ADVANCES IN DIAGNOSTIC BRONCHOSCOPY

Dr Nandakishore B

Overview of the seminar

- Electromagnetic navigational bronchoscopy
- Ultrathin bronchoscope
- Virtual bronchoscopic navigation
- Autoflourescence bronchoscopy(AFB)
- Narrow band imaging
- Recent advances in cryobiopsy

Elecromagnetic navigational bronchoscopy

- First described in 2003 by Becker et al.
- Developed as a novel technology that facilitates approaching peripheral lung lesions, which are difficult to sample by conventional means
- The navigation system involves creating an electromagnetic field around the chest and localizing an endoscopic tool using a microsensor overlaid upon previously acquired CT images

Becker HD et al,Respiration.2003

Components of EMN bronchoscopy system

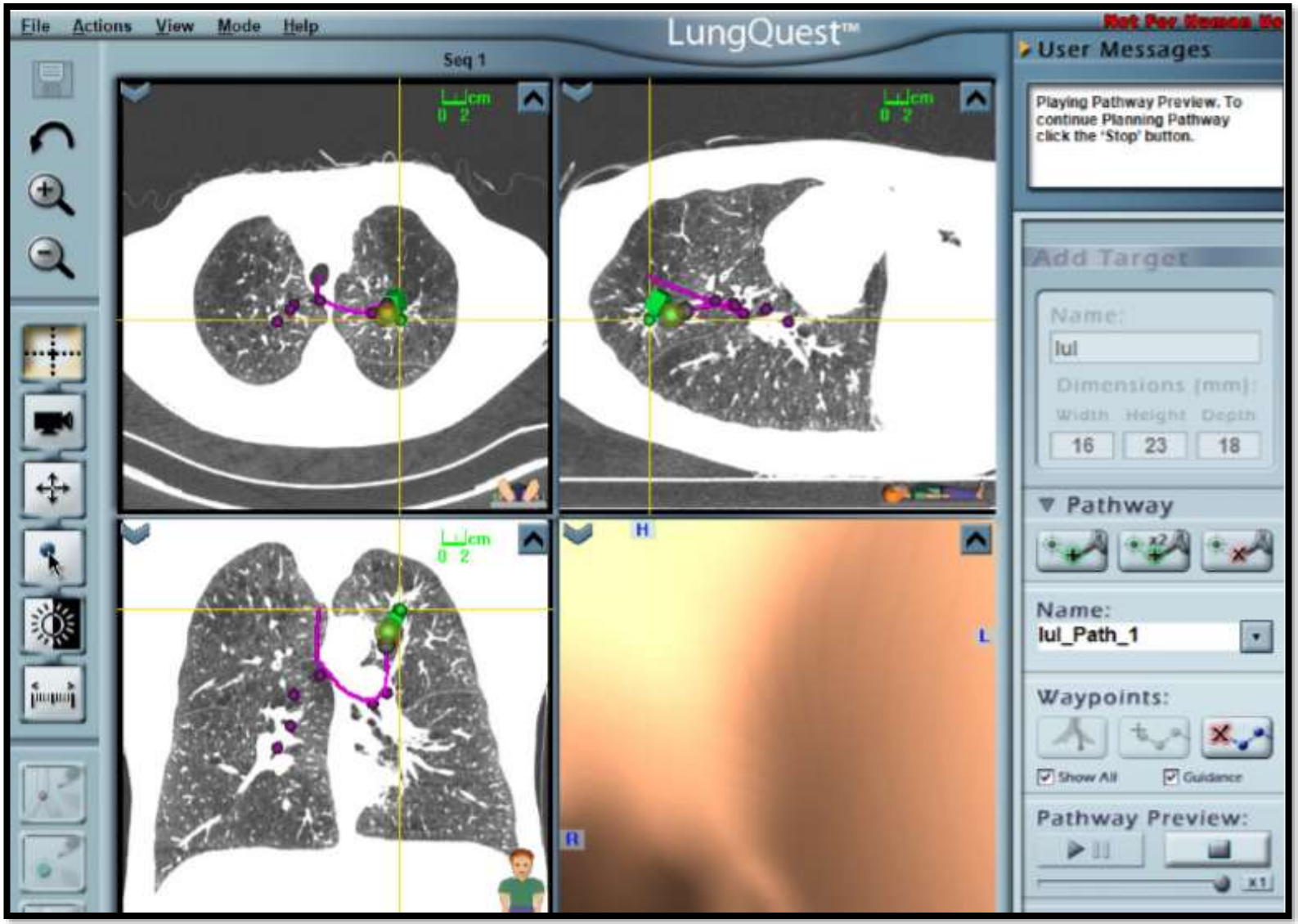
- virtual bronchoscopy planning software
- a "location board" which emits low frequency electromagnetic waves
- an extended working channel that is similar in function to a guide sheath
- an eight way steerable catheter to enable selective cannulation of bronchi
- "locatable guide" containing sensors that allow precise tracking of both position and orientation throughout the electromagnetic field

Fong KM et al, J Thorac Dis 2012

Planning phase

- CT images in Digital Imaging and Communications In Medicine(DICOM) format to be loaded onto the iLogic software
- Planning screen consists of four panels, showing axial, coronal , sagittal CT views, and virtual endobronchial view
- Any point on any view can be selected and the corresponding location will be visible on the remaining views
- 6-7 easily locatable anatomical "registration points" (e.g., main and secondary carinas) are marked bilaterally for the purpose of manual registration during the actual procedure

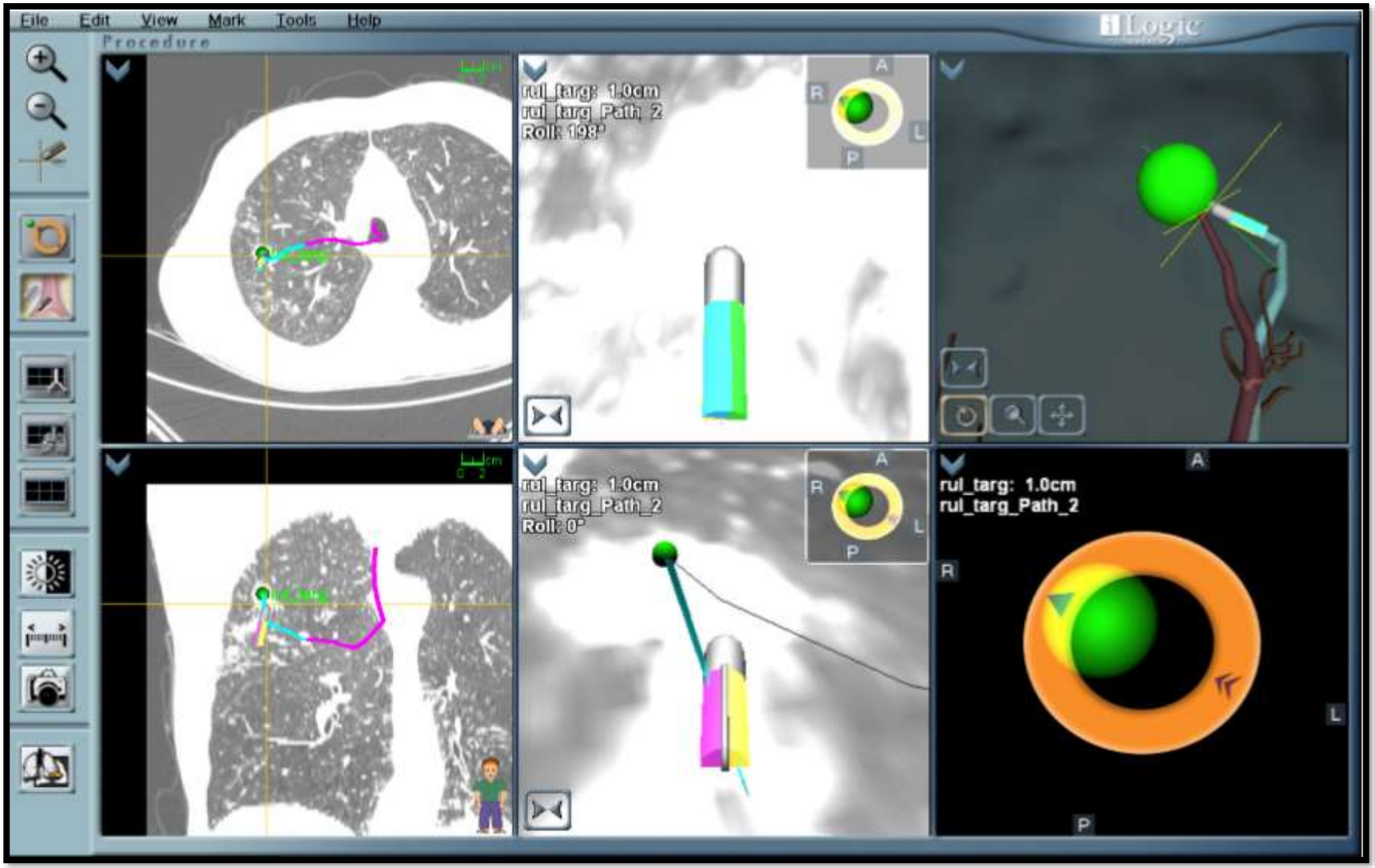
Planning screen



Procedure

- Extended working channel (EWC) and locatable guide (LG) are inserted through the bronchoscopic working channel until approximately 8mm of the locatable guide is visible
- Registration, the process of matching the CT images to the patient's real life anatomy, can then begin either as an automated process or manually
- Registration accuracy is measured as the Average Fiducial Target Registration Error (AFTRE) and should be <5 mm

Procedure screen showing 6 viewports



Navigation

- The LG can be aimed in different directions by turning the handle to one of eight preset positions, denoted by two arrows on the handle, then pulling on the neck of the catheter
- The bronchoscope is wedged into the subsegement leading to the target lesion and the EWC and LG are then slowly advanced with the aim of keeping the selected waypoint in the centre of the circle presented on the tip view
- If the waypoint is not centred, arrows will appear on the circle edge, indicating the direction in which the LG handle needs to be turned before further advancing the EWC/LG

Sampling

- Once the LG tip is aligned with and in close proximity to the target lesion the EWC is locked onto the bronchoscope, the LG is removed, and biopsy tools are then inserted through the EWC
- Fluoroscopy or radial probe EBUS can be used to confirm EWC position in real time

Review

Respiration

Respiration 2014;87:165–176
DOI: 10.1159/000355710

Received: January 2, 2013
Accepted after revision: September 14, 2013
Published online: January 3, 2014

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]

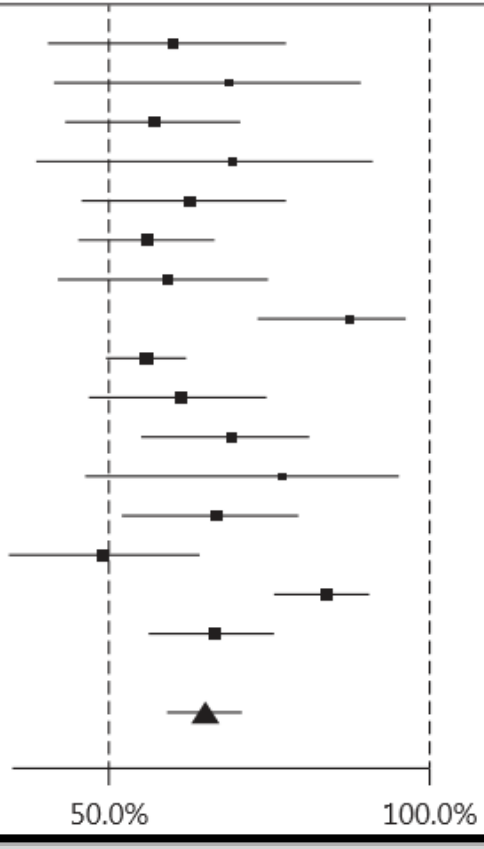
[a]Division of Pulmonology, Department of Medical Specializations, [b]Division of Clinical Epidemiology, Department of Community Medicine, and [c]Division of Thoracic Surgery, Department of Surgery, University Hospitals of Geneva, Geneva, Switzerland; [d]Pulmonary Department, Fundación Jimenez Diaz-CIBERES, Madrid, Spain

- The authors classified ENB results into 3 groups:
  - positive (either malignant or benign)
  - intermediate (histological diagnosis needing confirmation such as chronic inflammation, organizing pneumonia or atypical cells without sufficient features to ascertain malignancy)
  - indeterminate (e.g. normal lung tissue or reported as inconclusive)
- For each of these categories, authors extracted the final diagnoses confirmed by surgery, further biopsies or extended follow-up, when necessary by contacting the authors for additional information

Diagnostic yield of ENB

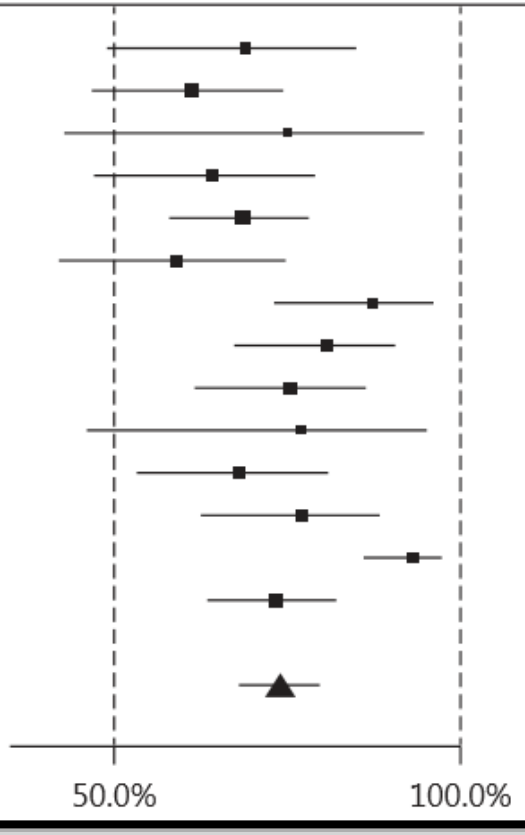
Study, first author	Number/ total	Diagnostic yield (95% CI)
Becker, 2005 [3]	18/30	60.0 (40.6; 77.3)
Hautmann, 2005 [13]	11/16	68.8 (41.3; 89.0)
Gildea, 2006 [14]	32/56	57.1 (43.2; 70.3)
Schwarz, 2006 [15]	9/13	69.2 (38.6; 90.9)
Makris, 2007 [16]	25/40	62.5 (45.8; 77.3)
Eberhardt, 2007 [17]	52/93	55.9 (45.2; 66.2)
Eberhardt, 2007 [18]	23/39	59.0 (42.1; 74.1)
Eberhardt, 2007 [18]	35/40	87.5 (73.2; 95.8)
Wilson, 2007 [19]	151/271	55.7 (49.6; 61.7)
Bertoletti, 2009 [20]	33/54	61.1 (46.9; 74.1)
Eberhardt, 2009 [21]	38/55	69.1 (55.2; 80.9)
Lamprecht, 2009 [22]	10/13	76.9 (46.2; 95.0)
Seijo, 2010 [23]	34/51	66.7 (52.1; 79.2)
Mahajan, 2011 [24]	24/49	49.0 (34.4; 63.7)
Lamprecht, 2012 [26]	94/112	83.9 (75.8; 90.2)
Pearlstein, 2012 [25]	67/101	66.3 (56.2; 75.4)
Pooled (random effects) I^2 = 66%		64.9 (59.2; 70.3)

Forest plot



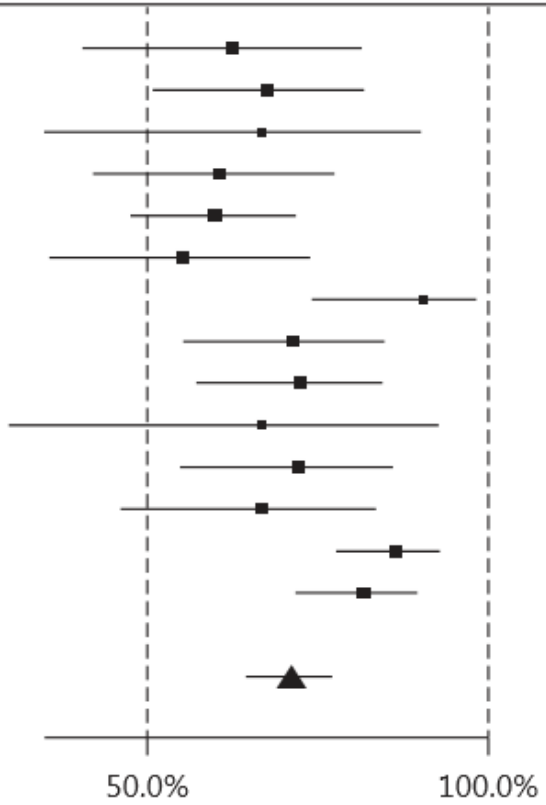
Diagnostic accuracy of ENB

Study, first author	Number/ total	Diagnostic accuracy (95% CI)
Becker, 2005 [3]	20/29	69.0 (49.2; 84.7)
Gildea, 2006 [14]	33/54	61.1 (46.9; 74.1)
Schwarz, 2006 [15]	9/12	75.0 (42.8; 94.5)
Makris, 2007 [16]	25/39	64.1 (47.2; 77.8)
Eberhardt, 2007 [17]	63/92	68.5 (58.0; 77.8)
Eberhardt, 2007 [18]	23/39	59.0 (42.1; 74.4)
Eberhardt, 2007 [18]	35/40	87.5 (73.2; 95.8)
Bertoletti, 2009 [20]	42/52	80.8 (67.5; 90.4)
Eberhardt, 2009 [21]	40/53	75.5 (61.7; 86.2)
Lamprecht, 2009 [22]	10/13	76.9 (46.2; 95.0)
Seijo, 2010 [23]	34/50	68.0 (53.3; 80.5)
Mahajan, 2011 [24]	37/48	77.1 (62.7; 88.0)
Lamprecht, 2012 [26]	94/101	93.1 (86.2; 97.2)
Pearlstein, 2012 [25]	74/101	73.3 (63.5; 81.6)
Pooled (random effects)		73.9 (68.0; 79.2)
I^2 = 62%		



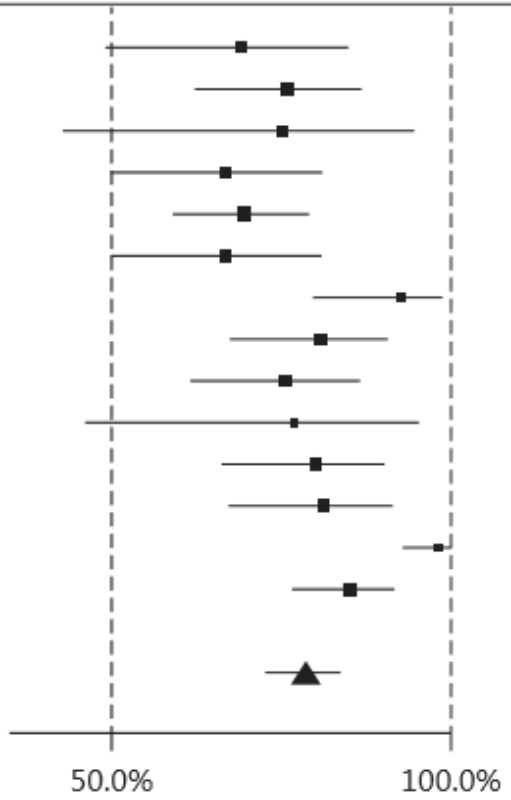
ENB's sensitivity for malignancy

Study, first author	Number/ total	Sensitivity (95% CI)
Becker, 2005 [3]	15/24	62.5 (40.6; 81.2)
Gildea, 2006 [14]	27/40	67.5 (50.9; 81.4)
Schwarz, 2006 [15]	8/12	66.7 (34.9; 90.1)
Makris, 2007 [16]	20/33	60.6 (42.1; 77.1)
Eberhardt, 2007 [17]	42/70	60.0 (47.6; 71.5)
Eberhardt, 2007 [18]	16/29	55.2 (35.7; 73.6)
Eberhardt, 2007 [18]	28/31	90.3 (74.2; 98.0)
Bertoletti, 2009 [20]	30/42	71.4 (55.4; 84.3)
Eberhardt, 2009 [21]	34/47	72.3 (57.4; 84.4)
Lamprecht, 2009 [22]	6/9	66.7 (29.9; 92.5)
Seijo, 2010 [23]	26/36	72.2 (54.8; 85.8)
Mahajan, 2011 [24]	18/27	66.7 (46.0; 83.5)
Lamprecht, 2012 [26]	82/95	86.3 (77.7; 92.5)
Pearlstein, 2012 [25]	67/82	81.7 (71.6; 89.4)
Pooled (random effects) I^2 = 57%		71.1 (64.6; 76.8)



ENB's accuracy for malignancy

Study, first author	Number/ total	Accuracy (95% CI)
Becker, 2005 [3]	20/29	69.0 (49.2; 84.7)
Gildea, 2006 [14]	41/54	75.9 (62.4; 86.5)
Schwarz, 2006 [15]	9/12	75.0 (42.8; 94.5)
Makris, 2007 [16]	26/39	66.7 (49.8; 80.9)
Eberhardt, 2007 [17]	64/92	69.6 (59.1; 78.7)
Eberhardt, 2007 [18]	26/39	66.7 (49.8; 80.9)
Eberhardt, 2007 [18]	37/40	92.5 (79.6; 98.4)
Bertoletti, 2009 [20]	42/52	80.8 (67.5; 90.4)
Eberhardt, 2009 [21]	40/53	75.5 (61.7; 86.2)
Lamprecht, 2009 [22]	10/13	76.9 (46.2; 95.0)
Seijo, 2010 [23]	40/50	80.0 (66.3; 90.0)
Mahajan, 2011 [24]	39/48	81.2 (67.4; 91.1)
Lamprecht, 2012 [26]	99/101	98.0 (93.0; 99.8)
Pearlstein, 2012 [25]	86/101	85.1 (76.7; 91.4)
Pooled (random effects) I^2 = 60%		78.6 (72.8; 83.4)



Systematic review: predicting factors of ENB's yield

- Reported significant predicting factors
  - Location in lower lobe
  - Size of the nodule
  - Bronchus sign
  - Lower registration error(AFTRE)
  - Nodule visualization with radial probe EBUS
  - Catheter suction technique

Study level characteristics associated with significant modification of ENB's performance

		Studies, n	Pooled outcome (95% CI)	p values
			diagnostic yield	
General anesthesia	yes	9	69.2% (60.6–76.7)	0.02
	no	7	57.5% (53.2–61.8)	
			sensitivity for malignancy	
ROSE	yes	4	80.2% (72.1–86.4)	0.006
	no	10	66.3% (60.3–71.8)	
			diagnostic yield	
Fluoros-copy	yes	6	56.3% (51.5–60.9)	0.006
	no	10	68.8% (61.3–75.4)	

Safety

- 32 pneumothoraces in 1,033 procedures (3.1%, 95% CI 2.1–4.3), but only 17 patients required chest tube drainage (1.6%, 95% CI 1.0–2.6)
- Minor or moderate bleeding was reported in 9 cases (0.9%, 95% CI 0.4–1.6), none of them requiring specific treatment
- One self-limited hematoma
- One episode of hypercapnic respiratory failure attributed to sedation

Multimodality Bronchoscopic Diagnosis of Peripheral Lung Lesions

A Randomized Controlled Trial

Ralf Eberhardt[1], Devanand Anantham[2], Armin Ernst[2], David Feller-Kopman[2], and Felix Herth[1]

[1]Department of Pneumology and Critical Care Medicine, Thoraxklinik, University of Heidelberg, Heidelberg, Germany; and [2]Interventional Pulmonology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts

Rationale: Endobronchial ultrasound (EBUS) and electromagnetic navigation bronchoscopy (ENB) have increased the diagnostic yield of bronchoscopic diagnosis of peripheral lung lesions. However, the role of combining these modalities to overcome each individual technique's limitations and, consequently, to further increase the diagnostic yield remains untested.

Objectives: A prospective randomized controlled trial involving three diagnostic arms: EBUS only, ENB only, and a combined procedure.

Methods: All procedures were performed via flexible bronchoscopy and transbronchial forceps biopsies were obtained without fluoroscopic guidance. In the combined group, after electromagnetic navigation, the ultrasound probe was passed through an extended working channel to visualize the lesion. Biopsies were taken if ultrasound visualization showed that the extended working channel was within the target. Primary outcome was diagnostic yield. The reference "gold standard" was a surgical biopsy if bronchoscopic biopsy did not reveal a definite histological diagnosis compatible with the clinical presentation. Secondary outcomes were yields by size, lobar distribution, and lesion pathology. Complication rates were also documented.

Measurements and Main Results: Of the 120 patients recruited, 118 had a definitive histological diagnosis and were included in the final analysis. The diagnostic yield of the combined procedure (88%) was greater than EBUS (69%) or ENB alone (59%; $p = 0.02$). The combined procedure's yield was independent of lesion size or lobar distribution. The pneumothorax rates ranged from 5 to 8%, with no significant differences between the groups.

Conclusions: Combined EBUS and ENB improves the diagnostic yield of flexible bronchoscopy in peripheral lung lesions without compromising safety.

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

Endobronchial ultrasound (EBUS) and electromagnetic navigation bronchoscopy (ENB) have increased the yield of flexible bronchoscopy in the diagnosis of peripheral lung lesions. Yet, direct comparisons and the role of combined diagnosis are unknown.

What This Study Adds to the Field

Combined EBUS and ENB improves the diagnostic yield of flexible bronchoscopy in peripheral lung lesions without compromising safety.

EBUS enables direct visualization of the target lesion before attempting biopsy. However, EBUS lacks a navigation system and requires the operator to maneuver the bronchoscope blindly to the lesion with the knowledge of prior radiological investigations like computed tomography (CT) scans. In previous studies, 11 to 24% of lesions could not be localized by EBUS (3, 5, 7, 9).

ENB consists of four components: an electromagnetic location board, a locatable sensor probe with an eight-way steering mechanism that is able to navigate the bronchial tree, an extending working channel (EWC) that can carry either the sensor

Am J Respir Crit Care Med Vol176. pp 36–41, 2007

Conclusion

Strengths of ENB

- Effective and safe procedure to sample peripheral pulmonary lesions. The yield of this technique seems to be similar to other guided endoscopic procedures
- Combination of ENB and radial EBUS may lead to significantly better yields
- Safety profile, especially regarding the risk of procedure related pneumothorax, which is about 10 times lower

Drawbacks of ENB

- Relatively expensive
- Time consuming
- Requires lot of resources
- Mandates adequate preprocedure planning with a recent adequate CT scan
- ENB's performance seems slightly inferior to reported outcomes with CT guided transthoracic needle biopsies

Areas of research

- When to choose ENB over TTNA?
- Comparison of ENB with other techniques such as virtual bronchoscopy and ultrathin bronchoscopy
- Predictors of diagnostic yield, aside from the “bronchus sign” need to be delineated to optimize patient selection

Ultrathin bronchoscope

- Size (5.7 mm) of conventional bronchoscope limits it from being advanced beyond subsegmental bronchus
- Ultrathin bronchoscope by virtue of its smaller diameter(2.8-3.5 mm) can be inserted beyond the 6th generation bronchi, offering the bronchoscopist an opportunity to get closer to the peripheral target
- There is also an increased likelihood of discovering an endobronchial lesion that may have been beyond the scope of the conventional bronchoscope

Narula et al, Clin Chest Med 34(2013)

ORIGINAL ARTICLE

Ultrathin Bronchoscopy with Multimodal Devices for Peripheral Pulmonary Lesions

A Randomized Trial

Masahide Oki[1], Hideo Saka[1], Masahiko Ando[2], Fumihiro Asano[3], Noriaki Kurimoto[4], Katsuhiko Morita[5], Chiyoe Kitagawa[1], Yoshihito Kogure[1], and Teruomi Miyazawa[6]

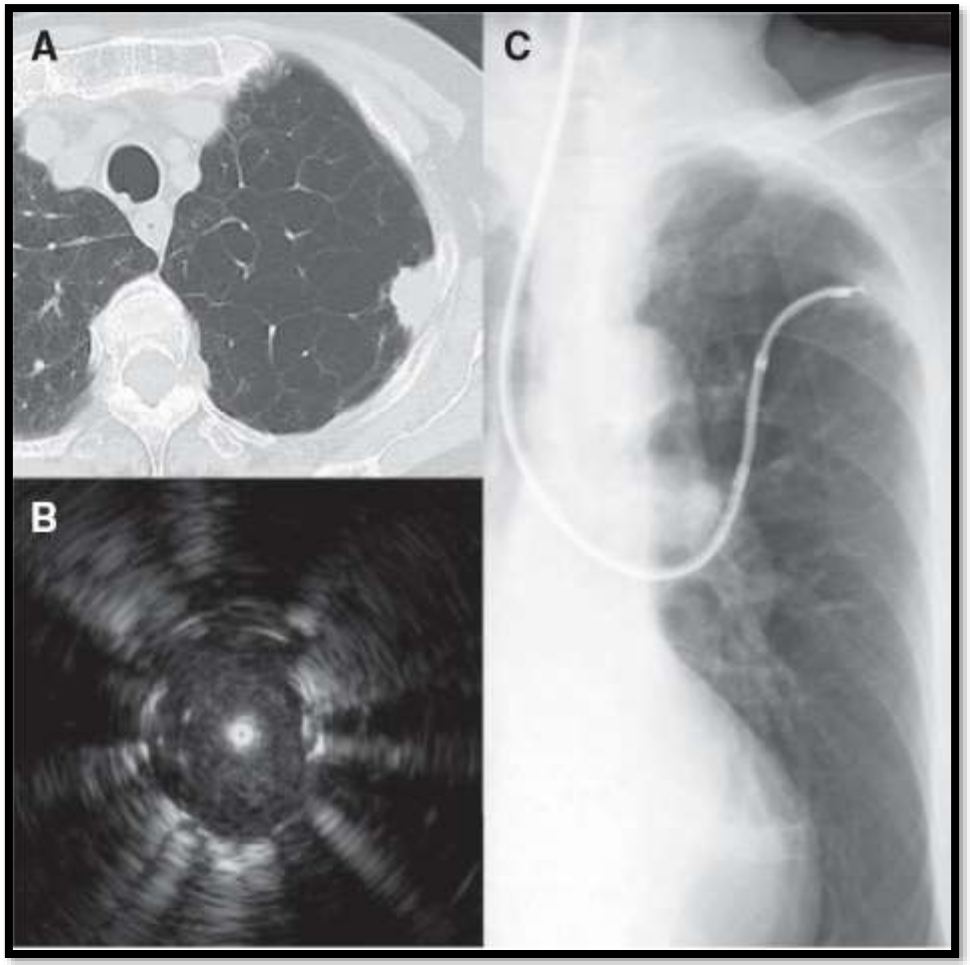
[1]Department of Respiratory Medicine, Nagoya Medical Center, Nagoya, Japan; [2]Center for Advanced Medicine and Clinical Research, Nagoya University Hospital, Nagoya, Japan; [3]Department of Pulmonary Medicine, Gifu Prefectural General Medical Center, Gifu, Japan; [4]Department of Chest Surgery and [6]Department of Pulmonary and Infectious Diseases, St. Marianna University School of Medicine, Kawasaki, Japan; and [5]Department of Surgery, Iwakuni Minami Hospital, Iwakuni, Japan

- RCT comparing the diagnostic yield of transbronchial biopsy under EBUS, fluoroscopy, and virtual bronchoscopic navigation guidance using a novel ultrathin bronchoscope with that using a thin bronchoscope with a guide sheath for peripheral pulmonary lesions

Oki M et al, AJRCCM, 192:2015

Ultrathin bronchoscopic method

- A prototype ultrathin hybrid bronchofiber - videoscope with a charge-coupled device built into the control section was used
- It has a 3.0-mm distal end diameter, a 1.7-mm working channel diameter, 180° up and 130° down angulation, and a 90° field of view
- EBUS procedures were performed with an endoscopic ultrasound center and a 1.4-mm mechanical radial-type ultrasonic probe
- For TBB, a 1.5-mm biopsy forceps was used



CT image(A), ultrasonic image (B) and fluoroscopic image of transbronchial biopsy using an ultrathin bronchoscope(C) of a lung cancer examined and diagnosed with the ultrathin bronchoscopic method

Histopathologic diagnostic yield

Variables	UTB Group (*n* = 150) N/Total (%)	95% CI	*P* Value	TB-GS Group (*n* = 155) N/Total (%)	95% CI	*P* Value	*P* Value
Benign							
≤20 mm	5/17 (29)	10–56	0.067	5/24 (21)	7–42	0.019	0.529
>20 to ≤30 mm	6/9 (67)	30–93		11/20 (55)	32–77		0.555
Total	11/26 (42)	23–63		16/44 (36)	22–52		0.622
Malignant							
≤20 mm	47/62 (76)	63–86	0.115	35/57 (61)	48–74	0.048	0.090
>20 to ≤30 mm	53/61 (87)	76–94		41/52 (79)	65–89		0.255
Total	100/123 (81)	73–88		76/109 (70)	60–78		0.040
Unknown*							
≤20 mm	0/1 (0)			0/1 (0)			
>20 to ≤30 mm				0/1 (0)			
All							
≤20 mm	52/80 (65)	54–75	0.007	40/82 (49)	38–60	0.005	0.037
>20 to ≤30 mm	59/70 (84)	74–92		52/73 (71)	59–81		0.061
Total	111/150 (74)	66–81		92/155 (59)	51–67		0.044†

Definition of abbreviations: CI = confidence interval; TB-GS = thin bronchoscopy with a guide sheath; UTB = ultrathin bronchoscopy.
The 95% CIs are for the percentages.
*Patients who did not return to follow-up.
†Mantel-Haenszel test. Other variables were calculated with Pearson chi-square test.

Secondary outcomes

Variables	UTB Group ($n = 150$)		TB-GS Group ($n = 155$)		P Value[†]
Bronchus level reached with the bronchoscope, median (range), generation, all	5 (3–12)		4 (2–7)		<0.001
Right upper lobe	5 (4–9)	$P = 0.084$	4 (2–7)	$P = 0.385$	<0.001
Right middle lobe	6 (4–12)		4 (3–7)		0.031
Right lower lobe	5 (3–9)		4 (3–6)		<0.001
Left upper lobe	5 (4–7)		4 (3–7)		0.002
Lingula	5 (3–7)		4 (3–5)		0.186
Left lower lobe	4 (3–8)		4 (3–7)		0.173
Histopathologic diagnostic yield by lobar location					
Right upper lobe	32/45 (71)	$P = 0.389$	36/57 (63)	$P = 0.380$	0.398
Right middle lobe	13/17 (64)		4/8 (50)		0.186
Right lower lobe	23/36 (76)		18/30 (60)		0.745
Left upper lobe	20/23 (87)		20/32 (63)		0.045[‡]
Lingula	4/6 (67)		5/6 (83)		0.505
Left lower lobe	19/23 (83)		9/22 (41)		0.004[§]
Histopathologic diagnostic yield by lesion location from the hilum					
Central or intermediate	24/37 (65)	$P = 0.144$	28/44 (64)	$P = 0.494$	0.909
Peripheral	87/113 (77)		64/111 (58)		0.002[‖]
Histopathologic diagnostic yield by bronchus sign					
Present	94/115 (82)	$P < 0.001$	80/127 (63)	$P = 0.050$	0.001[¶]
Absent	17/35 (49)		12/28 (43)		0.651
Location of probe in relation to lesion confirmed by EBUS					
Within the lesion	117 (78)		103 (66)		
Adjacent to the lesion	26 (17)		41 (26)		0.080
Invisible with EBUS	7 (5)		11 (7)		
Procedural time, median (range), min	27.5 (12–77)		28.5 (15–81)		0.101
Complications, all	5 (3)		7 (5)		0.595
Pneumothorax	3 (2)		5* (3)		
Pneumonia	1 (1)		0 (0)		
Bleeding	0 (0)		2 (1)		
Chest pain	1 (1)		0 (0)		

Specific challenges with UTB

- High flexibility, which may limit steerability in the lung periphery
- Tendency for the video image to be obscured by even small amounts of blood
- Limited number of instruments available that can be introduced via the small working channel

Conclusion

- Combination of a thinner bronchoscope and navigational technology seems quite reasonable, because the bronchial map provided by a navigation device ought to be less useful if the bronchoscope or a biopsy instrument cannot follow the indicated route
- VBN bronchoscopy does not require expensive disposable instruments, such as a LG and an EWC, so it is possible that the present UTB method is a cost-effective alternative to ENB
- To determine whether or not the present UTB method is an adequate alternative to TTNA or ENB, randomized studies comparing diagnostic yields, cost effectiveness, and safety are required

Virtual Bronchoscopic Navigation for Peripheral Pulmonary Lesions

- In VBN, a bronchoscope is guided using VB images on the bronchial route to a PPL
- VB images depend on the threshold values selected to differentiate between the airway wall and the lumen. An inappropriate threshold may guide the bronchoscope to an incorrect bronchus
- When a bronchoscope is rotated, the real bronchial image deviates from the VB image prepared earlier. The bronchoscope should therefore be advanced by rotating the VB image to adjust it to the real bronchial image at each bifurcation

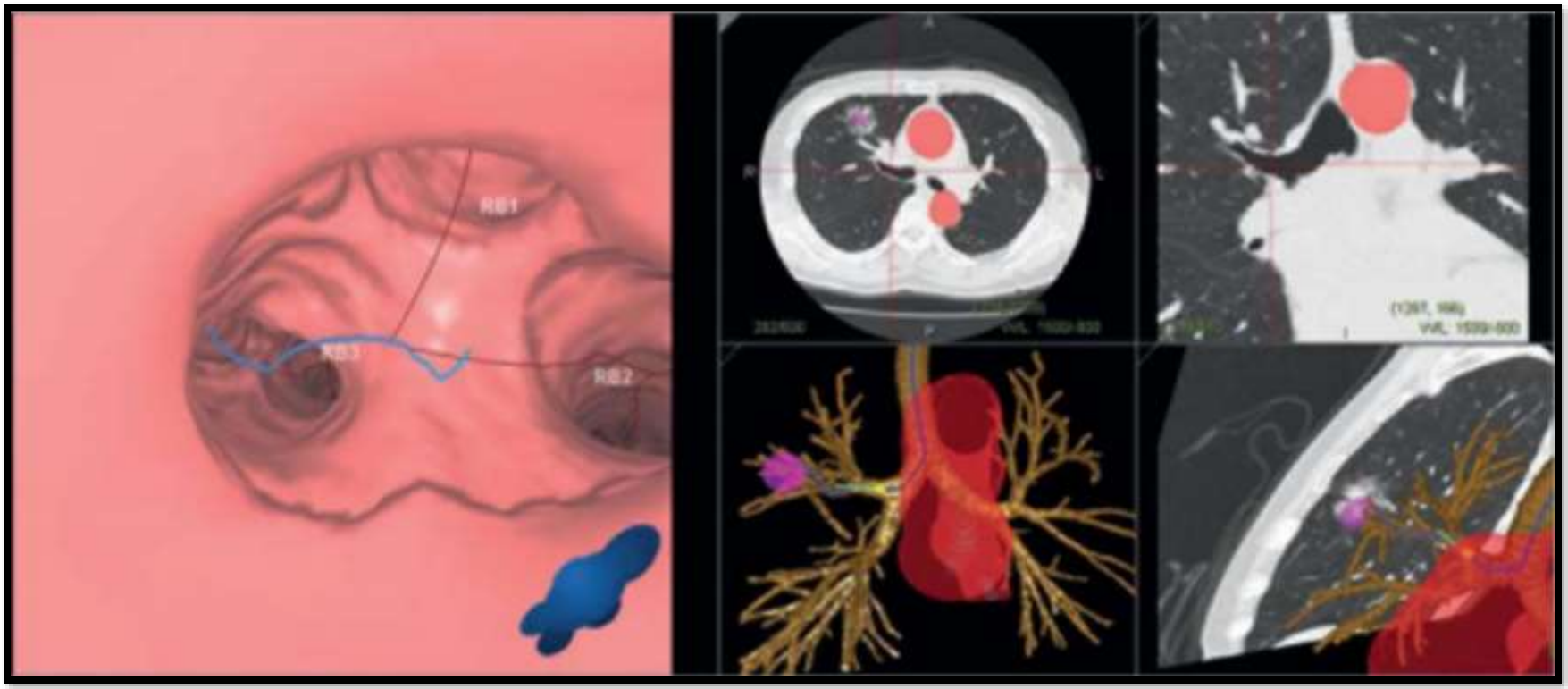
Asano F et al, n. J Bronchol 2002;9:108–111
Asano F et al, Chest 2006;130:559

- VBN systems
  - Bf-NAVI
  - LungPoint
  - DirectPath
- These VBN systems automatically search for a bronchial route to the target lesion by simply setting the target lesion, preparing VB images on the bronchial route and displaying the VB images in reference to the real images
- All VBN systems are composed of 2 phases: planning and guidance

Planning

- With LungPoint, automatic processing is initiated upon input of CT information in a DICOM (Digital Imaging and Communications in Medicine) format into the system, after which the airway is extracted
- Axial, sagittal and coronal cross-sectional CT images are then displayed
- When the target lesion is set in these CT images, 3 cross sectional images and the bronchial tree in which an automatically selected bronchial route to the target lesion are presented, and a VB image on the bronchial route is displayed

Lungpoint Planning Screen

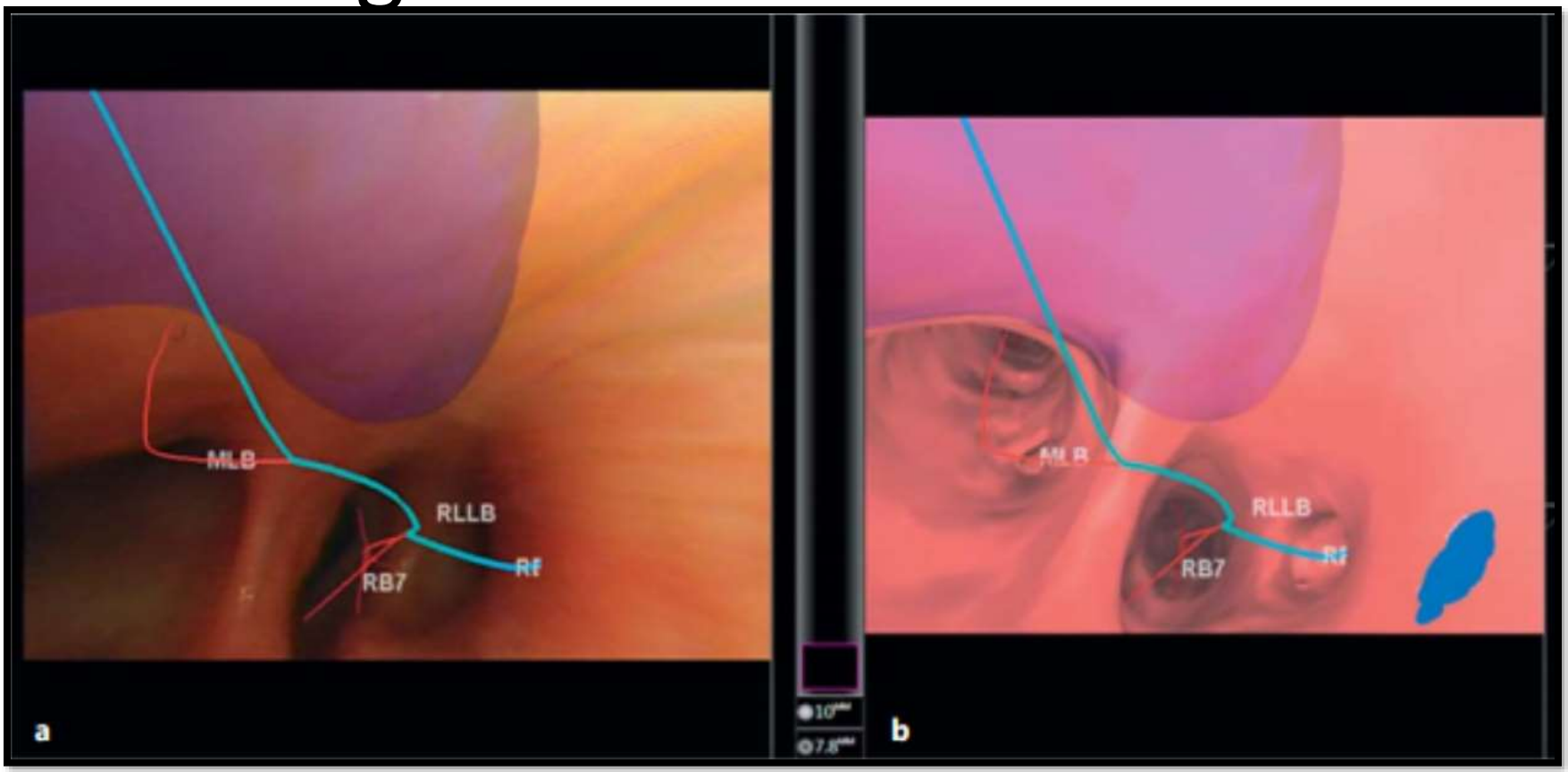


Upper center: axial view. A PPL is shown in the right and a target is set on the lesion (pink circle). The red circle represents the aorta. Upper right: coronal view. Lower center: bronchial tree. The blue line on the bronchial tree is an automatically searched route to the lesion (pink circle). The yellow circle represents the tip of the virtual bronchoscope that moves in conjunction with VB images

Guidance

- With LungPoint, the live bronchoscopic view is captured in the system, and the VB image that closely resembles the real image is automatically selected and displayed using image pattern recognition
- At the same time, VB image information on the route and distance to the target lesion, the names of the bronchi and large vessels outside the bronchus are superimposed on the live bronchoscopic images and displayed

LungPoint Guidance Screen



a -Real bronchial image. b -VB image consistent with the real image is automatically selected and displayed. The bronchial route (blue line) to the lesion and the names of the bronchi are presented. These are also presented on the real image. Both images move in conjunction automatically

Studies of VBN for the diagnosis of PPLs

First author	Year	Study design	VBN system	Bronchoscope external diameter	Confirmation of arrival	Lesion size selection	Lesions, n	Diagnostic yield	Lesions <2 cm, n	Diagnostic yield for lesions <2 cm	Complications, n	Complication rate	Complications
Shinagawa [16]	2004	Pro	Not used	2.8 mm	CT	<2 cm	26	65.4%	26	65.4%	0	0.0%	None
Asahina [26]	2005	Pro	Not used	4.0 or 5.3 mm	EBUS	≤3 cm	30	63.3%	18	44.4%	0	0.0%	None
Asano [11]	2006	Pro	Bf-NAVI	2.8 mm	CT	≤3 cm	38	81.6%	26	80.8%	n/a	n/a	n/a
Shinagawa [17]	2007	Pro	Bf-NAVI	2.8 mm	CT	<2 cm	71	70.4%	71	70.4%	1	1.4%	1 PTX
Tachihara [29]	2007	Pro	Bf-NAVI	2.8 or 5.2 mm	Flu	≤3 cm	96	62.5%	77	54.5%	0	0.0%	None
Asano [10]	2008	Pro	Bf-NAVI	4.0 mm	EBUS	n/a	32	84.4%	15	73.3%	0	0.0%	None
Eberhardt [33]	2010	Pro	LungPoint	2.8 mm	Non-Flu	n/a	25	80.0%	n/a	n/a	1	4.0%	1 PTX (0 CTI)
Omiya [30]	2010	Retro	Bf-NAVI	2.8 and 4.0 mm	Flu	≤3 cm	37	75.7%	13	76.9%	n/a	n/a	n/a
Iwano [31]	2011	Retro	Not used	2.8 mm	Flu	n/a	122	78.7%	30	73.3%	n/a	n/a	n/a
Oshige [27]	2011	Pro	Bf-NAVI	4.0 or 5.9 mm	EBUS	n/a	57	84.2%	22	72.7%	0	0.0%	None
Ishida [24]	2011	RCT	Bf-NAVI	4.0 mm	EBUS	≤3 cm	99	80.8%	58	75.9%	0	0.0%	None
Asano [32]	2013	RCT	Bf-NAVI	2.8 mm	Flu	≤3 cm	167	67.1%	114	64.9%	4	2.4%	1 PTX (0 CTI), 2 Hemo, 1 Brad
Tamiya [28]	2013	Pro	LungPoint	4.0 mm	EBUS	≤3 cm	68	77.9%	27	74.1%	n/a	n/a	n/a
Summary							868	73.8%	497	67.4%		1.0%	

Brad = Bradycardia; CTI = chest tube insertion; Flu = fluoroscopy; Hemo = hemorrhage; n/a = not available; Pro = prospective study; PTX = pneumothorax; Retro = retrospective study.

In many cases, VBN is used in combination with CT, X-ray fluoroscopy and endobronchial ultrasonograpy (EBUS) because the arrival of a biopsy instrument at the target lesion cannot be confirmed using VBN alone

RCT

- Ishida et al. randomly allocated 200 patients with PPLs (≤ 3 cm) to a VBN-assisted (VBNA) and a non-VBN-assisted (NVBNA) group
- A thin bronchoscope with an outer diameter of 4 mm was guided by a VBN system in the VBNA group and using axial CT images as a reference in the NVBNA group
- Biopsy was performed concomitantly with EBUS-GS under X-ray fluoroscopy
- The diagnostic yield in the VBNA group was 80.4%, significantly higher than that (67.0%) in the NVBNA group ($p = 0.032$)
- In addition, the time to initiation of the biopsy and the examination time were significantly shorter in the VBNA group

Ishida T et al,Thorax 2011;66:1072–1077

- Asano et al. randomly allocated 350 patients with PPLs ≤ 3 cm to 2 groups
- An ultrathin bronchoscope with an outer diameter of 2.8 mm was guided with a VBN system in the VBNA group and using axial CT images as a reference in the NVBNA group
- Biopsy was performed under X-ray fluoroscopy in both groups
- The diagnostic yield in the VBNA group was 67.1%, higher than, but not significantly different from that (59.9%) in the NVBNA group ($p = 0.173$)

Asano F et al,Am J Respir Crit Care Med 2013; 188:327–333

- On subanalysis, the diagnostic yields of lesions located in the right upper lobe (81.3 vs. 53.2%, p = 0.004), those located in the peripheral third of the lung field (64.7 vs. 52.1%, p = 0.047) and those invisible on posterior-anterior radiographs (63.2 vs. 40.5%, p = 0.043) were significantly higher in the VBNA group
- There was no significant improvement of the diagnostic yield by VBN because unlike EBUS, confirmation of reaching the lesion using X-ray fluoroscopy alone was insufficient and only a small amount of specimen could be biopsied using ultrathin bronchoscopy

- **Factors Affecting the Diagnostic Yield** :
  - the location of lesions (the diagnostic yield was low in the superior segment of the left lower lobe)
  - the internal opacity of lesions (the yield for non-solid-type lesions was low)
  - EBUS probe localization (the yield was high when the probe was within the lesion)
- **Safety:**
  - The overall complication rate was 1.0% (95% CI 0.2–1.8%)
  - The complications that developed in 6 patients included pneumothorax (n = 3), hemorrhage (n = 2) and transient bradycardia (n = 1)

Advantages of VBN

- VBN complication rate is equivalent to that on conventional bronchoscopy and far lower than TTNA
- Diagnostic yield of 67.4%,which is much higher than that of conventional bronchoscopy (34%) reported in the ACCP guidelines
- Compared with EMN, VBN has the significant advantages of not requiring specific training because the technique is similar to conventional bronchoscopy and not needing a sensor or a specific biopsy instrument other than the system, thereby reducing costs

Rivera MP et al, Chest 2013; 143:e142S–e165S

Disadvantages of VBN

- When VBN is not planned from beginning, requires unnecessary exposure to repeat CT
- Since CT information acquired before the examination is used for navigational bronchoscopy, navigation does not occur precisely in real time. This results in discrepancy between navigation success and diagnostic yield

Future prospects

1) Need to perform randomized comparative studies with TTNA and conventional bronchoscopy to clarify the position of VBN in the diagnostic methods for PPLs
2) To carry out a cost/benefit analysis
3) To investigate the results in terms of the skill level of operators and the learning curve
4) Further improvement and advancement of the navigation system must be carried out

Asano F et al, Respiration 2014;88:430–440

CHEST

Original Research

PULMONARY PROCEDURES

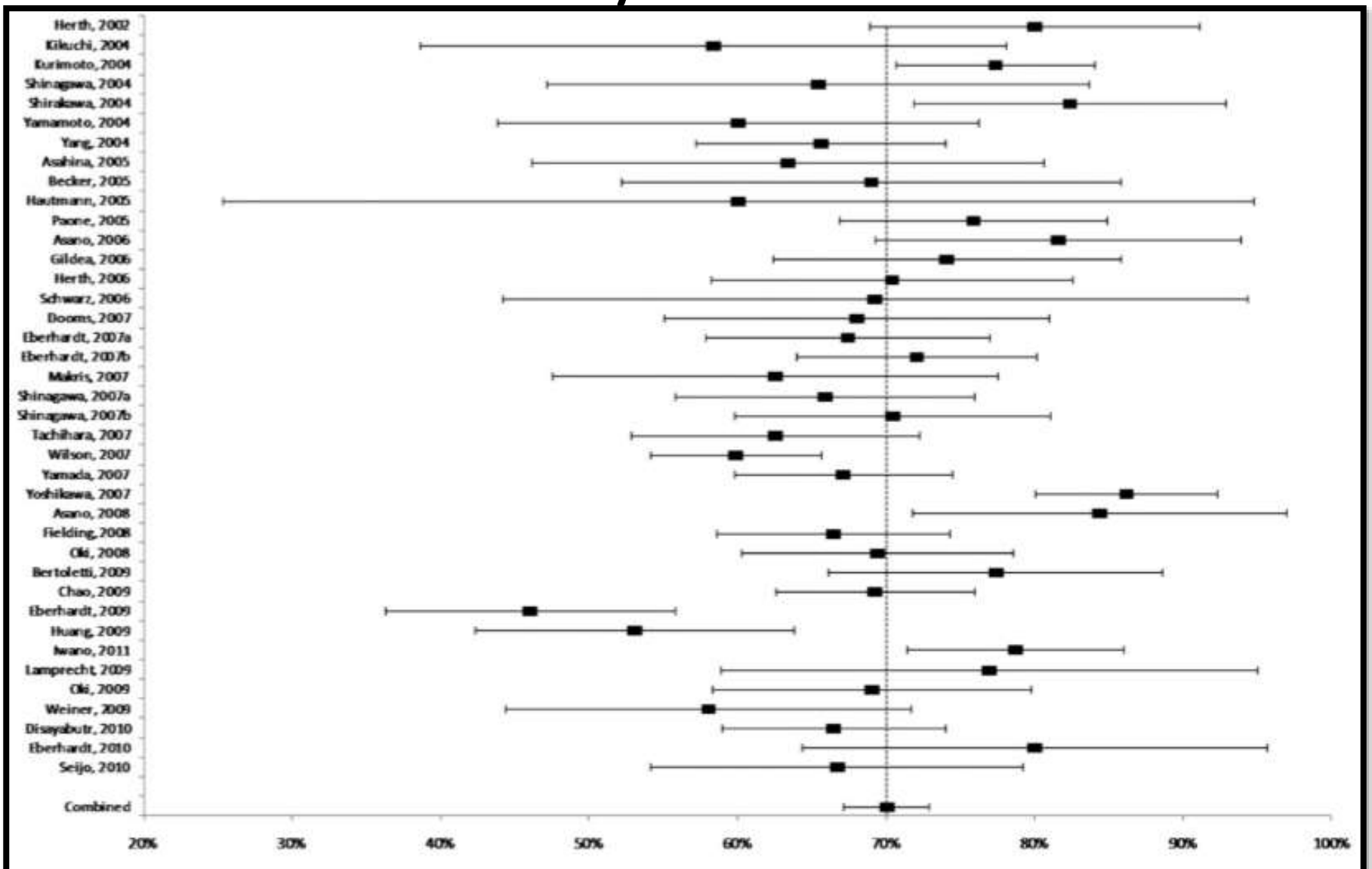
Meta-analysis of Guided Bronchoscopy for the Evaluation of the Pulmonary Nodule

Jessica S. Wang Memoli, MD; Paul J. Nietert, PhD; and Gerard A. Silvestri, MD, FCCP

- Studies evaluating the diagnostic yield of ENB, VB, R-EBUS, ultrathin bronchoscope, and/or guide sheath for peripheral nodules were included
- The overall diagnostic yield and yield based on size were extracted. Adverse events, if reported, were recorded
- Meta-analysis techniques incorporating inverse variance weighting and a random-effects meta-analysis approach were used

CHEST 2012; 142(2):385–393

Metaanalysis summary of diagnostic yield



Inverse Weighted Diagnostic Yield Overall and by Modality

Technology	Studies, No.	Weighted Proportion, %	95% CI	Q Statistic	Q *P* Value
VB	10	72.0	(65.7-78.4)	21.0	.01
ENB	11	67.0	(62.6-71.4)	13.3	.21
GS	10	73.2	(64.4-81.9)	63.8	<.0001
U	11	70.0	(65.0-75.1)	15.2	.12
R-EBUS	20	71.1	(66.5-75.7)	84.2	<.0001
All	39	70.0	(67.1-72.9)	119.4	<.0001

- The yield increased as the lesion size increased
- The pneumothorax rate was 1.5%, which is significantly smaller than that reported for TTNA
- This meta-analysis shows that the diagnostic yield of guided bronchoscopic techniques is better than that of traditional transbronchial biopsy
- Although the yield remains lower than that of TTNA, the procedural risk is lower
- Guided bronchoscopy may be an alternative or be complementary to TTNA for tissue sampling of pulmonary nodule

Autoflourescence bronchoscopy(AFB)

- When the bronchial surface is illuminated by light, the light can be reflected, back-scattered, absorbed, or induce tissue autofluorescence
- Tissue autofluorescence is not visible to the unaided eye, because its intensity is very low and overwhelmed by the reflected and back-scattered light
- However, with suitable instrumentation the tissue autofluorescence can be visualized
- The intensity of the autofluorescence differs substantially between normal and tumorous tissues, which allows visualization of cancers and precancerous lesions in bronchi

Palcic B et al. Chest 1991;99(3):742-743

Autofluorescence diagnosis systems integrated into videoendoscopes

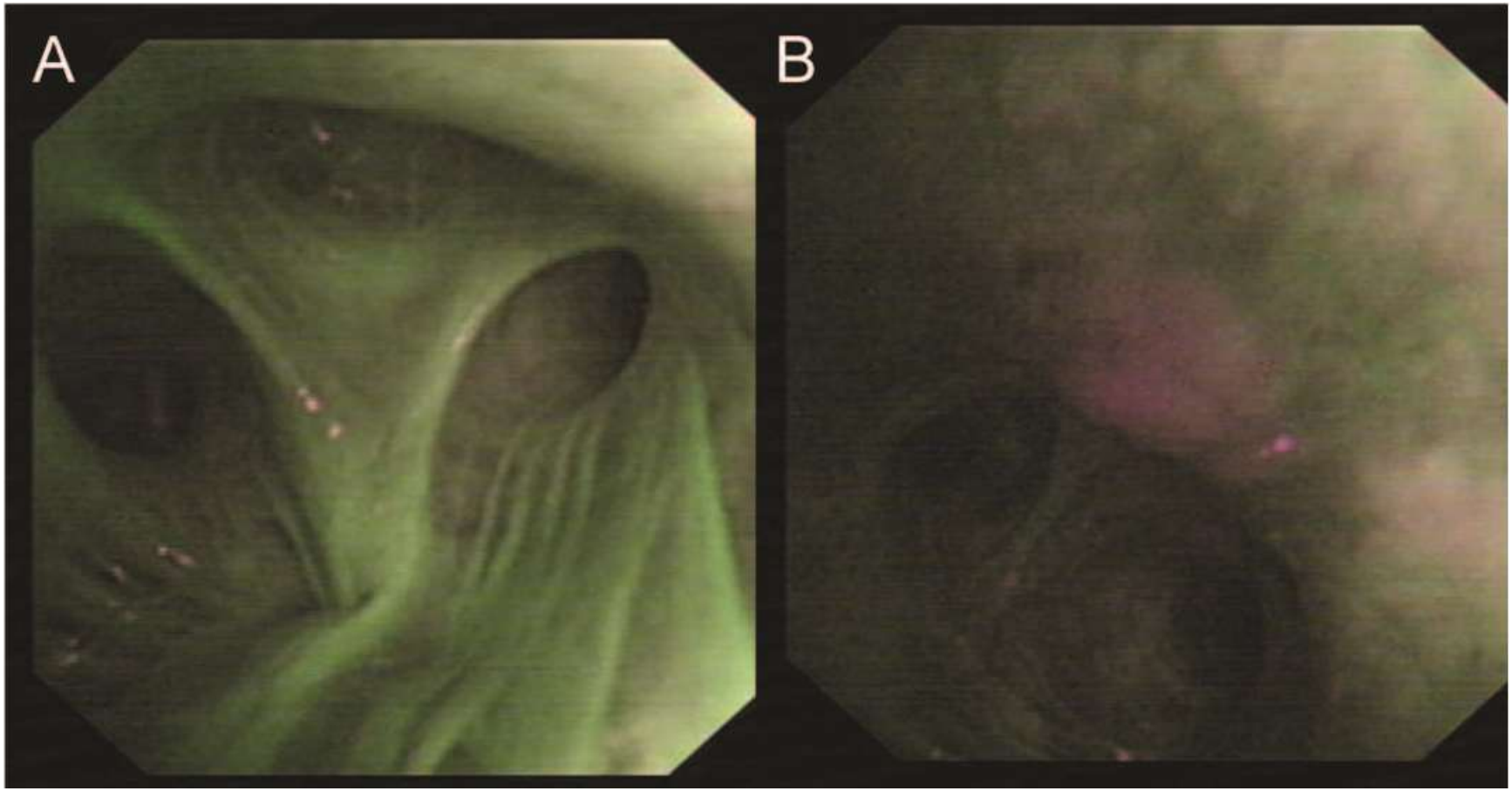
- 2 video autofluorescence systems are currently available: the SAFE 3000 and AFI systems
- The SAFE 3000 system uses both a xenon lamp, for white-light imaging, and a monochromatic diode laser, for autofluorescence imaging
- System enables immediate simultaneous viewing of both white-light video and AFB images
- Normal bronchial tissue emits intense green autofluorescence when excited by blue light from a diode laser (408 nm), so normal mucosa appears green and abnormal mucosa lacks this green autofluorescence and appears dark

Ikeda N et al,LungCancer2006; 52(1):21-27
Qing H et al, Respir Care; 2013

AFI system

- Consists of 3 parts: an autofluorescence videobronchoscope , a video processor unit and a xenon light source
- The system transmits 3 wavelengths: excitation blue light(395–445nm, to induce autofluorescence), 550 nm (red reflected light), and 610 nm (blue reflected light)
  - Normal mucosa appears green
  - Inflammation appears blue (because it contains a high concentration of hemoglobin, which absorbs the green and red wavelengths)
  - Cancers and precancerous lesions appear magenta, because they mix red/blue reflected signals and lack the green autofluorescence signal

Chiyo M et al, Lung Cancer 2005;4(3):307-313



Autofluorescence imaging videobronchoscopy in a 61year-old male with small cell lung cancer confirmed via pathology. A: Right upper lobe shows no mucosal abnormalities: all the mucosa appears green. B: Left upper lobe shows the magenta color that indicates mucosal abnormality

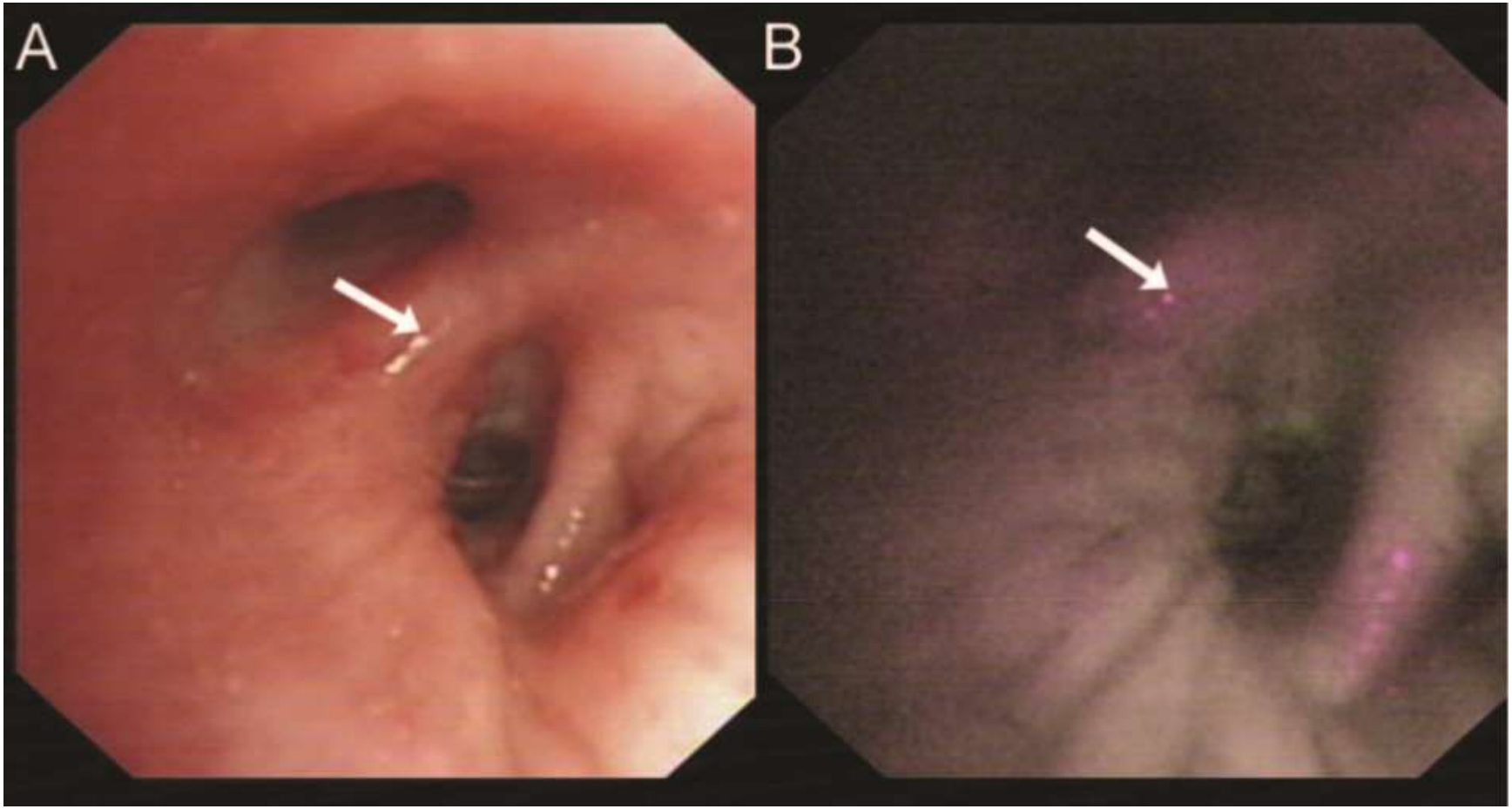
Mechanisms of Different Autofluorescence Intensities in Normal and Cancerous Tissue

- Autofluorescence can change if the epithelial layer thickens or if there is change in concentrations of fluorophores and nonfluorescent chromophores in the tissue
- Autofluorescence is intensely produced by submucosal stroma, but epithelium, mucosa, and cancerous tissue emit very little fluorescence
- Because of the thicker epithelium and mucosa in a cancer lesion than in normal mucosa, or because of the presence of cancer itself, the autofluorescence is intensely absorbed

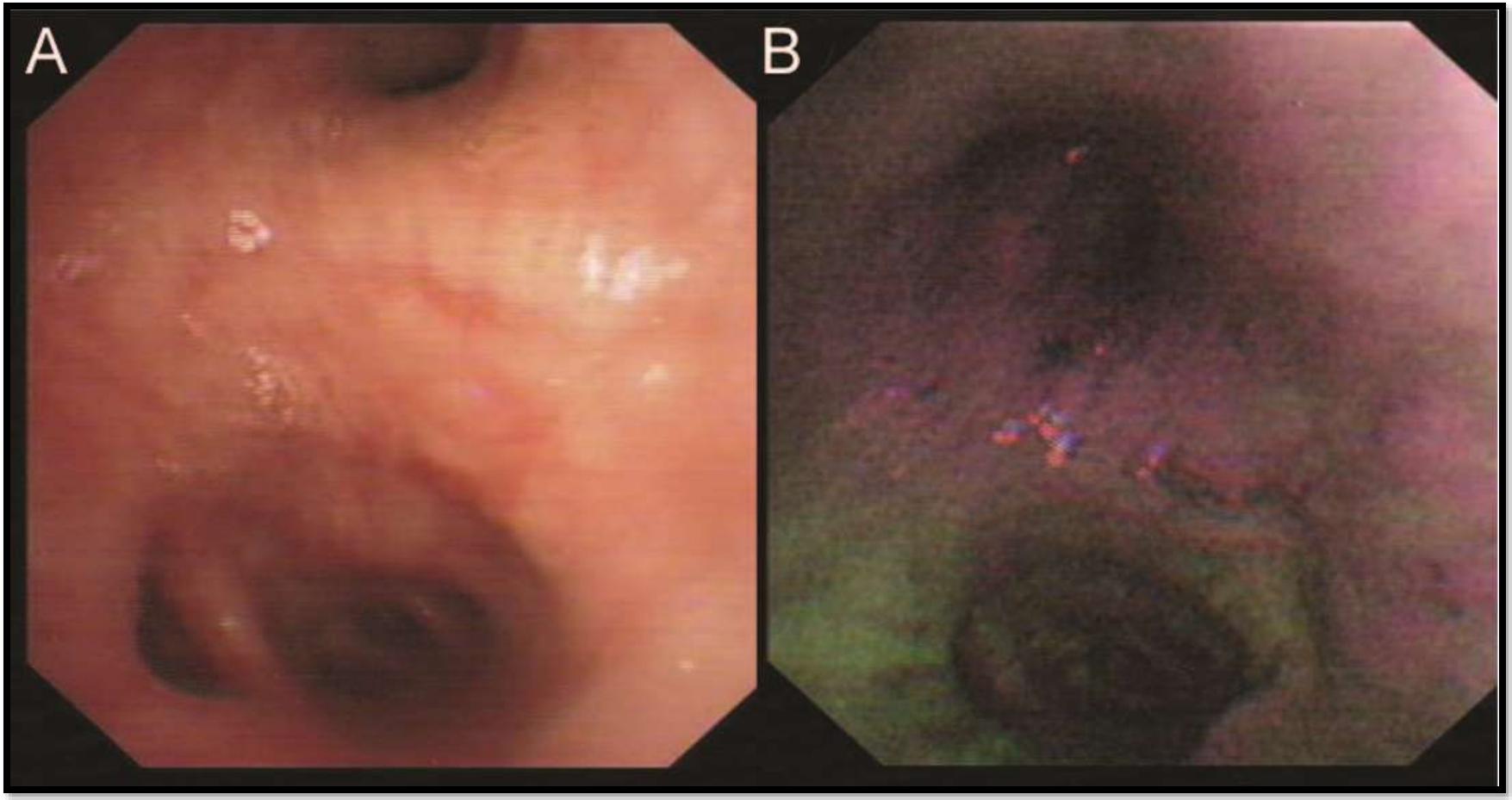
- Most endogenous fluorophores are associated with the tissue matrix, such as collagen and elastin, or are involved in cellular metabolic processes
- Dysplasia or cancer lesions →express matrix metalloproteinases →degrade the extracellular matrix→loss of autofluorescence
- Cancerous tissue has higher metabolism than normal tissue, so its blood volume increases while oxygen concentration in the cells decreases

- Cancer tissue→increased blood flow→ increase in amount of porphyrin →red light is increased
- Reduction in oxygen concentration→reduction in flavin→reduction in green autofluorescence
- Angiogenesis in cancerous or precancerous lesions→ increased absorption of the excitation light by hemoglobin→attenuation of autofluorescence of tissues

Zellweger M et al,J Biomed Opt 2001;6(1):41-51



Bronchoscopy at the bifurcation of the right middle lobe and lower lobe. A: White-light bronchoscopy shows non-specific swelling or thickening (arrow), which might be judged normal and not biopsied. B: Autofluorescence imaging videobronchoscopy shows magenta color that indicates mucosal abnormality, which pathology found was adenocarcinoma



Bronchoscopy at the bifurcation of the left upper lobe and lower lobe. A: White-light bronchoscopy shows edema or thickening. B: Autofluorescence imaging videobronchoscopy image shows magenta color that indicates mucosal abnormality. Pathology with acid-fast stain led to a diagnosis of tuberculosis

Autofluorescence Imaging Videobronchoscopy Versus White-Light Bronchoscopy

First Author	Pathology Finding	Subjects no.	Autofluorescence Imaging Videobronchoscopy					White-Light Bronchoscopy				
			Biopsy specimens no.	Positive no.	Negative no.	Sensitivity %	Specificity %	Biopsy specimens no.	Positive no.	Negative no.	Sensitivity %	Specificity %
Chiyo[19]	Dysplasia or worse	32	32	26	6	81.3	83.3	32	18	14	56.2	50
	Bronchitis		30	5	25			30	15	15		
Ueno[50]	Severe dysplasia or worse	31	19	18	1	94.7	71.1	19	14	5	73.7	91.1
	Other		45	13	32			45	4	41		
Li[20]	Severe dysplasia or worse	136	76	72	4	94.7	57	76	50	26	65.8	83.6
	Other		165	71	94			165	27	138		
Herth[21]	Moderate to severe dysplasia or carcinoma in situ	57	17	3	14	64.7	40	17	11	6	17.6	87.5
	Metaplasia and mild dysplasia		40	5	35			40	24	16		
Cetti[24]	Moderate dysplasia or worse	49	16	15	1	93.8	81.5	16	15	1	93.8	92.3
	Other		64	53	11			65	5	60		
Zaric[22]	Carcinoma	27	40	36	4	90	85.3	45	29	16	64.4	55.5
	Other		68	10	58			63	28	35		
Zaric[23]	Carcinoma	104	312	286	26	91.7	92.6	312	242	70	77.6	85.3
	Other		312	23	289			312	46	266		
Zaric[49]	Carcinoma	118				89.1	77.8				76.8	51.9
	Other											

- In a meta-analysis, the advantage of AFBs depended on the incidence of pre-invasive lesions, but not invasive cancers
- AFI was developed to detect pre-invasive lesions, with the hope that early treatment would improve outcomes
- The quality of WLB images has improved with the advent of the videobronchoscope, and most of invasive cancers that can be detected by AFI also could be detected by WLB

Sun J et al, J Thorac Oncol 2011;6(8):1336-1344

- WLB is ineffective at detecting lesions smaller than 5 mm in diameter, and pre-invasive lesions are only a few cell layers thick, so the surface mucosa typically appears relatively normal during WLB
- AFI can detect tiny and superficial lesions, thereby improving diagnostic sensitivity for early stage lesions
- Edell et al reported that the relative sensitivity of AFB+ WLB versus WLB was 1.50 on a per-lesion basis (95% CI 1.26– 1.89) and 1.33 (95% CI 1.13–1.70) on per-patient basis

Edell E et al, J Thorac Oncol 2009; 4(1):49-54

Drawbacks of AFI

- AFI may have more false positive results if we do not choose proper indications for AFI. Some benign lesions, such as inflammatory bronchial lesions or tuberculosis, also appear as magenta on the AFI monitor
- The low specificity and high false positive rate may result in a greater number of abnormal lesions being identified during bronchoscopy, prolonging the procedure in order to biopsy the lesions, and thus increasing the number of specimens and pathology costs
- AFI system is also about twice as expensive as a WLB system

Conclusion

- The benefit of AFI in clinical practice is not overwhelming
- AFI can be used for the following indications
  - Evaluation of patients who have high-grade sputum atypia but no radiological abnormalities
  - Surveillance of patients with previously detected high-grade pre-invasive lesions (metaplasia, dysplasia, carcinoma in situ) but no evidence of invasive carcinoma
  - Planning endobronchial therapy for patients who have early invasive lung cancer

Narrow Band Imaging

- Narrow band imaging(NBI) is an optical technology of modified white light using special blue and green light that can clearly visualize microvascular structures in the mucosal layer
- NBI may also allow for better detection of early paraneoplastic and neoplastic mucosal lesions and may improve the effectiveness of endoscopic surveillance and screening

Gono K et al, J Biomed Opt.2004;9

- By using the light absorption characteristics of hemoglobin, NBI creates enhanced images of blood vessels when the tissue is irradiated with the two narrow wavebands of light
- Blue narrow band-wavelength 390- 445 nm: absorbed by surface mucosal layer capillaries
- Green narrow band-wavelength 530 - 550 nm: absorbed by the deeper submucosal thick blood vessels
- Narrow band widths reduce scattering of light and enable enhanced visualization of blood vessels

Herth et al,Clin Chest Med;2010

Narrow band imaging with high-resolution bronchovideoscopy: A new approach for visualizing angiogenesis in squamous cell carcinoma of the lung

Kiyoshi Shibuya[a,c,*], Takahiro Nakajima[a], Taiki Fujiwara[a], Masako Chiyo[a], Hidehisa Hoshino[a], Yasumitsu Moriya[a], Makoto Suzuki[a], Kenzo Hiroshima[b], Yukio Nakatani[b], Ichiro Yoshino[a]

[a] *Department of Thoracic Surgery, Graduate School of Medicine, Chiba University, 1-8-1 Inohana, Chuo-ku, Chiba 260-8670, Japan*
[b] *Department of Diagnostic Pathology, Graduate School of Medicine, Chiba University, 1-8-1 Inohana, Chuo-ku, Chiba 260-8670, Japan*
[c] *Department of Chest Surgery, Matsudo City Hospital, 4005 Kamihongo, Matsudo 271-8511, Japan*

ARTICLE INFO

Article history:
Received 18 February 2010
Received in revised form 21 April 2010
Accepted 25 April 2010

Keywords:
Narrow band imaging
High-resolution bronchovideoscopy
Angiogenesis
Multi-step carcinogenesis
Angiogenic squamous dysplasia
Squamous cell carcinoma

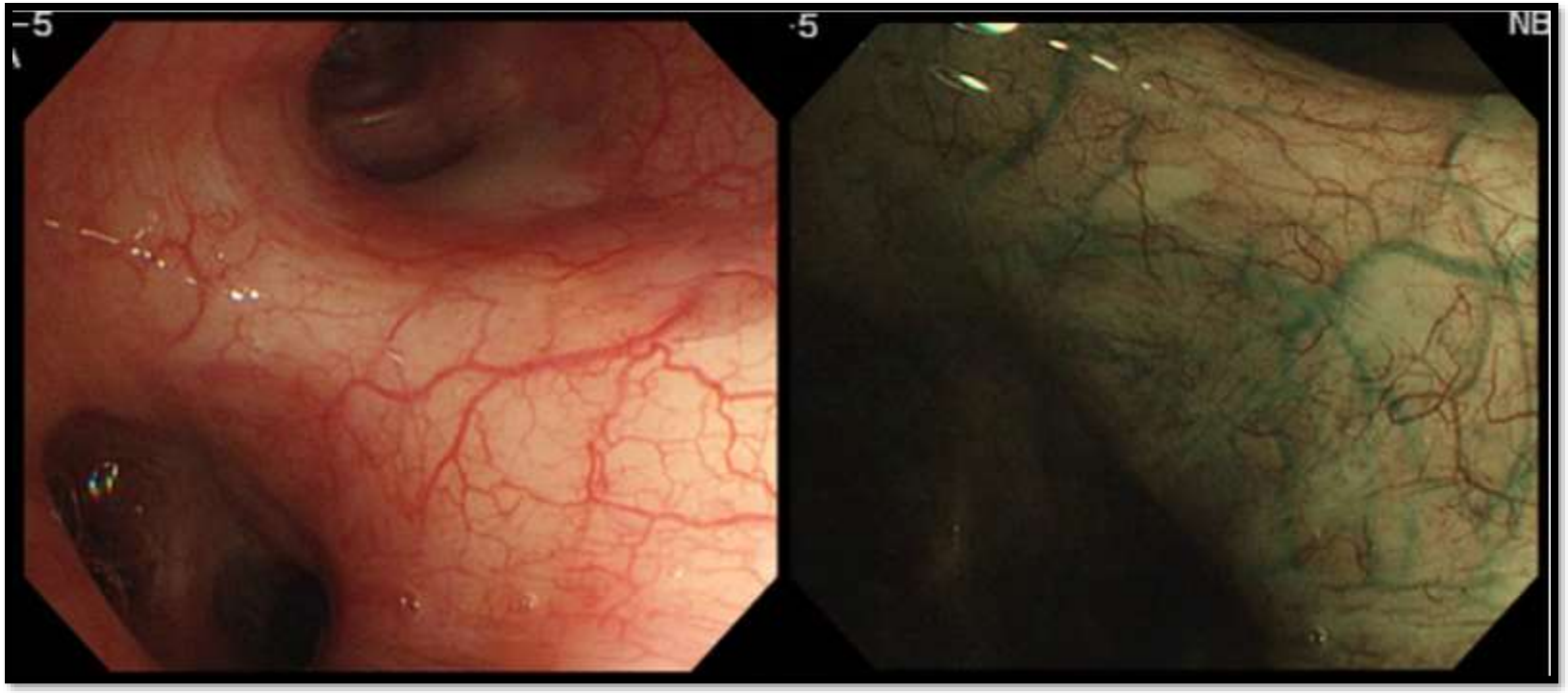
ABSTRACT

Objectives: We investigated the ability of a high-resolution bronchovideoscopy system with narrow band imaging (NBI) to detect blood vessel structures in squamous cell carcinoma (SCC) of bronchi, as well as squamous dysplasia.

Methods: Seventy-nine patients with either abnormal sputum cytology or lung cancer were entered into the study. First, high-resolution bronchovideoscopy with white light was performed. Observations were repeated using NBI light to examine microvascular structures in the bronchial mucosa. Spectral features of the RGB (red/green/blue) sequential videoscope system were changed from a conventional RGB filter to the new NBI filter. The wavelength ranges of the NBI filter were: 400–430 nm (blue), 400–430 nm (green) and 520–560 nm (red).

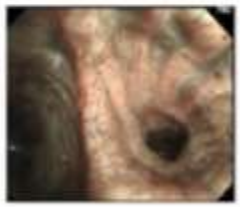
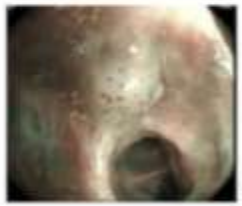
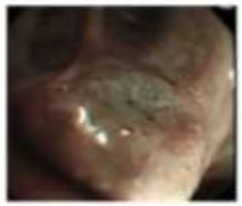
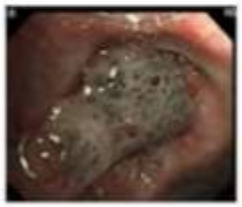
Results: The following were clearly observed with NBI with high-resolution bronchovideoscopy: increased vessel growth and complex networks of tortuous vessels of various sizes, in squamous dysplasia; some dotted vessels, in addition to increased vessel growth and complex networks of tortuous vessels, in ASD; several dotted vessels and spiral or screw type tumor vessels of various sizes and grades, in SCC. Capillary blood vessel and/or tumor vessel mean diameters of ASD, CIS, microinvasive and invasive carcinoma were 41.4 ± 9.8 μm, 63.7 ± 8.2 μm, 136.5 ± 29.9 μm and 259.4 ± 29.6 μm, respectively. These results indicated a statistically significant increase of mean vessel diameters in the four groups ($P < 0.0001$).

Conclusion: NBI with high-resolution bronchovideoscopy was useful for detecting the increased vessel growth and complex networks of tortuous vessels, dotted vessels and spiral or screw type tumor vessels of bronchial mucosa. This may enable detecting the onset of angiogenesis during multi-step carcinogenesis of the lung.



High resolution bronchovideoscopy combined with NBI of the bronchial mucosa.
Left- conventional white light image Right- NBI image

Vessel morphology during lung cancer pathogenesis

	Squamous dysplasia	ASD	CIS	Micro invasive	Invasive
Tortuous vessel networks	+	+	–	–	–
Dotted vessels	–	+	+	+ +	+ + +
Spiral and screw type vessels	–	–	+	+ +	+ + +
					

Summary of the bronchial mucosal blood vessel structures during multi-step carcinogenesis of squamous cell carcinoma using NBI with high resolution videobronchoscopy

Shibuya K et al, Lung cancer 69(2010)

Therapeutic Advances in Respiratory Disease *Original Research*

Narrow-band imaging bronchoscopy in the detection of premalignant airway lesions: a meta-analysis of diagnostic test accuracy

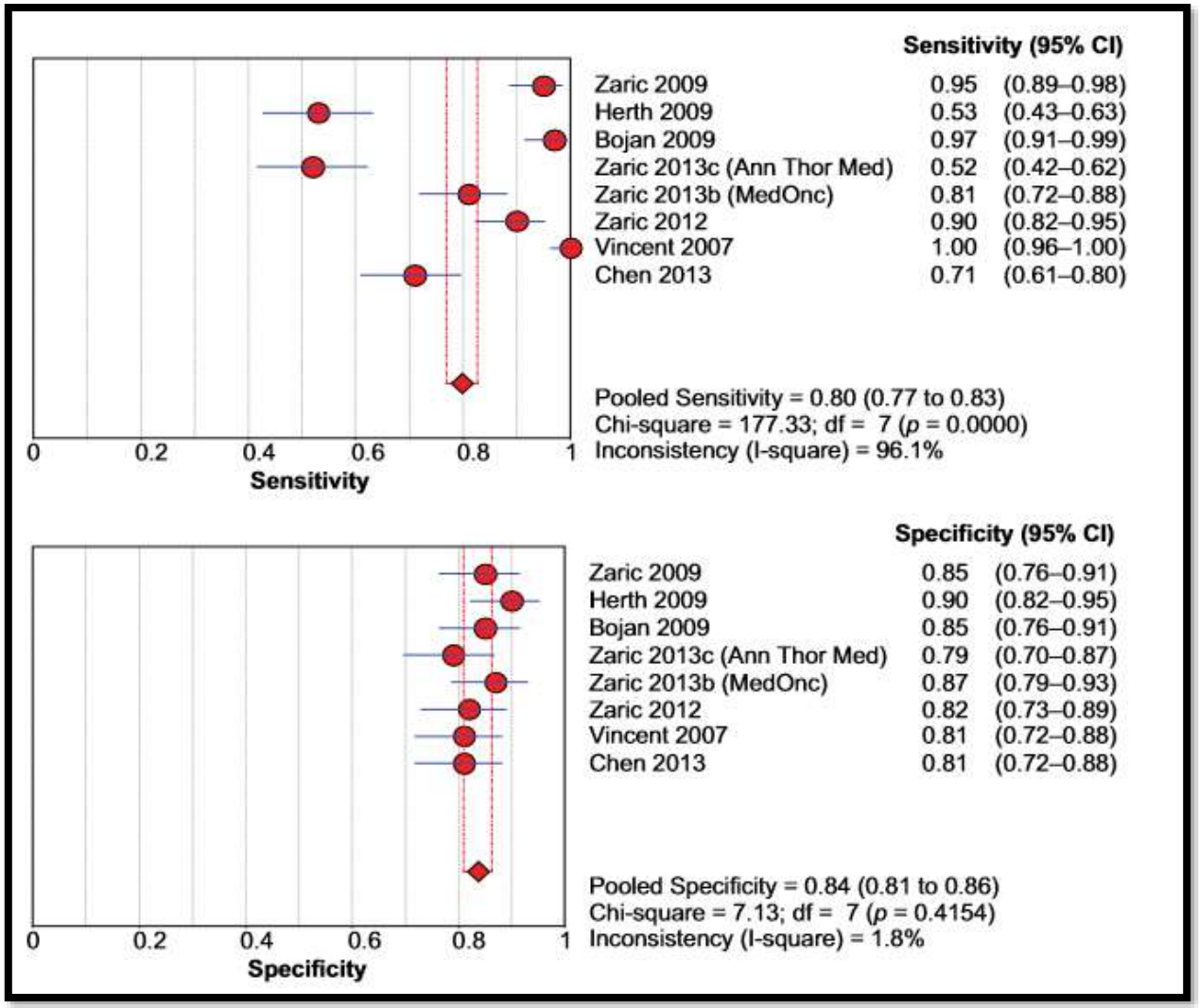
Ther Adv Respir Dis

2015, Vol. 9(5) 207–216

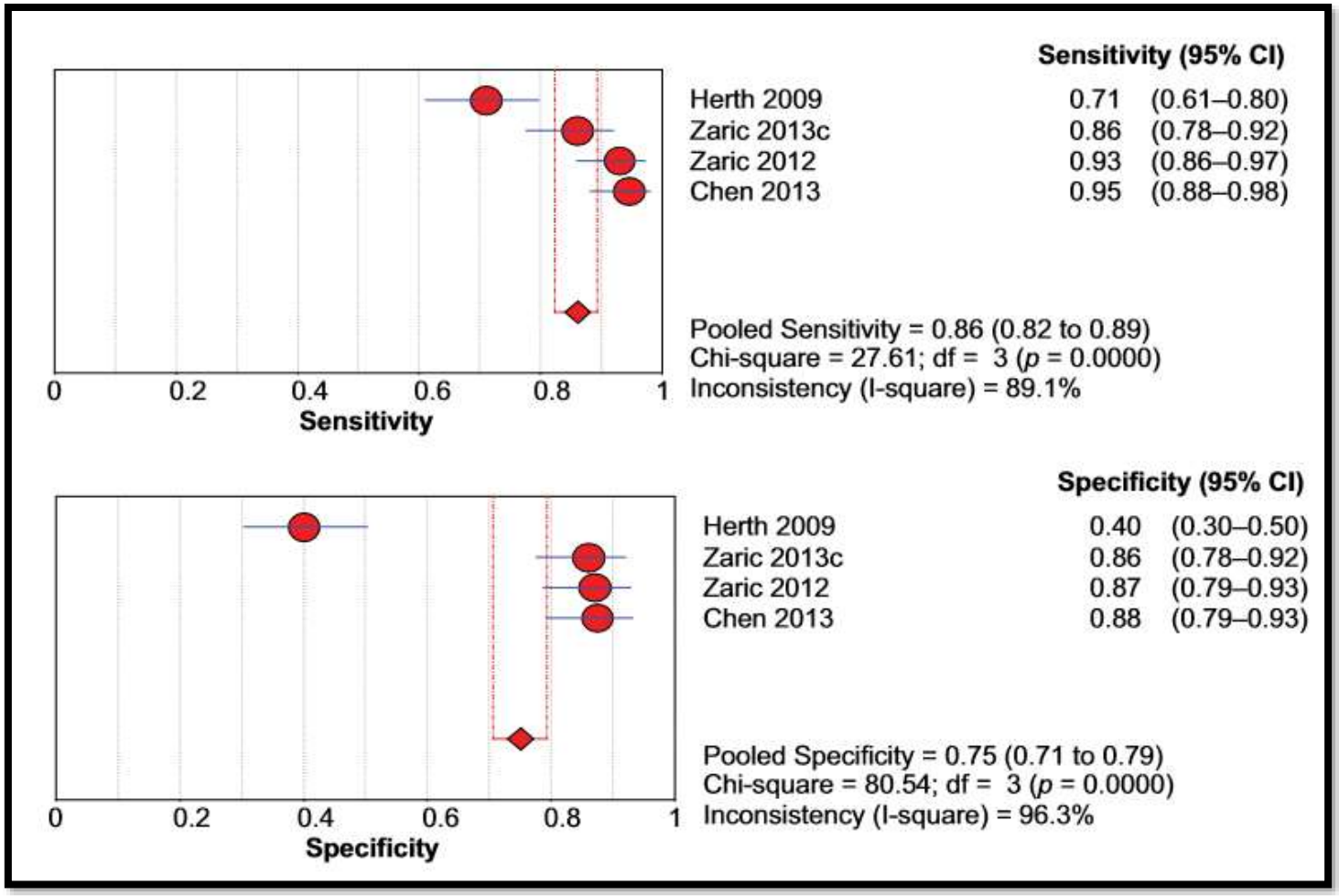
DOI: 10.1177/1753465815589698

Imran H. Iftikhar and Ali I. Musani

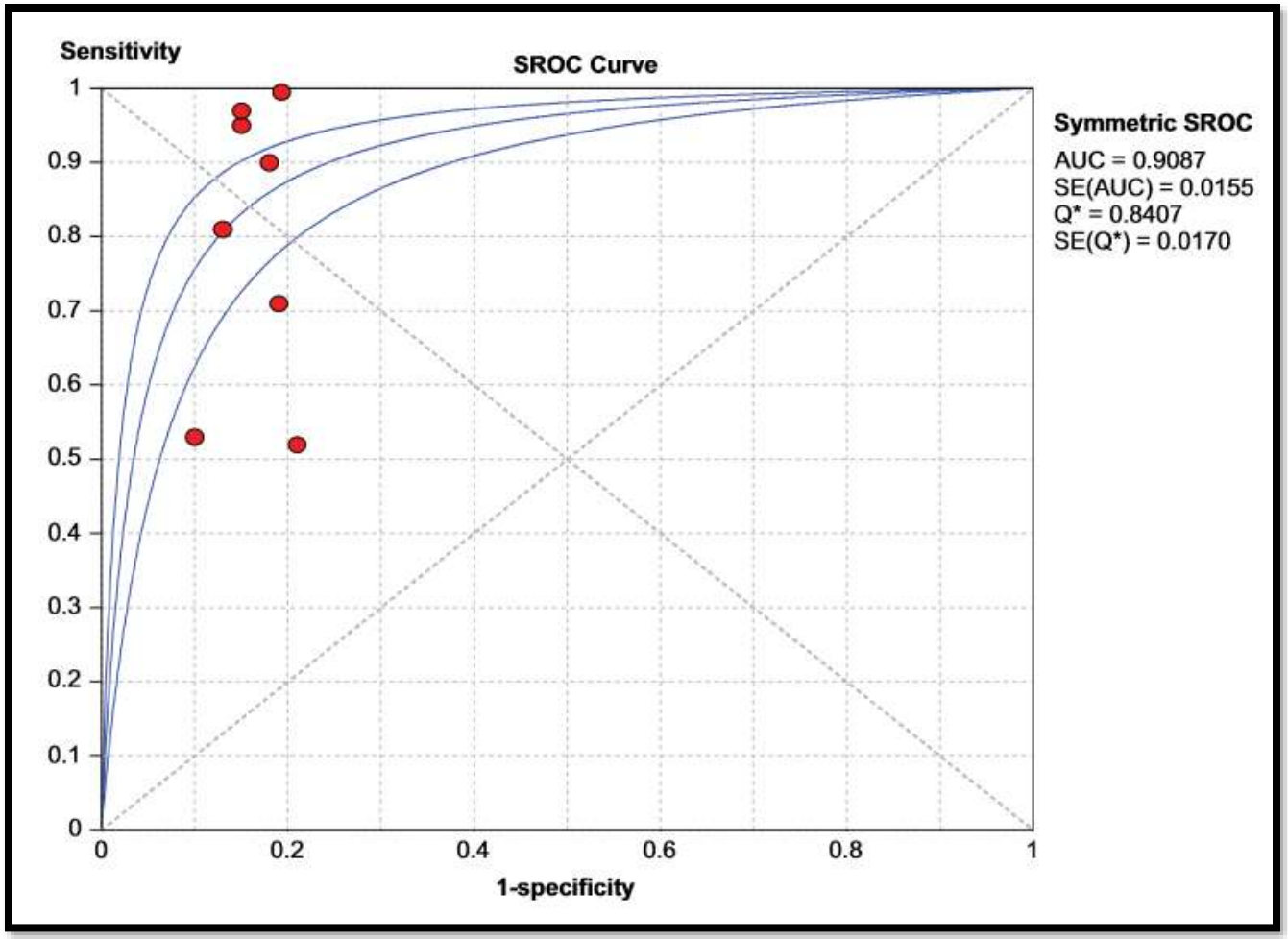
Sensitivity and specificity of NBI bronchoscopy



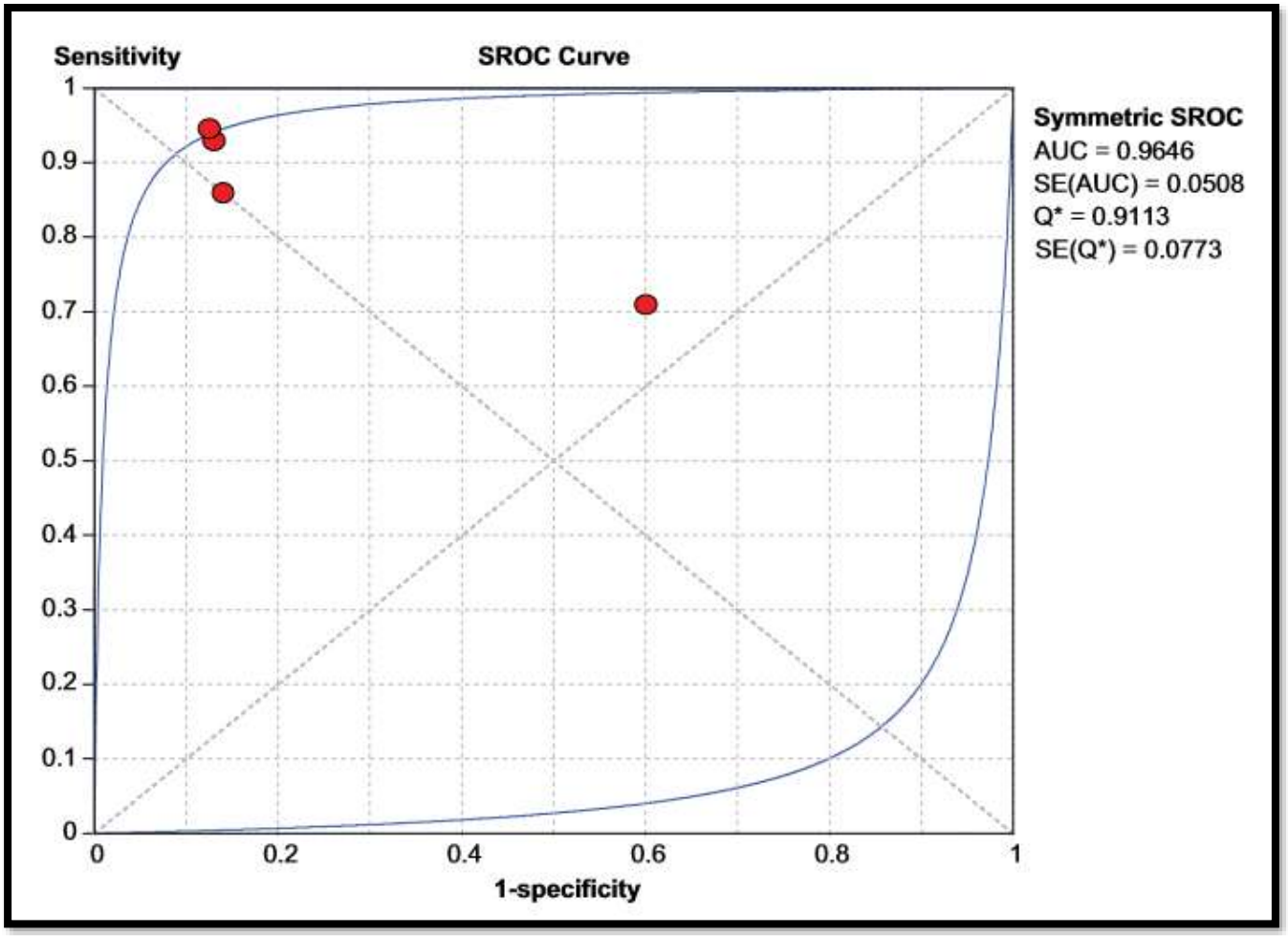
Sensitivity and specificity of combined NBI and AFI bronchoscopies



Summary receiver operating curve for NBI bronchoscopy



Summary receiver operating curve for combined NBI and AFI bronchoscopies



ORIGINAL ARTICLE

Narrow-Band Imaging Bronchoscopy Increases the Specificity of Bronchoscopic Early Lung Cancer Detection

Felix J. F. Herth, MD, Ralf Eberhardt, MD,* Devanand Anantham, MRCP,†*
Daniela Gompelmann, MD, Mohamed Wafaa Zakaria, MD,‡ and Armin Ernst, MD*§*

- A prospective analysis of an open-label study was conducted to compare the diagnostic yields of WLB, NBI, and AFI in the diagnosis of intraepithelial neoplasia
- 62 patients with high risk for lung cancer but without a known diagnosis were studied

J Thorac Oncol. 2009;4: 1060–1065

Comparison of WLB,AFI and NBI

	WLB	AFI	WLB + AFI	NBI	WLB + NBI	AFI + NBI	WLB + NBI + AFI
Number of patients with dysplasia (moderate to severe) and CIS identified as bronchoscopically positive ($n = 17$)	3	11	11	9	9	12	12
Sensitivity (CI)	0.18 (0–0.78)	0.65 (0.39–0.90)	0.65 (0.39–0.90)	0.53 (0.26–0.80)	0.53 (0.39–0.90)	0.71 (0.41–1.00)	0.71 (0.41–1.00)
Relative sensitivity	1.0	3.7	3.7	3.0	3.0	4.0	4.0
Number of patients with metaplasia and mild dysplasia identified as bronchoscopically negative ($n = 40$)	35	16	14	36	31	16	14
Specificity (CI)	0.88 (0.76–1.00)	0.4 (0.24–0.56)	0.35 (0.06–0.64)	0.90 (0.80–1.00)	0.78 (0.62–0.94)	0.40 (0.13–0.67)	0.35 (0.06–0.64)
Relative specificity	1.0	0.5	0.4	1.0	0.9	0.5	0.4

WLB, white light videobronchoscopy; AFI, autofluorescence imaging; NBI, narrow band imaging; CIS, carcinoma in situ; CI, confidence interval.

- Angiogenic squamous dysplasia and its detection by NBI may be advantageous over AFI screening in detecting early lung cancer
- NBI seems to increase specificity without compromising sensitivity
- This can perhaps be explained by angiogenesis being more specific than changes in extracellular matrix proteins and thickening of superficial mucosa in identifying intraepithelial neoplasia

Future prospects

- Before NBI finds its place in routine screening of early lung cancer, studies are warranted to better characterize the subset of at-risk patients with premalignant airway lesions likely to undergo malignant transformation, given that spontaneous regressions of these lesions have been described
- Need to develop consensus on followup surveillance and treatment decisions

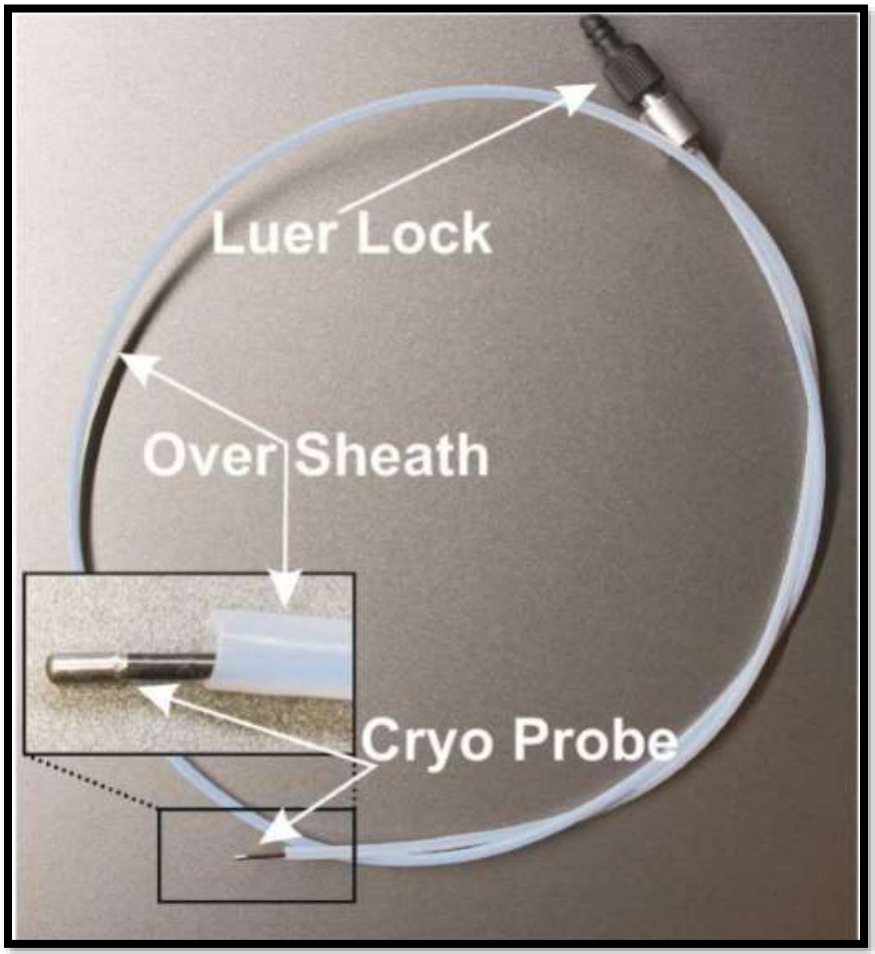
Recent advances in cryobiopsy

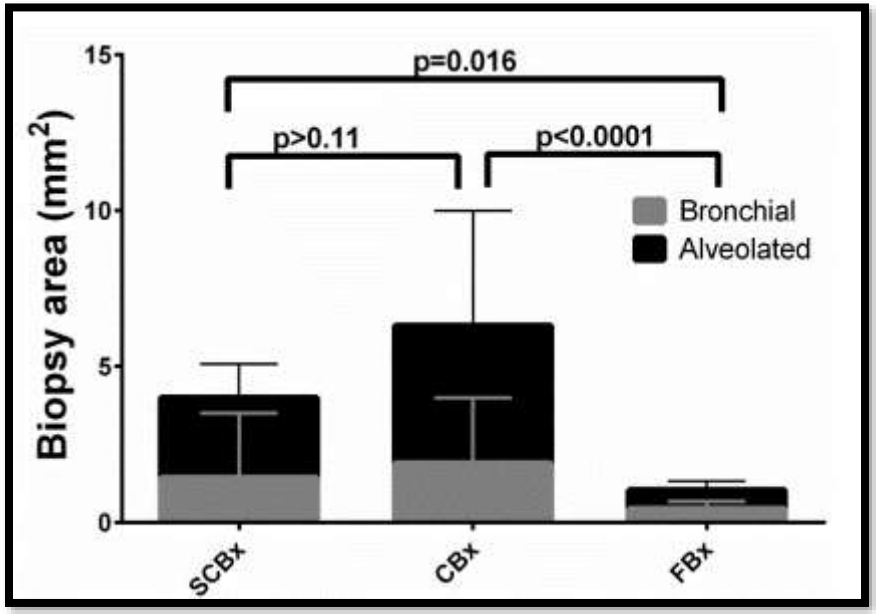
- One limitation of CBx is the need to retract en-bloc the cryoprobe with the specimen and the bronchoscope out of the patient's airway to retrieve the specimen which may limit the ability to safely manage complications
- In order to address this potential safety issue, a new smaller cryoprobe instrument with an over sheath that can be retracted through the working channel of the bronchoscope has been developed (ERBE, Germany)

A Randomized Controlled Trial of a Novel Sheath Cryoprobe for Bronchoscopic Lung Biopsy in a Porcine Model

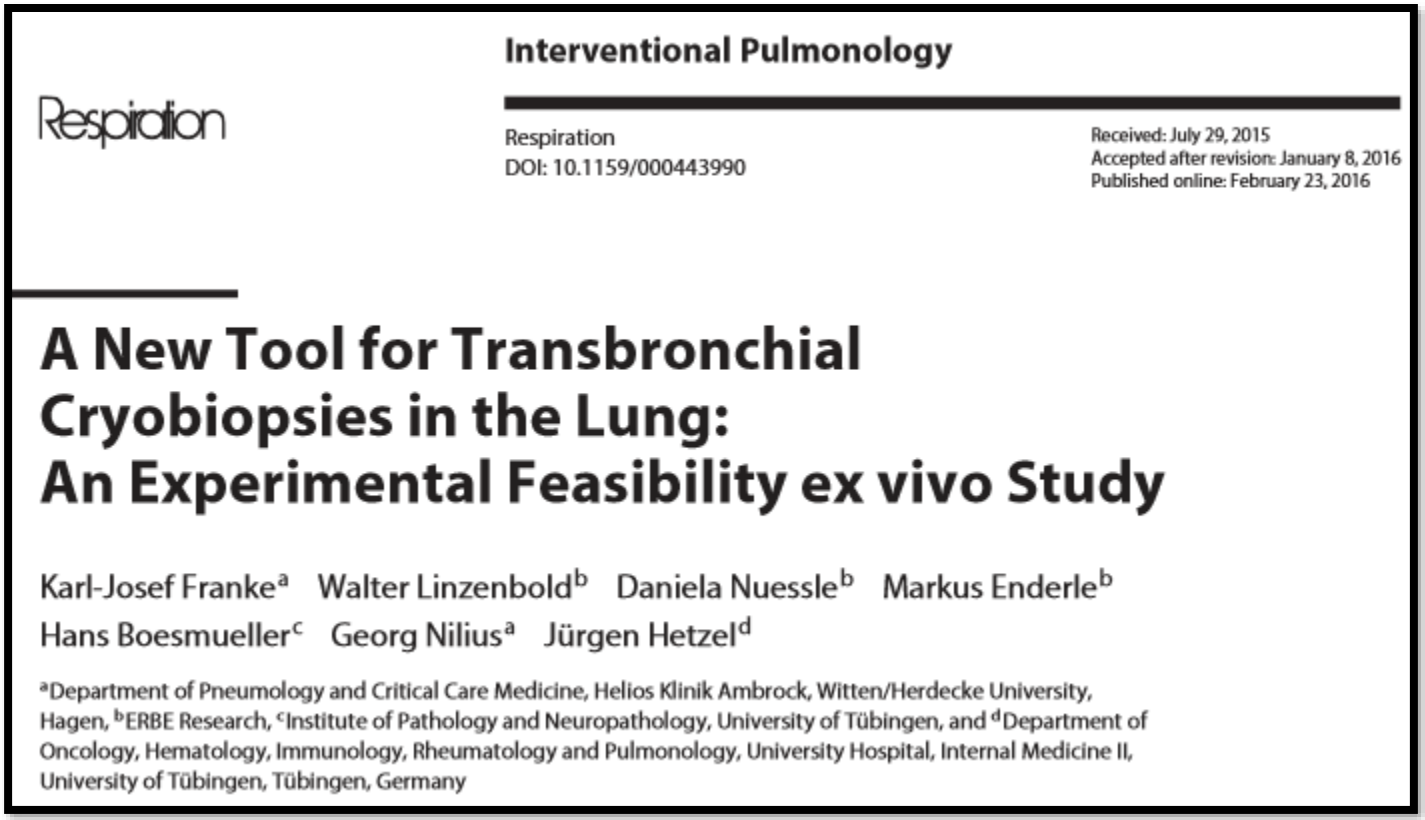
- Prospective, randomized, controlled, single blinded porcine study comparing a 1.1 mm SCBx probe, 1.9 mm CBx probe and 2.0 mm FBx forceps
- Specimens adequate for standard pathologic processing were retrieved with 82.1% of the SCBx specimens, 82.9% of the CBx and 30% of the FBx. The histologic assessability of both, SCBx ($p = 0.0002$) and CBx ($p = 0.0003$) was superior over FBx
- Procedure time for FBx was faster than both SCBx and CBx, but SCBx was significantly faster than CBx ($p < 0.0001$). Fluoroscopy time was lower for both SCBx and CBx as compared to FBx
- There were no significant bleeding events

Yarmus L et al, CHEST; Jan 2016


Luer Lock
Over Sheath
Cryo Probe


p=0.016
p>0.11
p<0.0001
Biopsy area (mm²)
15
10
5
0
Bronchial
Alveolated
SCBx
CBx
FBx

- A potential concern with SCBx was the quality of the biopsy specimen compared to CBx since unlike CBx, the SCBx specimens were compressed through the working channel
- However, there were no significant differences in the distortion of lung architecture between both cryo techniques



Interventional Pulmonology

Respiration

Respiration
DOI: 10.1159/000443990

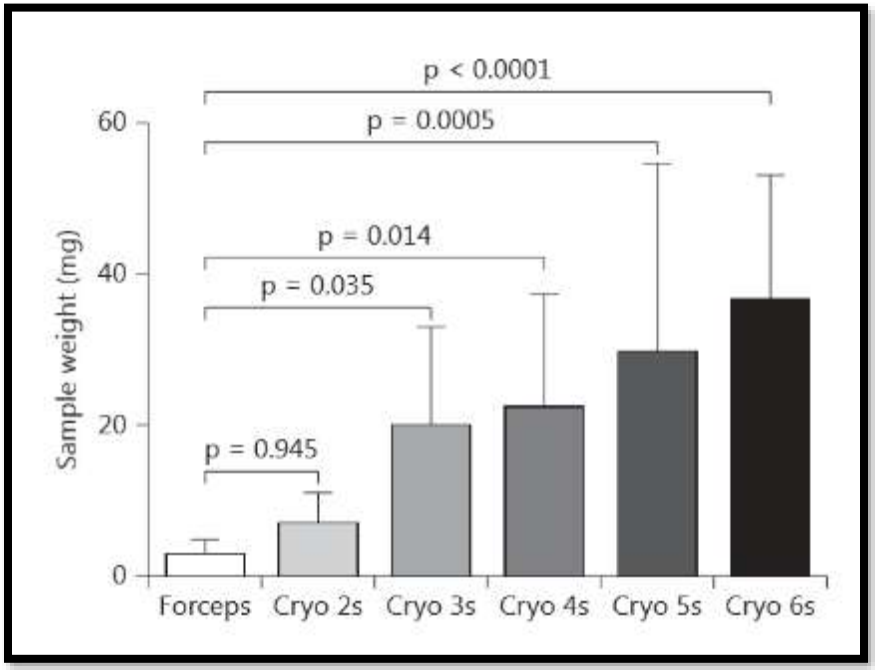
Received: July 29, 2015
Accepted after revision: January 8, 2016
Published online: February 23, 2016

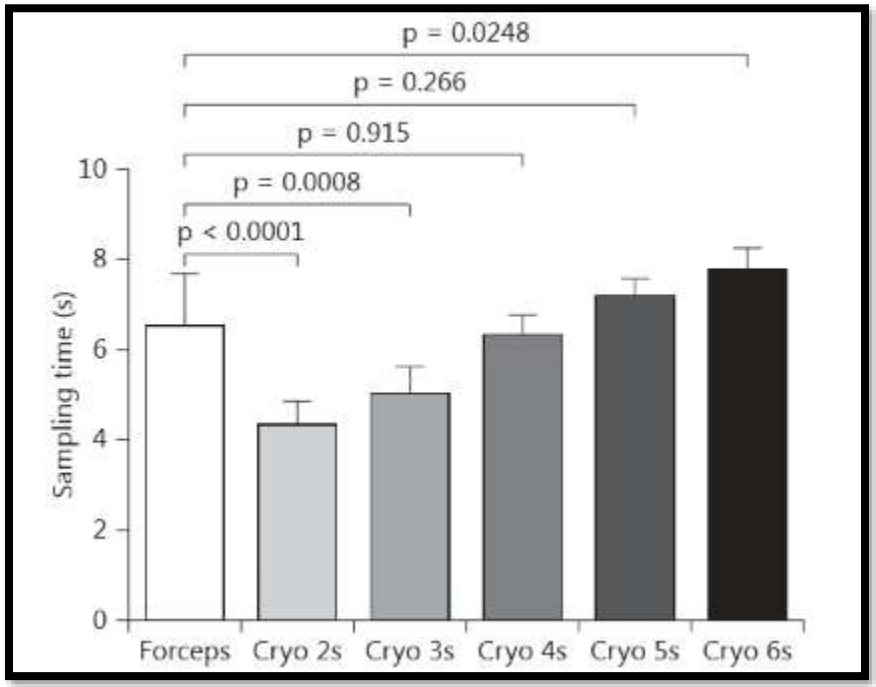
A New Tool for Transbronchial Cryobiopsies in the Lung: An Experimental Feasibility ex vivo Study

Karl-Josef Franke[a] Walter Linzenbold[b] Daniela Nuessle[b] Markus Enderle[b]
Hans Boesmueller[c] Georg Nilius[a] Jürgen Hetzel[d]

[a]Department of Pneumology and Critical Care Medicine, Helios Klinik Ambrock, Witten/Herdecke University, Hagen, [b]ERBE Research, [c]Institute of Pathology and Neuropathology, University of Tübingen, and [d]Department of Oncology, Hematology, Immunology, Rheumatology and Pulmonology, University Hospital, Internal Medicine II, University of Tübingen, Tübingen, Germany

- The feasibility of obtaining transbronchial specimens with TBCB (mini cryoprobe with a diameter of 1.1 mm) was tested and the technique was compared to transbronchial forceps biopsy (TBFB) in a prospectively randomized ex vivo animal study using a standard flexible bronchoscopy technique


p < 0.0001
p = 0.0005
p = 0.014
p = 0.035
p = 0.945
Sample weight (mg)
60
40
20
0
Forceps
Cryo 2s
Cryo 3s
Cryo 4s
Cryo 5s
Cryo 6s


p = 0.0248
p = 0.266
p = 0.915
p = 0.0008
p < 0.0001
Sampling time (s)
10
8
6
4
2
0
Forceps
Cryo 2s
Cryo 3s
Cryo 4s
Cryo 5s
Cryo 6s

Conclusion

- Cryobiopsy with mini cryoprobe is a safe technique in animal models which provides a larger size biopsy compared to FBx with a similar safety and histologic profile as comparable to standard CBx
- The major advantage of the new probe is that it can be used through the working channel in a flexible way without the need of a rigid tube or intubation
- Human studies are warranted

Take home message

- The use of EMN,VBN and ultrathin bronchoscopy should be steadily promoted by identifying cases suitable for the procedure, carrying out a cost/benefit analysis and determining the optimum combination of procedures
- Advances in AFB, and NBI may prove valuable in detecting early malignant lesions of the lung parenchyma and large airways in the future; yet, for now, they remain research tools
- It is feasible to retrieve TBCB samples of good quality and size with the new mini cryoprobe through the working channel of the bronchoscope, while the bronchoscope remains within the central airways throughout the whole procedure