

**MINI
CORSI**



PNEUMOMEDICINA 2022

Milano, 26 - 28 maggio 2022 · Centro Congressi Palazzo delle Stelline

BRONCOSCOPIA di
PRECISIONE:
RP-EBUS EMN ROBOTICA
CONE BEAM CT

Emanuela Barisione
UOC PNEUMOLOGIA INTERVENTISTICA
GENOVA
Responsabile GDS AIPO
Pneumologia Interventistica e Trapianto



OSPEDALE POLICLINICO SAN MARTINO

Disclosures

- Chiesi Farmaceutici
- Astra Zeneca
- Glaxo Smith Kline
- Boehringer Ilgehaim



OSPEDALE POLICLINICO SAN MARTINO

AGENDA

- Background
- Tecniche di guida broncoscopica
- Associazione tra più tecniche
- Ruolo della Rapid On Site Evaluation
- Direzioni future
- Conclusioni

Cosa E' cambiato negli ultimi 15 anni in pneumologia interventistica?

LA TECNOLOGIA

GLI OBIETTIVI



BACKGROUND



I noduli polmonari sono un'evenienza sempre più frequente e che probabilmente tenderà ad aumentare:

- Programmi di screening
- Miglioramento ed evoluzione delle tecnologie
- Follow up di altre patologie
- Esami pre-chirurgici per patologie non toraciche ...



Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017¹

A: Solid Nodules*

Nodule T

Single

Low

High

intermediate-risk (5%–65% risk) and high-risk (>65% risk) categories. High-risk factors include older age, heavy smoking, larger nodule size, irregular or spiculated margins, and upper lobe location. Subjects with intermediate risk share both high- and low-risk char-

at 18–24 months

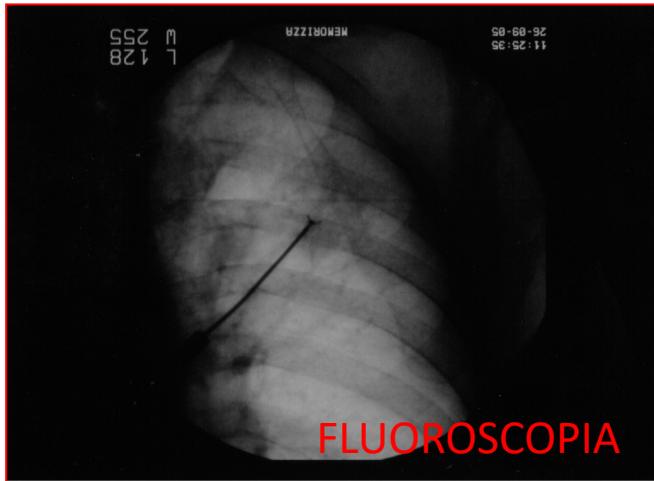
or tissue sampling

hs, PET/CT,

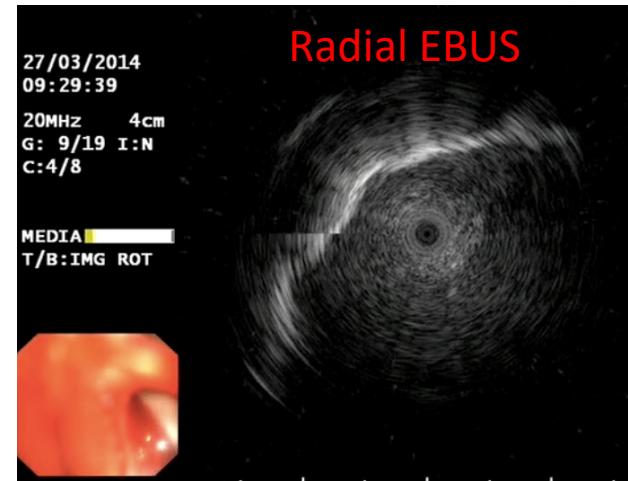
hs, PET/CT,

Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017¹

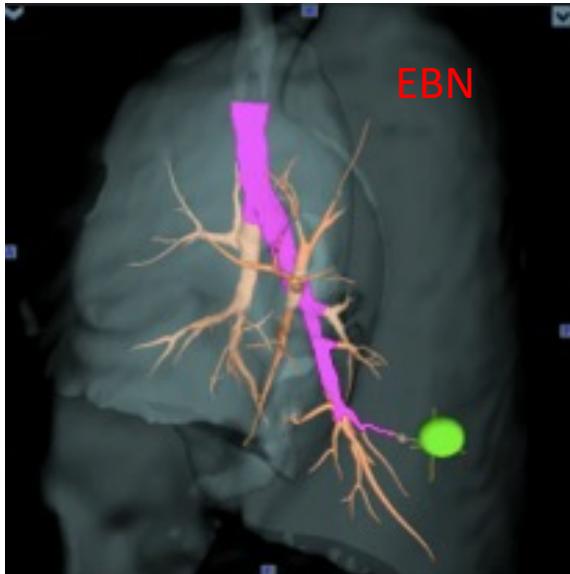
B: Subsolid Nodules*		
Nodule Type	Size	
	<6 mm (<100 mm ³)	≥6 mm (>100 mm ³)
Single		
Ground glass	No routine follow-up	CT at 6–12 months to confirm persistence, then CT every 2 years until 5 years
Part solid	No routine follow-up	CT at 3–6 months to confirm persistence. If unchanged and solid component remains <6 mm, annual CT should be performed for 5 years.



OSPEDALE POLICLINICO SAN MARTINO



Una lesione periferica ha necessita **sempre** di un sistema di guida



Nonsurgical biopsy

- Fluoroscopic guidance
 - R-EBUS
 - Ultrathin bronchoscopy
 - ENB and VB
 - Transthoracic Needle Biopsy
- 
- 



Transthoracic Needle Biopsy

- sensitivity 86 - 90 %
- pneumothorax 15 - 30% (7% chest tube)
- No staging
- Controindications:
 - Contralateral pneumonectomy
 - Severe emphysematous disease or large bullae
 - Intractable cough
 - Inability to lie in required position

- *Gould MK CHEST 2013; 143(5)(Suppl):e142S–e165S*
- *Heerink WJ Complication rates of CT-guided transthoracic lung biopsy: meta-analysis. Eur Radiol 2017;27:138-48.*





TBB under fluoroscopic guidance

L 128

M 255

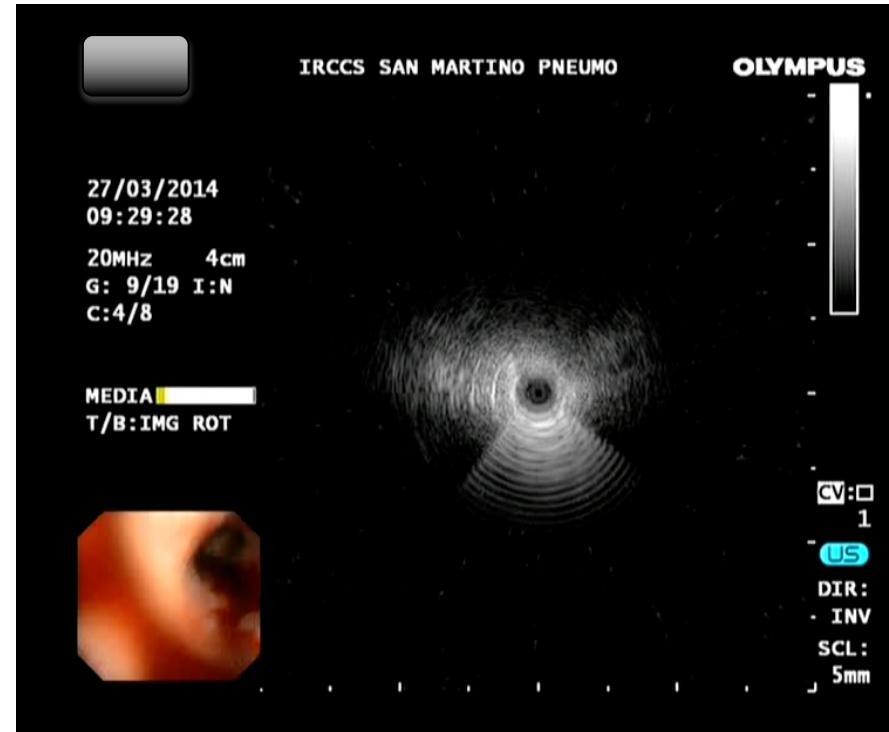
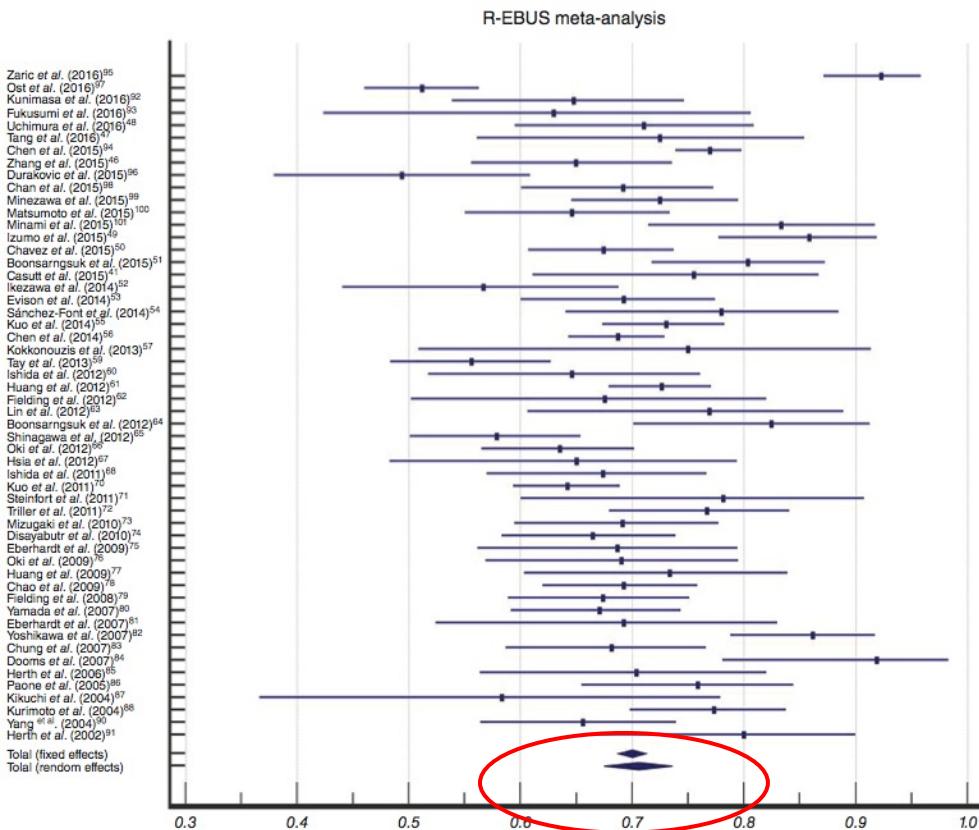
MEMRIZZA
11-25-98-35
26-98-35

All Methods:		< 2 cm LESION				> 2 cm LESION			
First Author	Year	N	Pos	Neg	Sens	N	Pos	Neg	Sens
Gasparini ¹¹⁰	1995	195	82	113	42	300	169	131	56
Hattori ⁷⁶	1971	17	13	4	76	182	150	32	82
Baaklini ⁸⁸	2000	16	4	12	25	135	93	42	69
W... ¹²²	1982	65	2	62	5	78	24	54	31
Size, bronchus sign, high number of TBB, TBNA is better than TBB									
Radke ¹⁰⁶	1979	21	6	15	29	76	49	27	64
Naidich ¹²¹	1988	15	4	11	27	46	26	20	57
Trkanjec ¹²⁹	2003	17	9	8	53	33	27	6	82
McDougall ¹⁰⁵	1981	9	1	8	11	36	21	15	58
Stringfield ¹⁰⁷	1977	3	1	2	33	26	13	13	50
Summary		383	131	252	34	984	622	362	63



Radial endobronchial ultrasound for the diagnosis of peripheral pulmonary lesions: A systematic review and meta-analysis

MUHAMMAD S. ALI ,¹ WILLIAM TRICK,² BENJAMIN I. MBA,² DIVYANSHU MOHANANEN³, JASKARAN SETHI¹
AND ALI I. MUSANI¹ *Respirology* (2017) **22**, 443–453



DY
70,6%

4 factors impact the DY:
Size, nature, BS, R-EBUS probe position
with regard to the lesion



RP-EBUS

- The DY is higher at 87% when the probe was in the centre of the lesion (concentric view) and much lower at 43% when the probe is adjacent (eccentric view)

Kurimoto N Chest 2002

- The yield increased with increasing size of the nodule

Chen A Ann Am Thorac Soc 2014

- The optimal number of biopsy has been reported is 5

Yamada N Chest 2007

- The procedure is safe (pnx 2.8% chest tube 0.4%)

Steinfeld DP Eur Respir J 2011

- Major limitation: operator dependence and poor visualization of GGO

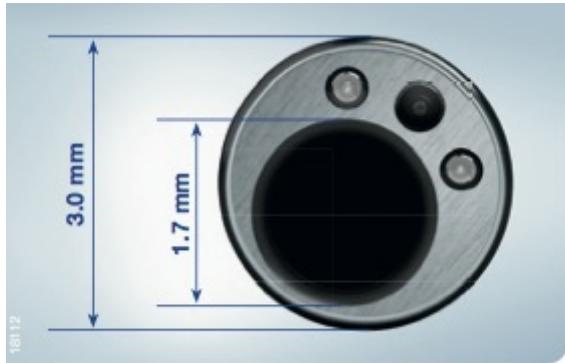
Dhillon SS J Thorac Dis 2017



BF-MP190F

Ultrathin Bronchoscope Ideal for Peripheral Lung Regions

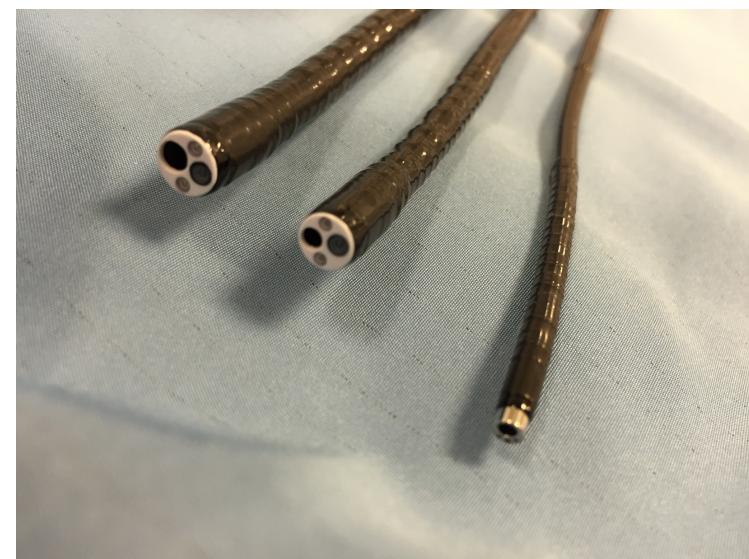
Ultrathin bronchoscopy



BF-1TH190

BF-H190

BF-MP190F



3.0 mm Øest, 1.7 mm Ø operative channel

Better maneuverability, can visualize deeper into tracheobronchial tree and
can reach up to the 6th-8th generation bronchi

Direct comparison studies with other techniques have not been performed

Only two small studies [*Yamamoto Lung Cancer 2004* and *Oki Eur Respir J 2007*] having 60% and 69.4% yield respectively and no complications



Electromagnetic navigational bronchoscopy (ENB)

SuperDimension System®

(Medtronic, Minneapolis, MN, USA)

ENB was designed to extend bronchoscopy to more peripheral airways using a combination of hard-ware based and soft-ware based solution

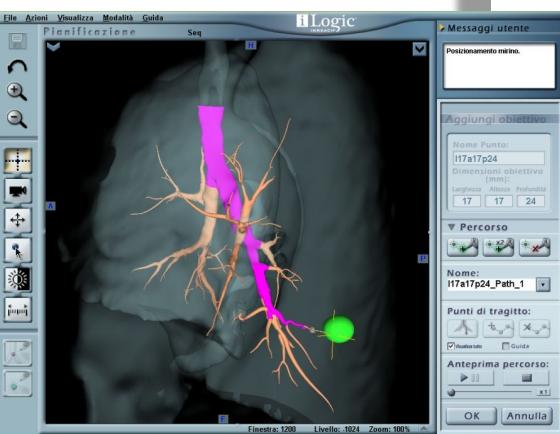
ENB is an image-guided approach that uses 3D reconstructed CT-scan and sensor location technology to guide an endoscopic probe to peripheral lung lesions

The software reconstructs the images into a multiplanar format, showing axial, coronal and sagittal CT views



Diagnostic Yield and Safety of Electromagnetic Navigation Bronchoscopy for Lung Nodules: A Systematic Review and Meta-Analysis

Gregoire Gex^a Jacques A. Pralong^a Christophe Combescure^b Luis Seijo^d
Thierry Rochat^a Paola M. Soccal^{a,c}



Reported significant predicting factors in univariate analysis

Location in lower lobe [18]

Size of the nodule [23]

Bronchus sign [23]

AFTRE [16]

Nodule visualization with radial-probe EBUS [18, 21]

Catheter suction technique versus forceps biopsies [21]

Reported significant predicting factors in multivariate analysis

Bronchus sign [23]



Author, year	Study population/ patients diagnosed by EMN	Diagnostic yield (%)
Becker <i>et al.</i> , 2005 ^[22]	18/30	60
Hautman <i>et al.</i> , 2005 ^[34]	11/16	69
Gildea <i>et al.</i> , 2006 ^[11]	32/56	57
Schwartz <i>et al.</i> , 2006 ^[24]	9/13	69
Makris <i>et al.</i> , 2007 ^[19]	25/40	63
Eberhardt <i>et al.</i> , 2007 ^[12]	52/93	56
Eberhardt <i>et al.</i> , 2007 ^[23]	23/39	59
Eberhardt <i>et al.</i> , 2007 ^[23]	35/40	88
Wilson <i>et al.</i> , 2007 ^[25]	151/271	56
Bertoletti <i>et al.</i> , 2009 ^[35]	33/54	61
Lamprecht <i>et al.</i> , 2009 ^[20]	10/13	77
Eberhardt <i>et al.</i> , 2010 ^[21]	38/55	69
Seijo <i>et al.</i> , 2010 ^[26]	34/51	67
Mahajan, 2011 ^[36]	24/49	49
Lamprecht <i>et al.</i> , 2012 ^[27]	94/112	84
Pearlstein <i>et al.</i> , 2012 ^[28]	67/101	66
Karnak <i>et al.</i> , 2013 ^[37]	32/35	91
Loo <i>et al.</i> , 2014	46/49	94



ENB

Elective indications

- Lesion not visible in fluoroscopy and/or R-EBUS
- Lesion unreachable with CT guided FNA
- Patient with high risk of PNX (bulous emphysema, respiratory failure, pneumonectomy)
- GGO

Problems

- High costs
- Complex procedure, long learning curve
- Not always CT compatible, sometimes you need to repeat CT
- Long term procedures (need for deep sedation)



SPIN™ THORACIC NAVIGATION TECHNOLOGY

Endobronchial and percutaneous access
EBUS compatibility
Tracking moving nodules
Inspiration/Expiration Lung mapping
No procedural radiation exposure



Cone-Beam CT With Augmented Fluoroscopy Combined With Electromagnetic Navigation Bronchoscopy for Biopsy of Pulmonary Nodules

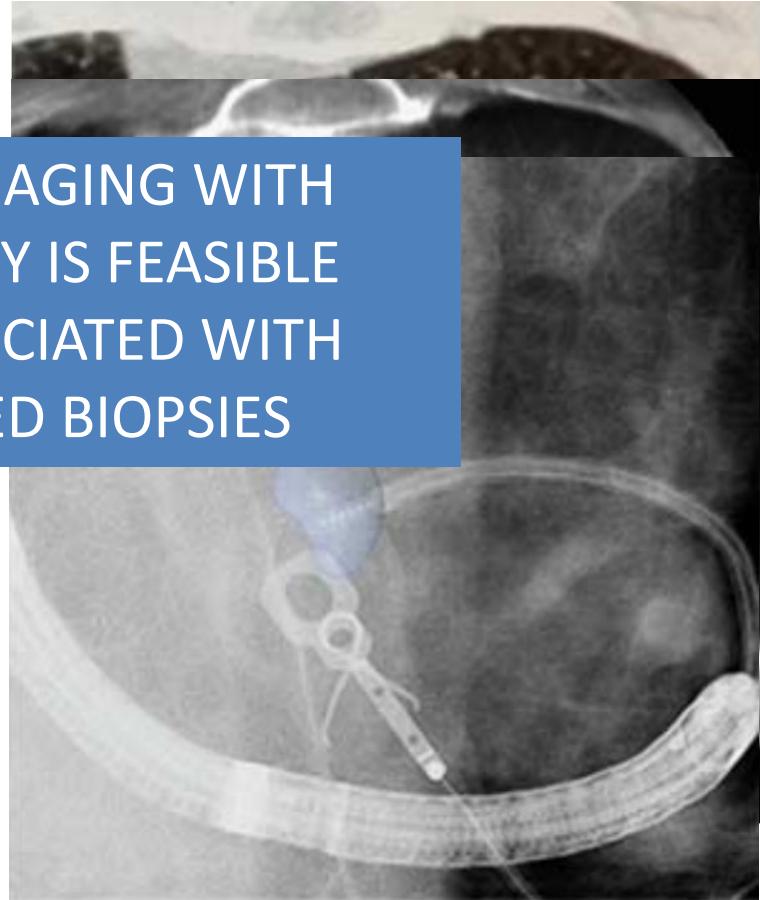
Michael A. Pritchett,

93 lesions - median size 16 mm
(in 75 pt)

The overall DY by lesion was 83.7%

Multivariate analysis showed no difference between lesion visibility on fluoroscopy and bronchus sign with DY.

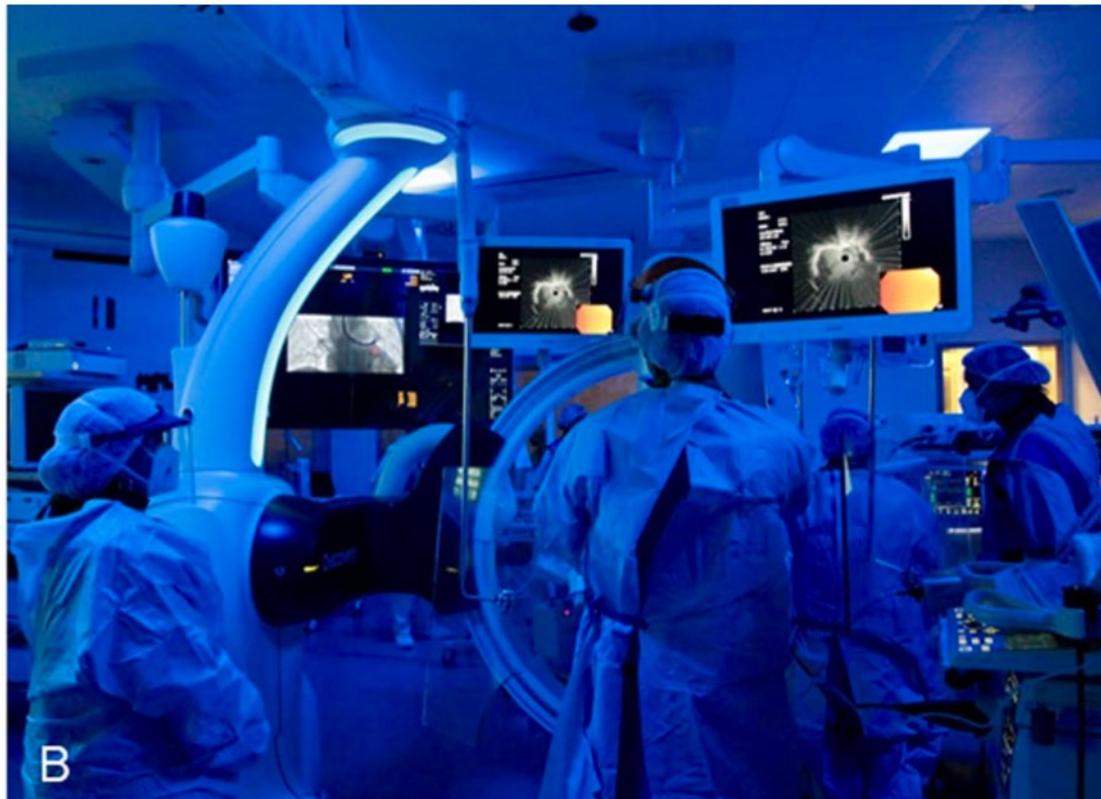
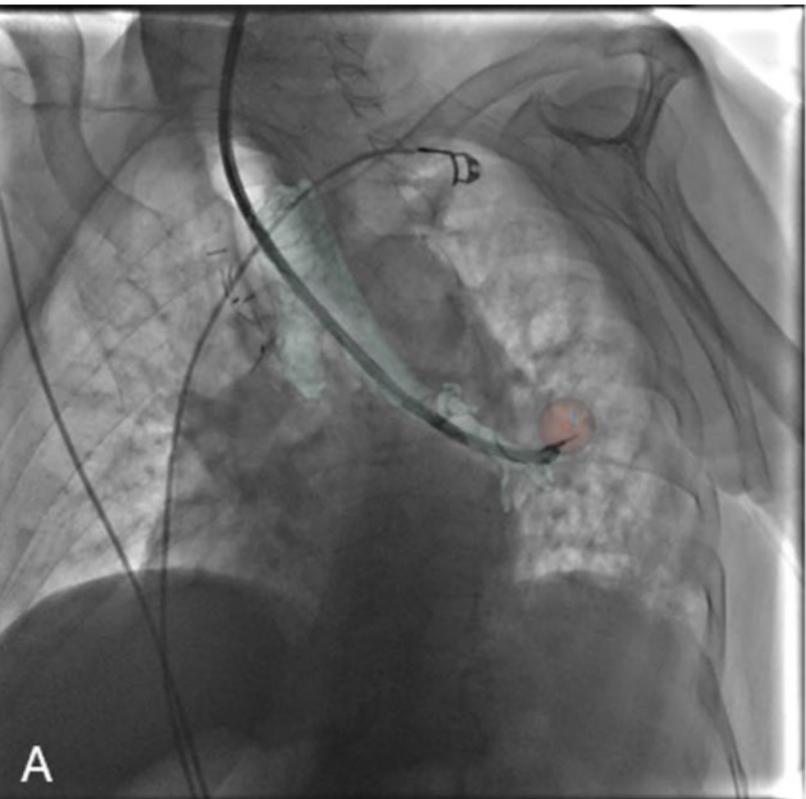
INTRAPROCEDURAL CBCT IMAGING WITH AUGMENTED FLUOROSCOPY IS FEASIBLE AND EFFECTIVE AND IS ASSOCIATED WITH HIGH DY DURING ENB GUIDED BIOPSIES



Pneumothorax occurred in 3 pt (4%)

Cone beam CT augmented fluoroscopy allows safe and efficient diagnosis of a difficult lung nodule

Piro et al. BMC Pulm Med (2021) 21:327

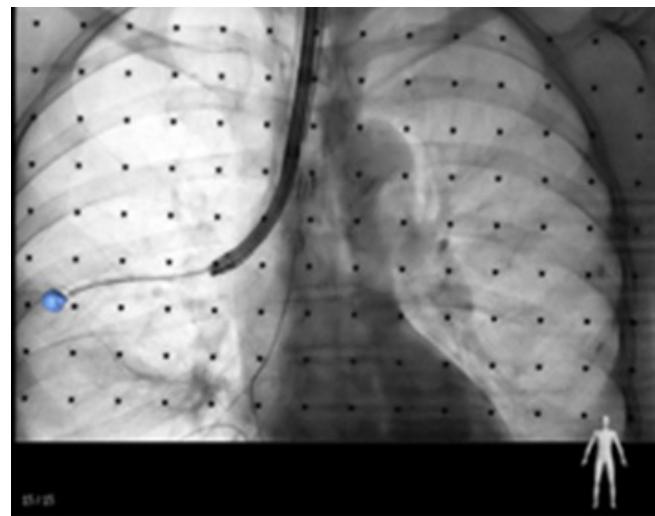
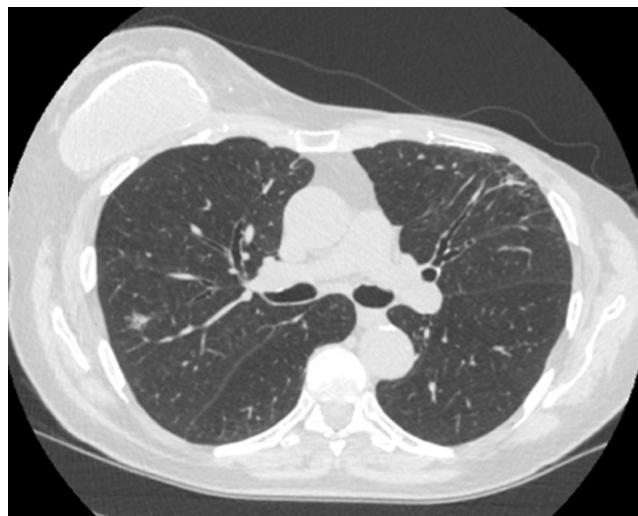


Cone beam navigation bronchoscopy: the next frontier

George Z. Cheng¹

J Thorac Dis 2020;12(6):3272-3278

- EBN has reached a new horizon in its evolution. Combing with real time imaging modalities such as cone-beam CT and augmented fluoroscopy naigation success can finally be confirmed with high degree of accuracy in real time.



Cone beam navigation bronchoscopy: the next frontier

George Z. Cheng¹

J Thorac Dis 2020;12(6):3272-3278

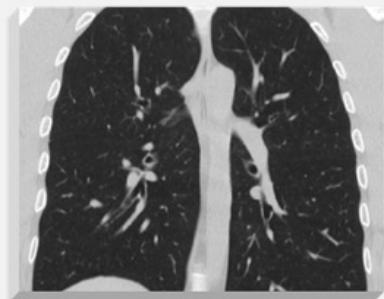
Studies	Design	Procedural modalities	CBCT used	Overall diagnostic yield	Lesions	Nodule size	Radiation information
Pritchett <i>et al.</i>	Retrospective study	CBCT + ENB + AF	Allura Xper FD20; Philips	83%	93	Median nodule size 20 (range, 7–55) mm	2.0 mSv per CBCT run, average 1.5 runs, 3.5 mSv
Sobieszczyk <i>et al.</i>	Retrospective study						Not reported
Casal <i>et al.</i>	Prospective observational cohort study						Estimated to range between 6 to 23 mSv, average
Bowling <i>et al.</i>	Retrospective study		Siemens	of 18 (range, 9–30) mm			bronchoscopy time 8.6 minutes (range, 5–13.4 minutes)
Ali <i>et al.</i>	Prospective study	CBCT + VBN + Ultrathin Bronchoscope	Artis Zeego; Siemens	90%	40	Median nodule size 20 (range, 9–30) mm	Not reported

MORE COMPARATIVE AND PROSPECTIVE STUDIES ARE NEEDED TO EVALUATE ARE NEEDED TO EVALUATE CBCT COMBINED NAVIGATION FOR DIAGNOSIS PPLs IN THE FUTURE TO DELINEATE THE BEST CLINICAL PRACTICE AND COMBINATION OF TECHNIQUE

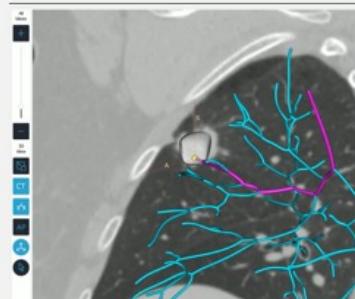
LungVision™ Platform



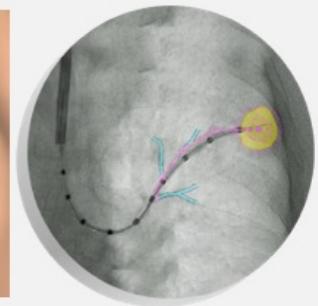
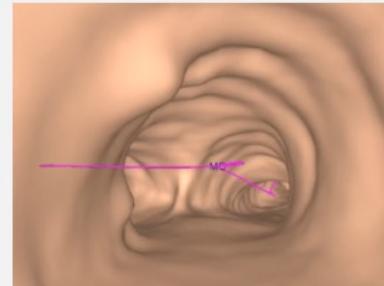
Pre-operative CT



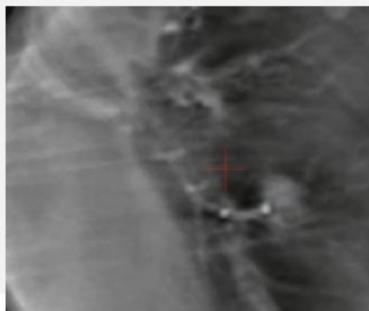
Planning



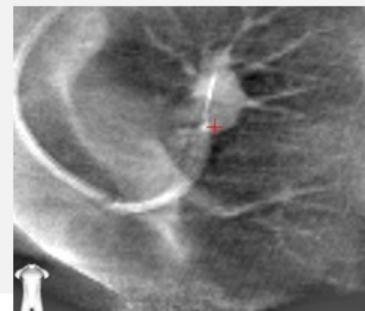
Navigation



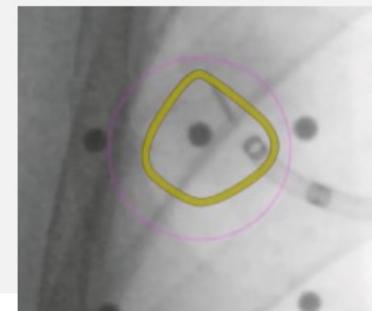
Lesion Localization



Tool-in-Lesion



Biopsy



Procedure Workflow

C-Arm Setup

Navigation

Confirmation with
CABT/REBUS

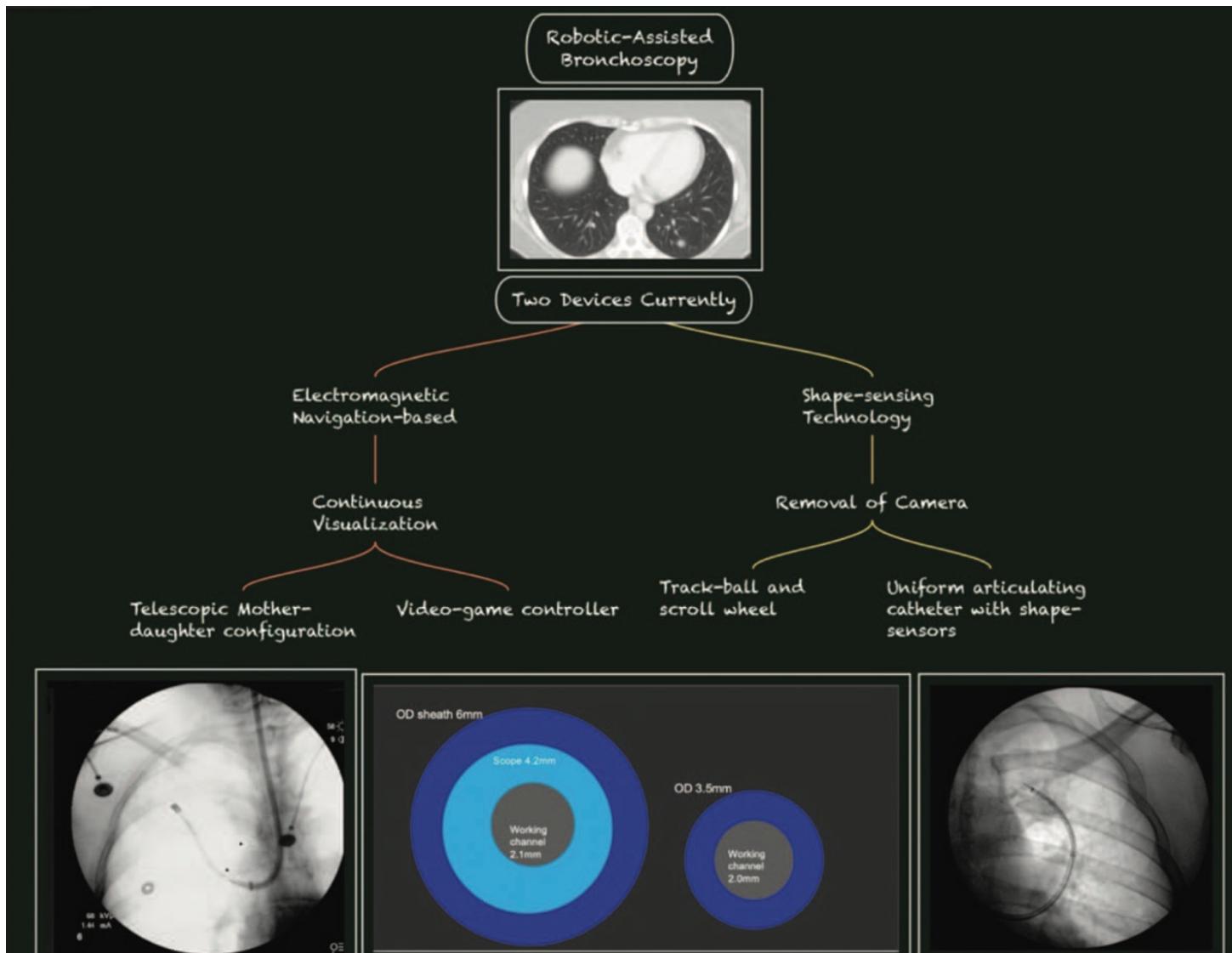
Biopsy

Sampling



Robotic bronchoscopy and future directions of interventional pulmonology

Erik Folchⁱ



Robotic bronchoscopy and future directions of interventional pulmonology

Erik Folchⁱ

Robotic Platform	Study	Overall Pneumothorax Rates	Pneumothorax Requiring Intervention	Number of Patients
Ion	Fielding 2019	0.0%	0.0%	29
	Benn 2021	3.8%	1.4%	52
	Kalchiem-Dekel 2021	1.5%	1.5%	131
	Reisenauer 2021	3.3%	0.4%	241
Monarch	Rojas Solano 2018	0.0%	0.0%	15
	Chaddha 2019	3.6%	2.4%	165
	Chen 2021	3.7%	1.9%	54

THE SAFETY OF BOTH PLATFORM IS COMPARABLE IF NOT BETTER THAN PRIOR NAVIGATION TECHNOLOGIES, AND SIGNIFICANTLY BETTER THAN CT-GUIDED PERCUTANEOUS NEEDLE BIOPSIES

Robotic bronchoscopy and future directions of interventional pulmonology

Erik Folchⁱ

wwwco-pulmonarymedicinecom

Volume 28 • Number 1 • January 2022

Robotic Platform	Study	Diagnostic Outcomes	Mean Largest Diameter (mm)	Size range (mm)	Number of Patients	Bronchus sign (%)
Ion	Fielding 2019	88.0%	14.8	10-26.4	29	58.6%
	Benn 2021	86.0%	21.9	7-60	52	46.0%
	Kalchiem-Dekel 2021	81.7%	18.0	13-27	131	62.9%
	Ost 2021 (PRECIe interim)	88.0%	17.0	10-30	69	25.0%
	Reisenauer 2021	NR	18.8	10-30	241	NR
Monarch	Rojas Solano 2018	NR	26.0	10-63	15	100.0%
	Chaddha 2019	69.1%	25.0	25-40	165	63.5%
	Chen 2020	74.1%	23.0	10-50	54	59.3%

These results are described as originally presented by the authors and should not be compared against each other but rather used as an overall picture of the potential of these robotic technologies

- Ishida T et al. **VBN** combined with **EBUS** to diagnose small peripheral pulmonary lesions: a randomized trial Thorax 2011;66:1072-7
- Asano F et al. **VBN** combined with **ultrathin bronchoscopy**. A randomized clinical trial Am J Respir Crit Care Med 2013;188:327-33
- Chee A et al Diagnostic utility of peripheral **EBUS** with **ENB** in peripheral lung nodules Respirology 2013;18:784-9
- Eberhard R et al. **Multimodality** bronchoscopy diagnosis of peripheral lung lesion: a randomized controlled trial Am J Respir Crit Care Med 2007;176:36-41
- Xu CH et al. Value of **R EBUS** guided localization of solitary pulmonary nodules with the combination of **ultrathin bronchoscopy** and **methylkene blu** prior to **video assisted thoracoscopic surgery** Molec and Clinic Oncol 2016;5:279-82
- Tamiya ; et al Diagnostic yield of combination bronchoscopy and **EBUS, under LungPoint guidance** for small peripheral pulmonary lesions. Respirology 2013;18:834-9



Multimodality bronchoscopic diagnosis of peripheral lung lesions: a randomized controlled trial.

Eberhardt R¹, Anantham D, Ernst A, Feller-Kopman D, Herth F.

118 patients

Diagnostic Yield

- ENB Alone 59%
- R-EBUS alone 69%
- ENB combined with R-EBUS 88%

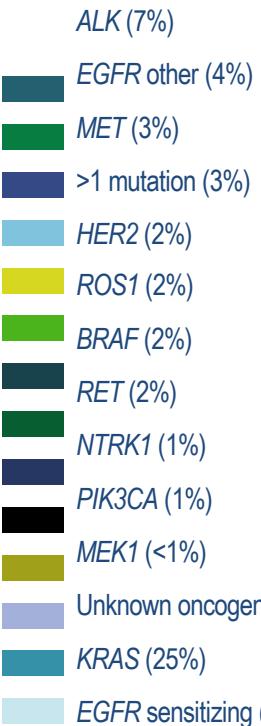


The combined procedure's yield was independent of lesion size or lobar distribution

The pneumothorax rate is from 5 to 8% with no significant difference between the group



ONCOGENIC DRIVERS IN NSCLC



EGFR sensitizing

Gefitinib; Erlotinib; Afatinib; Osimertinib; Dacomitinib

ALK

Crizotinib; Alectinib; Ceritinib; Lorlatinib; Brigatinib

ROS1

Crizotinib; Cabozantinib; Ceritinib; Lorlatinib; Entrectinib; Repotrectinib, DS-6051b

BRAF

Vemurafenib; Dabrafenib; Dabrafenib + Trametinib

MET

Crizotinib; Cabozantinib; Capmatinib; Savolitinib; Tepotinib; Merestinib; Glesatinib

HER2

Trastuzumab emtansine; Afatinib; Neratinib-temsirolimus; Dacomitinib; Poziotinib; XMT-1522; TAK-788; DS-8201a,

RET

Cabozantinib; Alectinib; Apatinib; Vandetanib; sunitinib; Ponatinib; Lenvatinib; BLU-667; LOXO-292

NTRK1

Entrectinib; LOXO-101 (larotrectinib); Ixo-195; DS-6051b; repotrectinib

PIK3CA

LY3023414; PQR 309

MEK1

Trametinib; Selumetinib; Cobimetinib

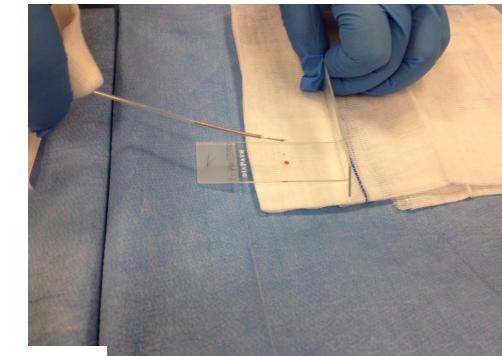


OSPEDALE POLICLINICO SAN MARTINO



GESTIONE del CAMPIONE

RUOLO della ROSE



Chest. 2015 Dec;148(6):1430-1437. doi: 10.1378/chest.15-0583.

Randomized Trial of Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration With and Without Rapid On-site Evaluation for Lung Cancer Genotyping.

Trisolini R¹, Cancellieri A², Tinelli C³, de Biase D⁴, Valentini I², Casadei G², Paioli D², Ferrari F², Gordini G², Patelli M², Tallini G⁴.

Studio randomizzato sull'influenza della ROSE sull'EBUS TBNA

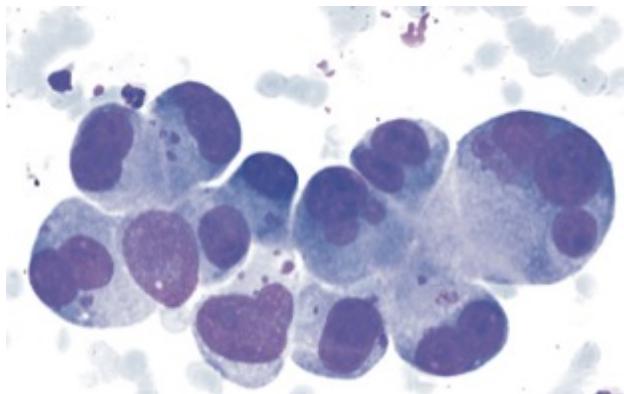
L'analisi molecolare è stata ottenuta nell'85,7% (90,8% ROSE, 80,3% senza ROSE)

La ROSE previene la necessità di ripetere una procedura diagnostica invasiva in pazienti con tumore del polmone avanzato e riduce in modo significativo la necessità di rivalutare i campioni

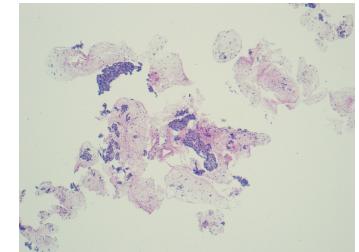
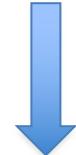
SMEARED CYTOLOGY



- ROSE
- Immunoistochimica
- Definizione dell'istotipo
- Valutazione molecolare:
 - EGFR
 - ALK



CELL BLOCK



- Immunoistochimica
- Definizione dell'istotipo
- Valutazione molecolare:
 - EGFR
 - ALK
 - PD-L1

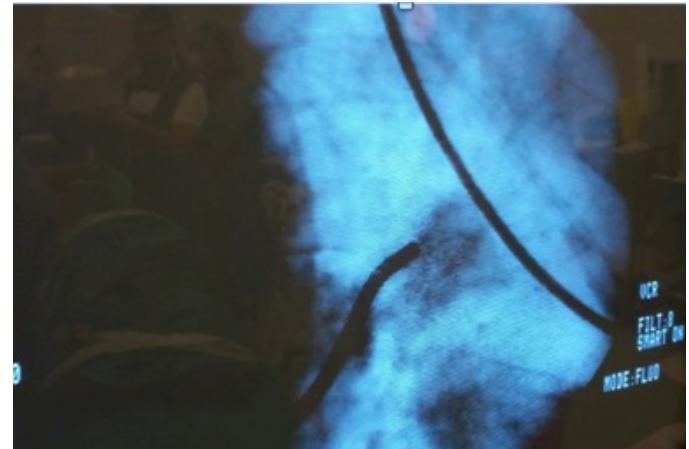
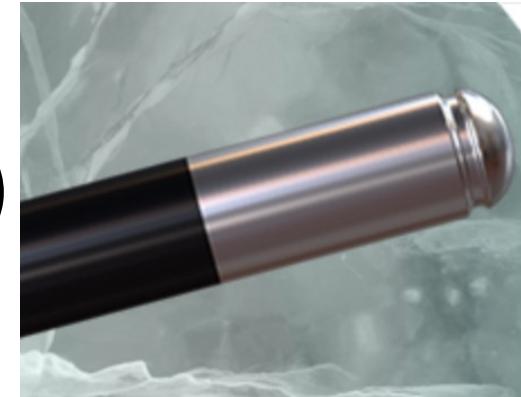
I patologi possono rivalutare il tessuto per altri usi



ESPERIENZA PERSONALE

ultrathin bronchoscopy AND cryoprobe

- 18 pt (14 male 78%)
- Median age 76 years (range 40-91)
- Complications pneumothorax 1
- moderate bleeding 3



Maschio 1948

Fumatore attivo 48 p/y

Ipertensione arteriosa in tp

Gotta

Da circa 2 messi tosse stizzosa

Alcuni episodi di escreato
striato di sangue

Nodulo 18x12 mm LSD (SUV 13.9)

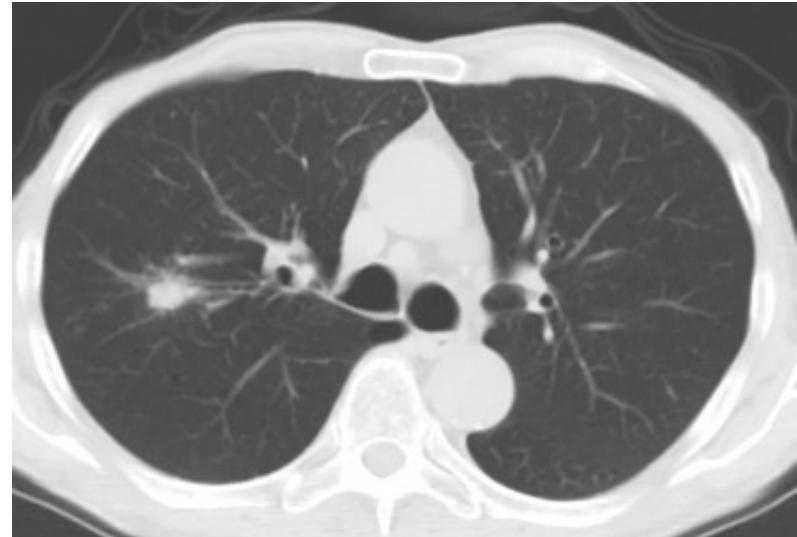
LAM 4R 11x 9 mm (SUV 3)

11R 14x 12 mm (SUV 8)

7 9x 8 mm (SUV 2.8)

TC cranio neg

cT1bN2M0 – stadio IIIA



Pianificazione con Navigatore Medtronic iLogic



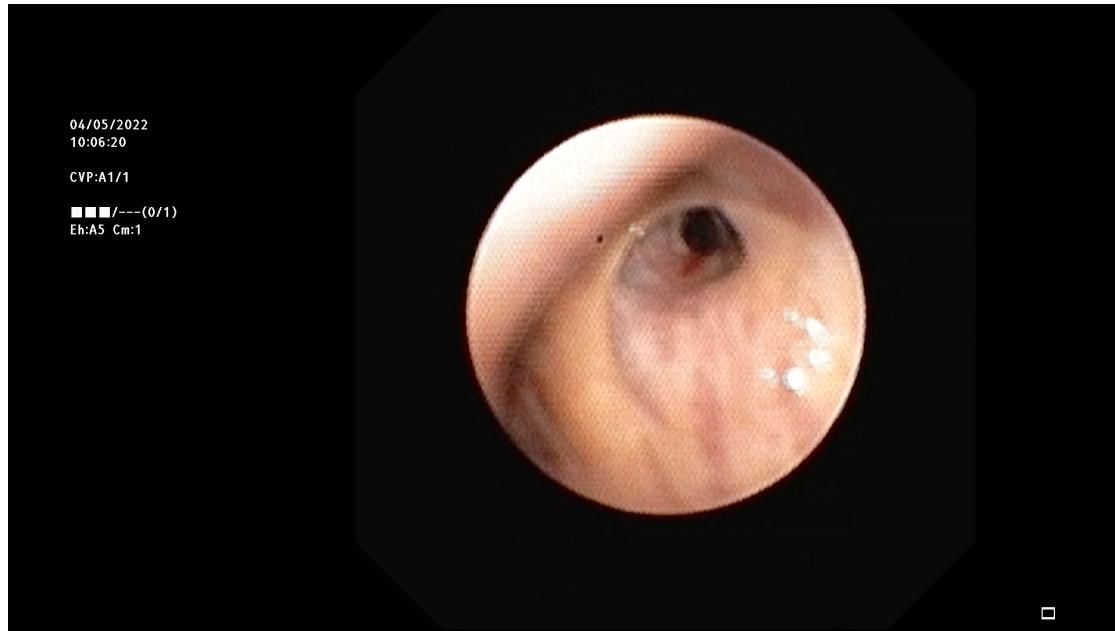
Broncoscopio ultrasottile + Fluoroscopia



Percorso con guida fluoroscopica



Prelievo con criosonda 1.1mm



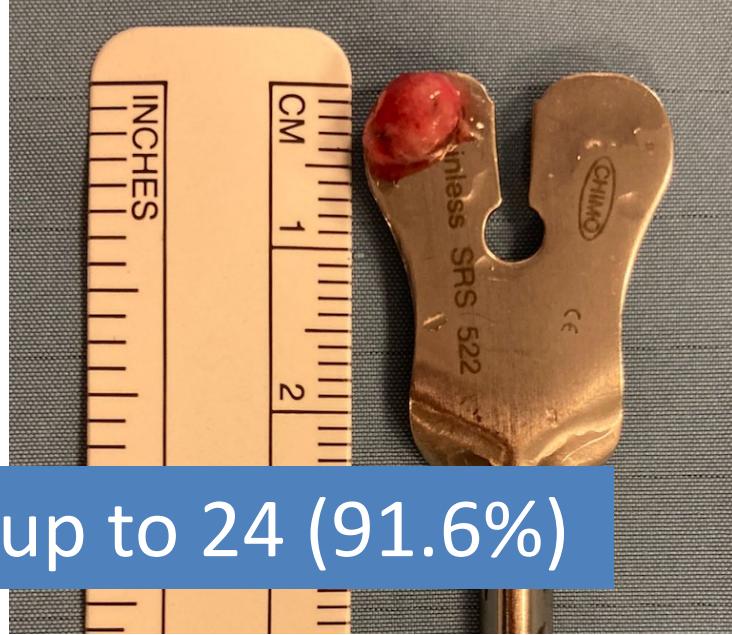
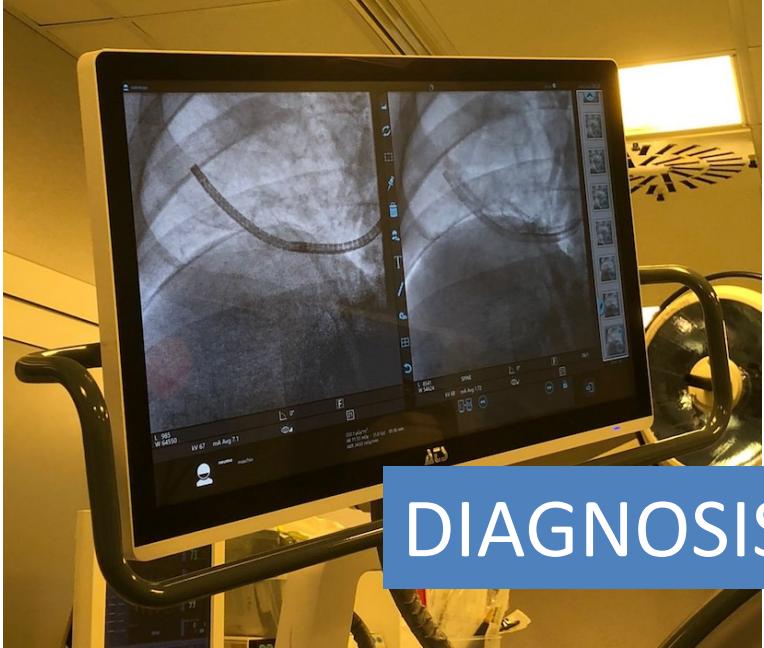
Controllo ecografico



STADIAZIONE del MEDIASTINO CON EBUS-TBNA
nelle stazioni 7 e 4R – nella stazione 11R + ADK

DIAGNOSI SU NODULO ADK

CHIRUGIA CONFIRMA ADK e EBUS TBNA VN



DIAGNOSIS 22 up to 24 (91.6%)

SITE	NUMBER
B6 left	2
B8 right	6
B3 right	3
B9 right	1
B4 left	1
B1+2 left	2
lingula	1

HISTOLOGY	NUMBER
Adenocarcinoma	15
Organizing pneumonia	1
Mucoepidermoid carcinoma	1
Squamous cell carcinoma	1
carcinoid	2
Non-Hodgkin's Lymphoma	1
Lipoma	1

Robotic bronchoscopy and future directions of interventional pulmonology

Erik Folchⁱ

FUTURE – ABLATION TECHNIQUES

- Percutaneous ablation techniques with microwave (MWA), radiofrequency (RFA), and cryotherapy ablation probes have been extensively used and rely on the use of CT-guided imaging to confirm tool-in- lesion as well as the ablation zone
- Until recently, the use of navigation bronchoscopy to guide flexible ablation probes to the lung periphery had been suboptimal in part due to limitations of localization and in part due to difficulties using rigid probe
- The characteristics of the robotic platform allow for a steady position from which to extend an ablation catheter and maintain position for 8–12 min whereas ablation occurs

Endobronchial ultrasound-guided bipolar radiofrequency ablation for lung cancer: A first-in-human clinical trial



The Journal of Thoracic and Cardiovascular Surgery

JTCVS

Ablate-and-resect study

Patients scheduled for surgical resection of clinical stage I/II lung cancer or metastatic lung lesions ≥ 1 cm were recruited

EBUS-guided RFA

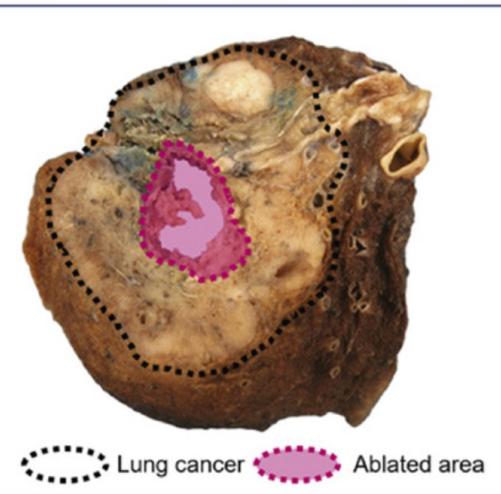
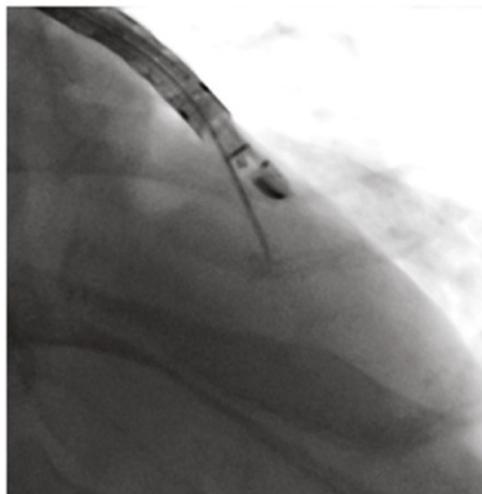
- Under general anesthesia
- Needle-type RFA device
- Energy: 4-8 kJ

Post-RFA adverse event assessment

- Endobronchial observation
- Contrast CT scan

Surgical resection

Pathological assessment



Lung cancer Ablated area

No major procedure-related adverse events were observed in five patients

All ablations were located within the tumor boundaries, as intended.

EBUS-guided RFA can be a therapeutic option for centrally located lung tumors

EBUS, endobronchial ultrasound; RFA, radiofrequency ablation; CT, computed tomography.

J Thorac Cardiovasc Surg. 2022 Mar 26;S0022-5223(22)00344-0.

Advanced Bronchoscopic Technologies for Biopsy of the Pulmonary Nodule: A 2021 Review

Micah Z. Levine ¹, Sam Goodman ¹, Robert J. Lentz ², Fabien Maldonado ², Otis B. Rickman ² and James Katsis ^{1,3,*}

CONCLUSIONS

- A standard method for determining diagnostic yield in biopsy literature would be valuable in guiding future practice to ensure we provide the best possible care for our patients
- The DY and safety profile are the essential determinants in what we should ultimately recommend to our patients
- Local expertise and shared decision-making are frequently utilized to guide management
- Bronchoscopy technology are frequently used in tandem and biopsy techniques inevitably vary between operators
- Large scale, prospective and randomized studies that utilize an agreed upon standard for calculating and reporting DY would be of high clinical value and allow providers to achieve a more accurate understanding of which technologies may be superior in their safety profile and offering the highest DY



diagnostics

Diagnostics 2021, 11, 2304



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Benetti Roberto
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Torriglia Carla

Camogliano Valter CPS

e tutto il team

UOC Pneumologia Interventistica



Quale strumento è in grado di fornirci il materiale maggiormente adeguato?

Review

EGFR mutation testing in lung cancer: a review of available methods and their use for analysis of tumour tissue and cytology samples

Gillian Ellison,¹ Guanshan Zhu,² Alexandros Moulis,³ Simon Dearden,¹ Georgina Speake,¹ Rose McCormack¹

METODICA	N°LAVORI	N°PAZIENTI
BAS/BAL	3	59
Brushing	3	118
TBNA	3	169
EBUS TBNA	6	1182

Cytology samples can be used to reliably detect EGFR mutations. Mutation detection rates cytology samples are comparable with those achieved with traditional tissue sample obtained by biopsy or resection



Endobronchial ultrasound-guided transbronchial needle aspiration for identifying EGFR mutations

I. Garcia-Olivé*,[#], E. Monsó*,[†], F. Andreo*,[†], J. Sanz-Santos*,[‡]

Human Cancer Biology

EML4-ALK Fusion Gene Assessment Using Metastatic Lymph Node Samples Obtained by Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration

Yuichi Sakairi, Takahiro Nakajima, Kazuhiro Yasufuku, Dai Ikebe, Hajime Kageyama, Manabu Soda, Kengo Takeuchi, Makiko Itami,

Clin Lung Cancer. 2017 Sep;18(5):527-534.e1. doi: 10.1016/j.cllc.2016.12.002. Epub 2016 Dec 22.

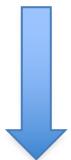
EBUS-TBNA as a Promising Method for the Evaluation of Tumor PD-L1 Expression in Lung Cancer.

Sakakibara R¹, Inamura K², Tambo Y³, Ninomiya H², Kitazono S³, Yanagitani N³, Horiike A³, Ohyanagi F³, Matsuura Y³, Nakao M³, Mun M³, Okumura S³, Inase N⁴, Nishio M³, Motoi N⁵, Ishikawa Y⁶.



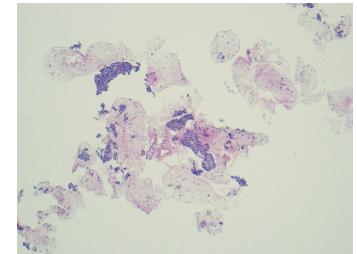
OSPEDALE POLICLINICO SAN MARTINO

SMEARED CYTOLOGY



- ROSE
- Immunoistochimica
- Definizione dell'istotipo
- Valutazione molecolare:
 - EGFR
 - ALK

CELL BLOCK



- Immunoistochimica
- Definizione dell'istotipo
- Valutazione molecolare:
 - EGFR
 - ALK
 - PD-L1

I patologi possono rivalutare il tessuto per altri usi

