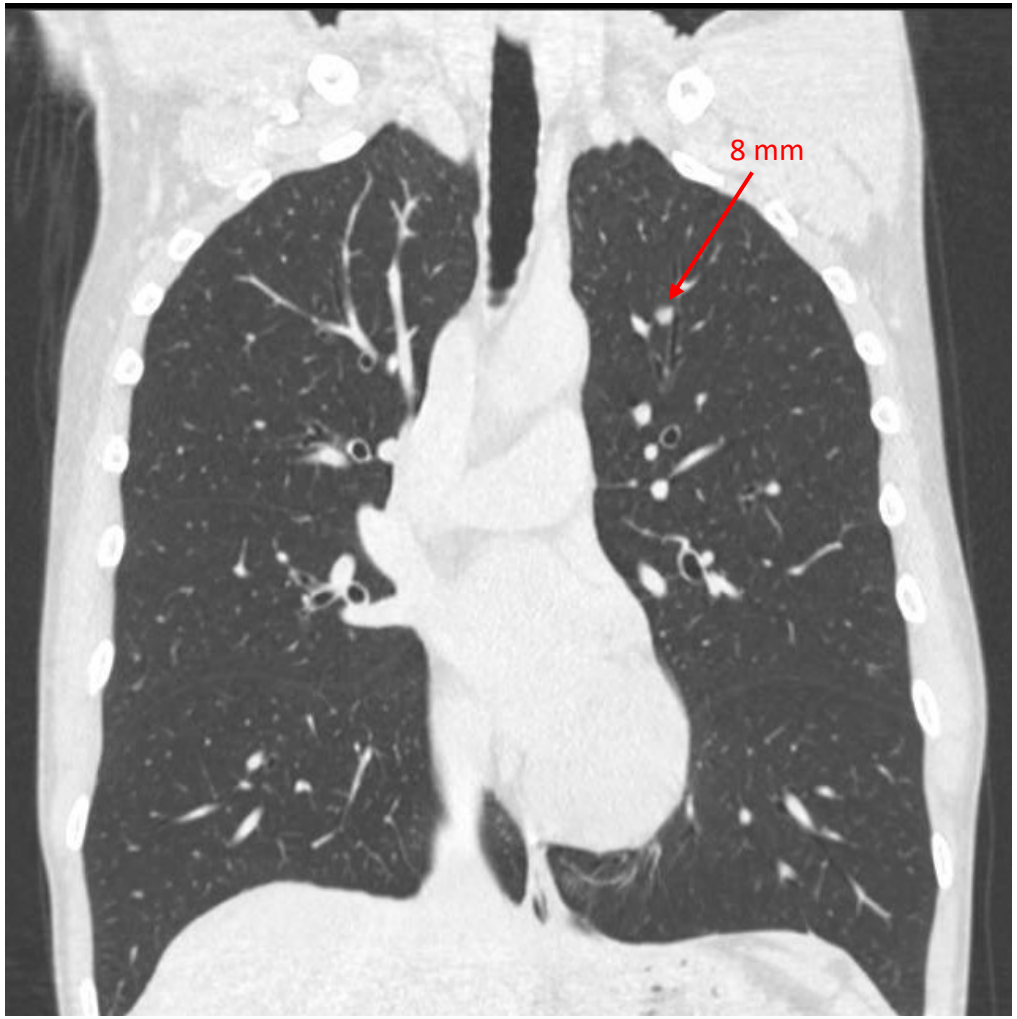
# Taille de prélèvements

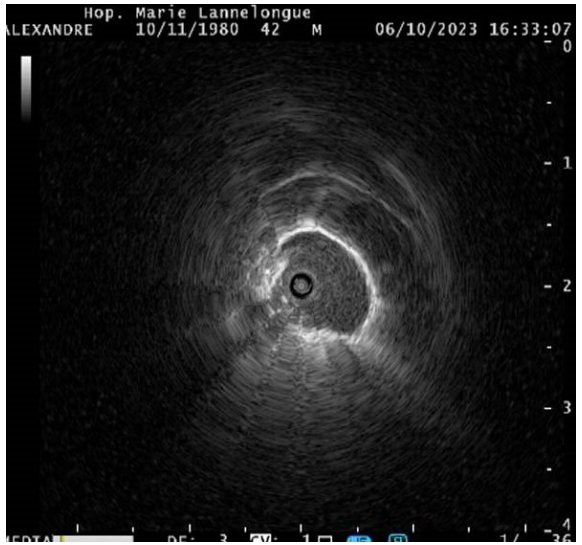




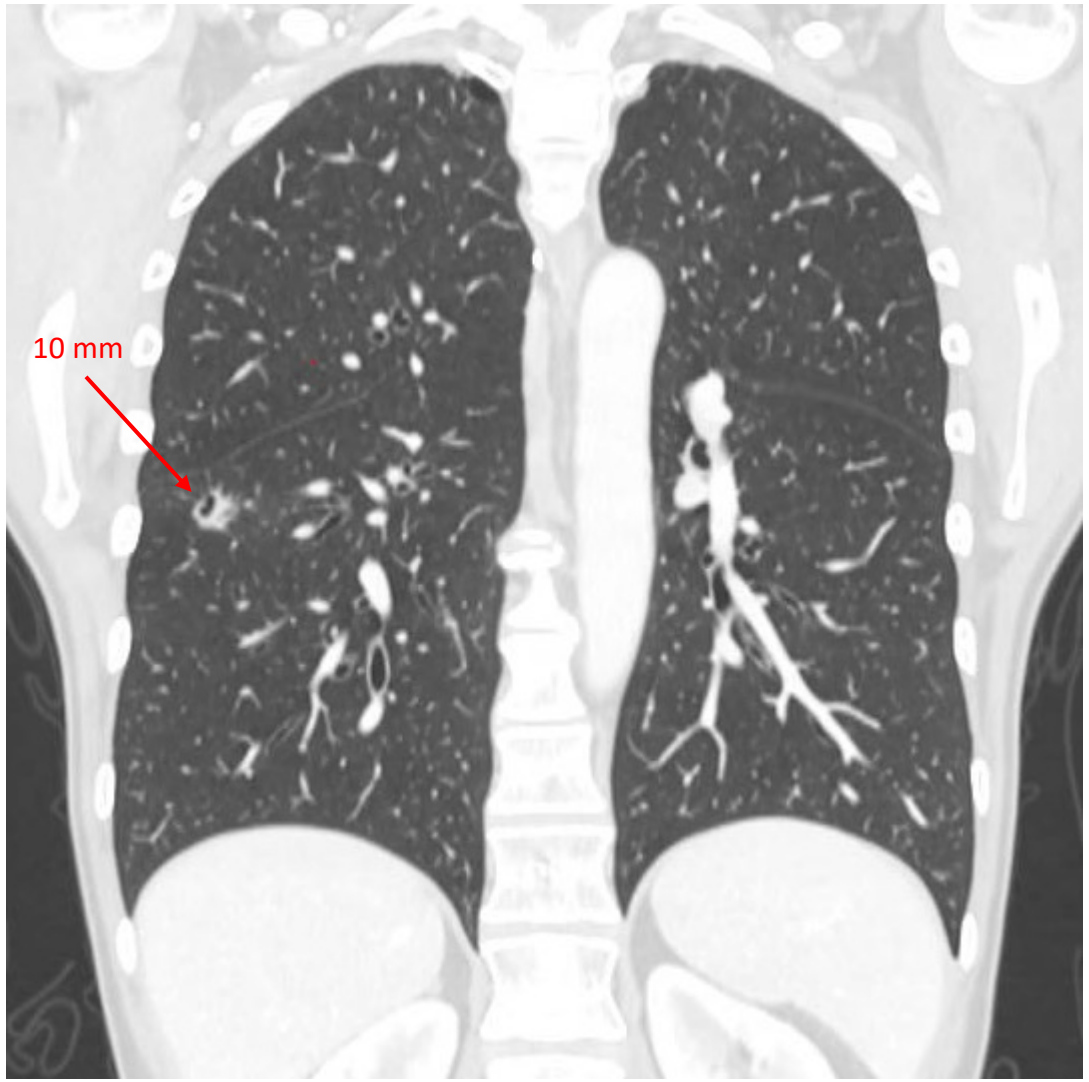


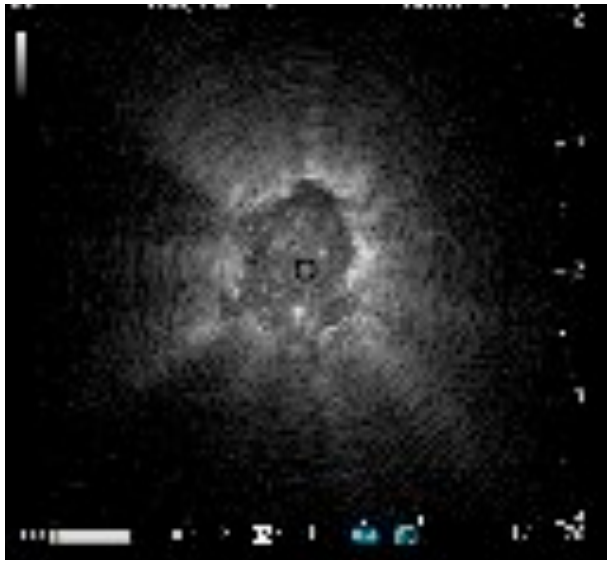
# Seminome


8 mm

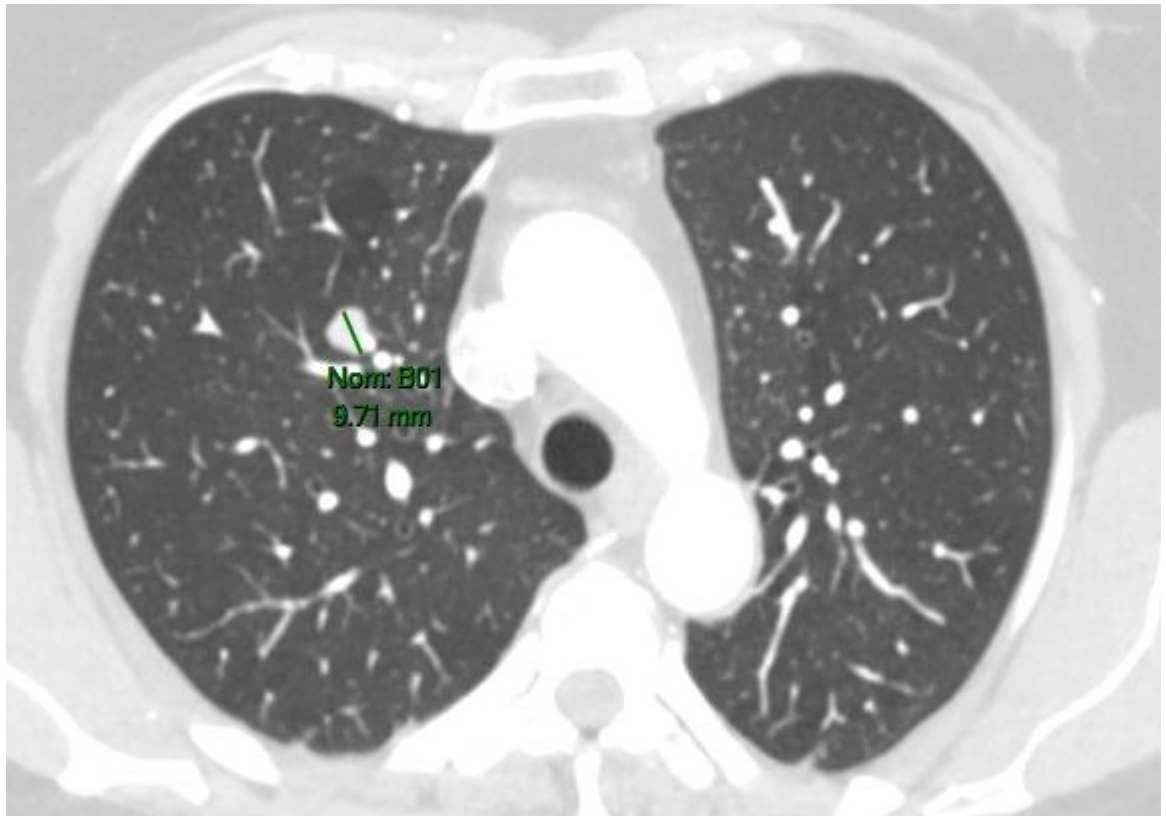

Hop. Marie Lannelongue
LEXANDRE 10/11/1980 42 M 06/10/2023 16:33:07

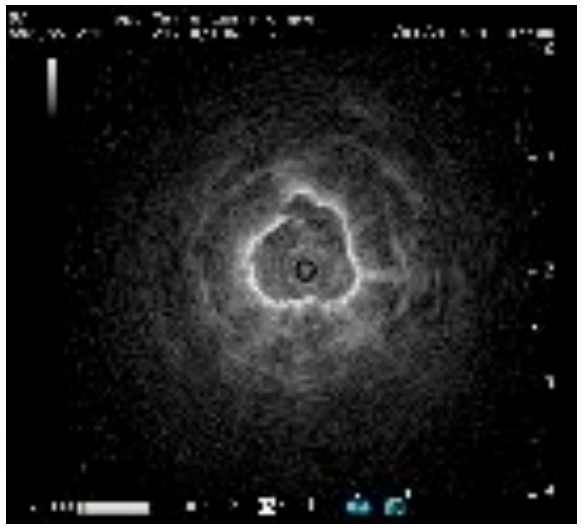
# ADK



# Tumeur carcinoïde



# Les indications de la cryobiopsie:

1. PID
2. Nodules pulmonaires périphériques
3. Adénopathies du médiastin
4. Désobstruction endobronchique
5. Ablation des corps étrangers
6. Decaillotage

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# Merci