ECENT DEVELOPMENTS IN ADVANCEI
DIAGNOSTIC BRONCHOSCOPY

MINIMIZING INVASIVENESS WHILE MAXIMIZING ACCURACY

150 years, Since Gustav Killian the “father of bronchoscopy”, bronchoscopy, especially flexible one, h

ay for airway inspection for diagnosing and theraputic purposes .

es to the wider use of flexible bronchoscopy have included difficulty in navigating to the lung periphery

ce of vasculature structures when performing diagnostic biopsies, and the ability to biopsy a lesion und

tion.

10–15 years have seen major advances in thoracic imaging, navigational platforms to direct the

scopist to lung lesions, and the ability to visualize lesions during biopsy.

key advancements in diagnostic bronchoscopy aim to enhance imaging and provide bronchos
on to lung lesions are worth mentioning

Techniques : convex EBUS, radial EBUS [rEBUS], fluoroscopy

onal Techniques: Virtual bronchoscopic navigation , electromagnetic navigational bronchoscopy,

renchymal nodule access, CT bronchoscopy.

ive bronchoscopic local imaging techniques: Optical coherence tomography (OCT), Confocal las

roscopy, Thin convex probe EBUS.

ogical Changes in the Bronchoscope : Ultrathin bronchoscopy , Robotic bronchoscopy.

ULTRASOUND

ntral airway radial ultrasound probes are used to detail imaging of the airway wall and surrounding str

MHz radial probe EBUS fitted with a catheter that has a water-inflatable balloon at the tip), peripheral

llow for visualisation and subsequent sampling of peripheral intrapulmonary lesions

MHz ultra-miniature radial probe can be extended into subsegmental bronchi housed in a guide sheat

feasibility study for the sampling of peripheral pulmonary lesions tested a prototype of a

visualisation device integrating r-EBUS and biopsy needle into a single device to sample lesions in re

EBUS-TBNA


OLYMPUS

‹ probe (CP)-endobronchial ultrasound

TBNA has emerged as a technique that combined the high yield of mediastinoscopy (up to 90 %)with t

invasiveness of TBNA , has the ability to locate lymph nodes and obtain the sample under direct visu

JS is integrated with a convex-shaped ultrasonic transducer at the tip of the bronchoscope. The physic

e the airway walls and surrounding structures by placing the end of the bronchoscope directly against t

wall or by inflating the balloon with saline solution. It can be observed in real-time that the needle pass

the bronchial wall and the lesion of interest , It is possible to avoid blood vessels through the power D

nstalled with ultrasound

cation rates in EBUS-TBNA were low (1% to 5%) such as bronchogenic cyst infection, mediastinal abs

tinitis, pericarditis, and sepsis have been reported

Convex probe (CP)-endobronchial ultrasound is the “gold standard” for lung cancer staging except for

ng lymphoma remains lower at ~70% .

xcellent diagnostic accuracy for infectious aetiologies such as mediastinal tuberculosis (TB) lymphade

EBUS has proven utility in the evaluation of sarcoidosis.

cyst drainage and therapeutic drug injections

Concurrent EBUS and endoscopic ultrasound (EBUS is limited to the anterosuperior mediastinum, and

ed to sample the posteroinferior mediastinum, which justifies the case for combining EBUS with EUS fo

orough and systematic mediastinal staging)


YASHO
HOSPI
www.yashodahospitals.co
Video source: Astrazen

st recent advances in EBUS are focused on involving the **ultrasonographic characteristics of the LI**
r patterns and elastography

est study on this topic to date was published by Fujiwara and coworkers :Round shape, distinct margin
eneous echogenicity, presence of coagulation necrosis were found to be independently predictive
nancy. When all four factors were absent, 96% of the lymph nodes were benign.

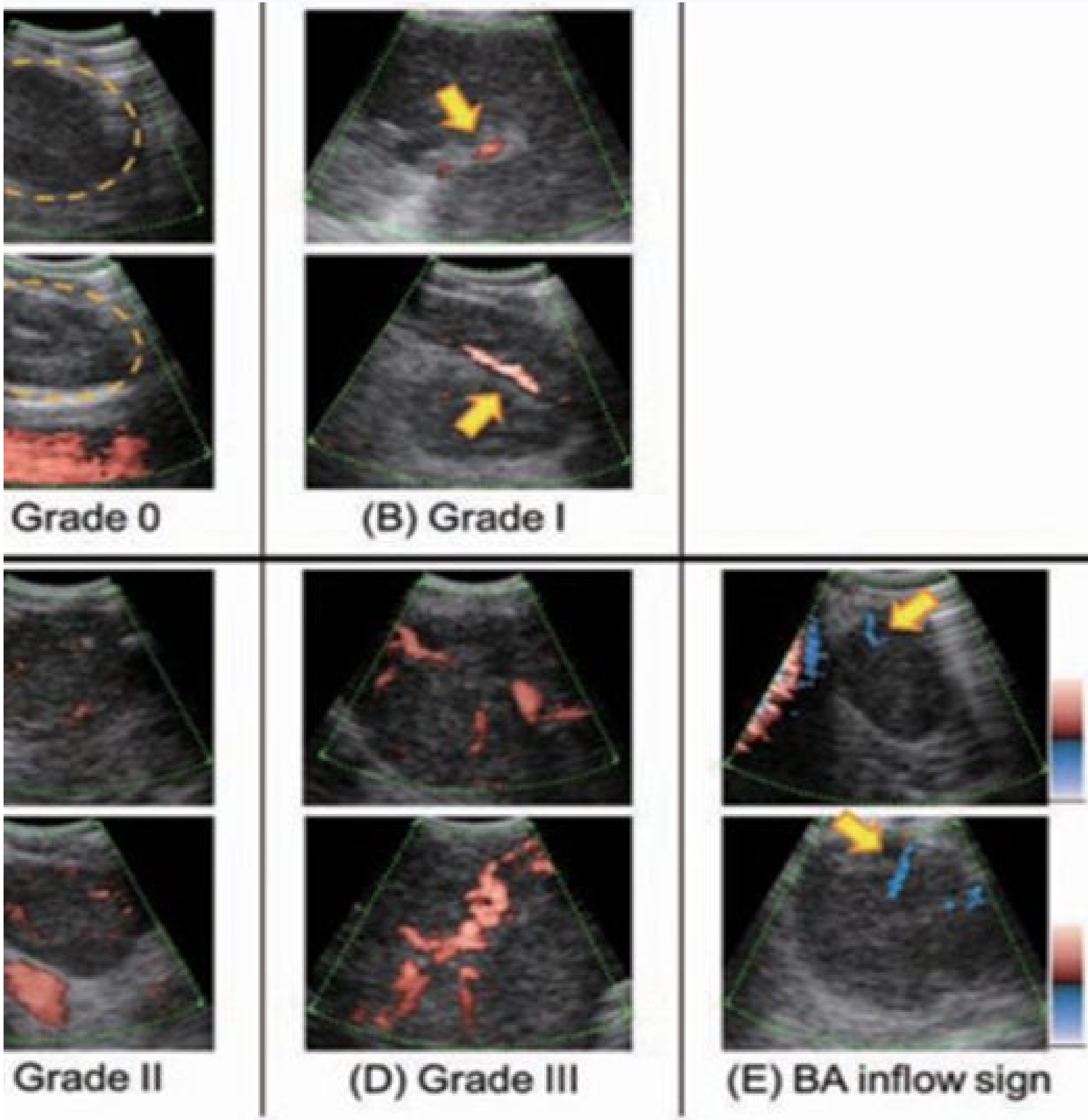
Chest 2010;13

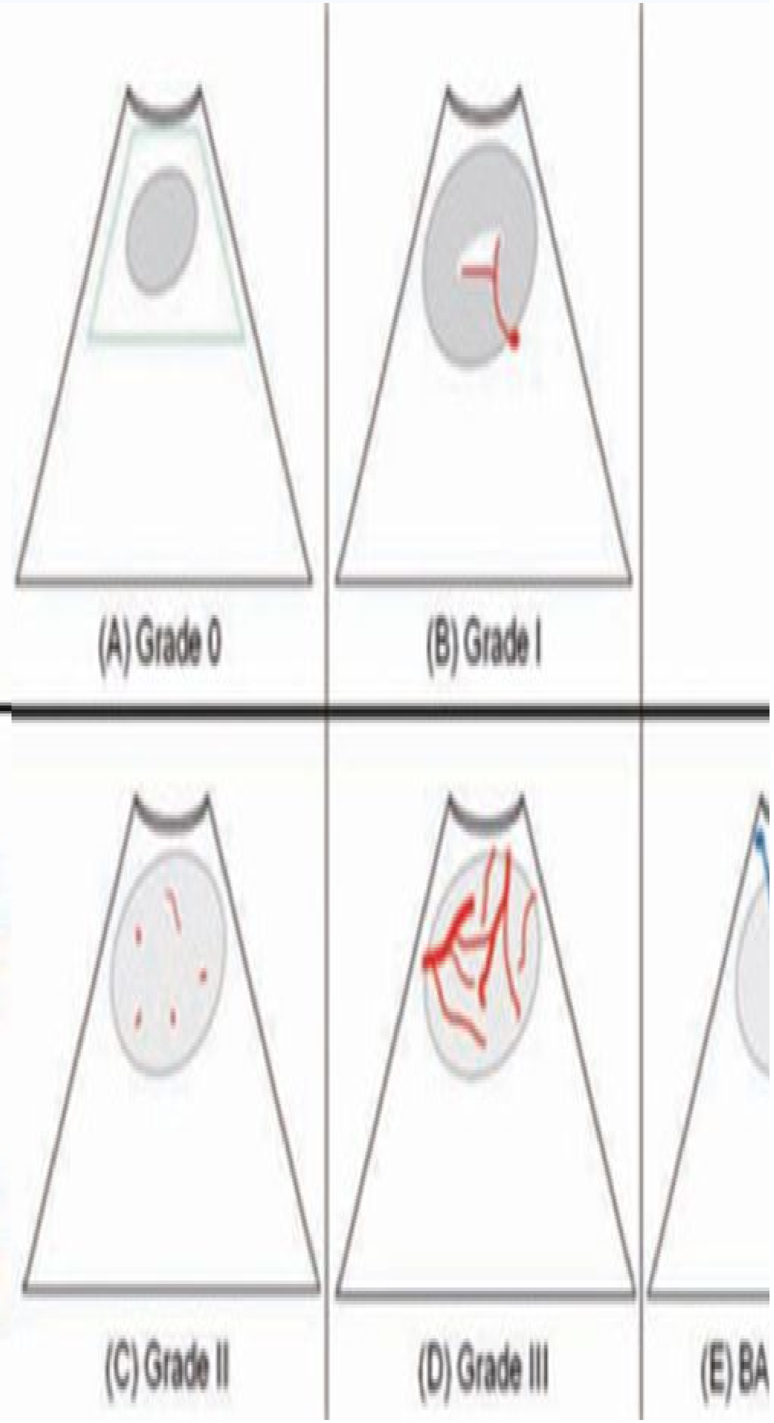
et al. found that lymph nodes measuring >10 mm were associated with malignancy.

Chest 2011;14

jima et al. ,a classification system was developed based on the pattern and number of vessels in the l
aded from 0–III .When grade 0 (no or minimal flow) and I (few main vessels running towards center of
fined as "benign" and grade II (few punctiform or rod-shaped flow signals) and III (rich flow with more t
vith different diameter and a helical flow signal) as "malignant", they found that the sensitivity and diag
y rate were 87.7% and 78% respectively. They also described with color-doppler imaging the "inflow si
ng of **blood arising in bronchial artery and flowing towards the LN (away from the probe)** resultir
nal . The accuracy of predicting metastasis solely from a positive BA inflow sign was 80.3%.

J Thorac Oncol 2012;7:


Grade 0
(B) Grade I
Grade II
(D) Grade III
(E) BA inflow sign


(A) Grade 0
(B) Grade I
(C) Grade II
(D) Grade III
(E) BA

graphy

, pathological processes such as malignancy makes tissues less compressible.

, a new EBUS processor has been equipped with elastography which allows measurement of tissue

ssibility (the elasticity of the tissue within the scanned area is compared with the surrounding tissue,

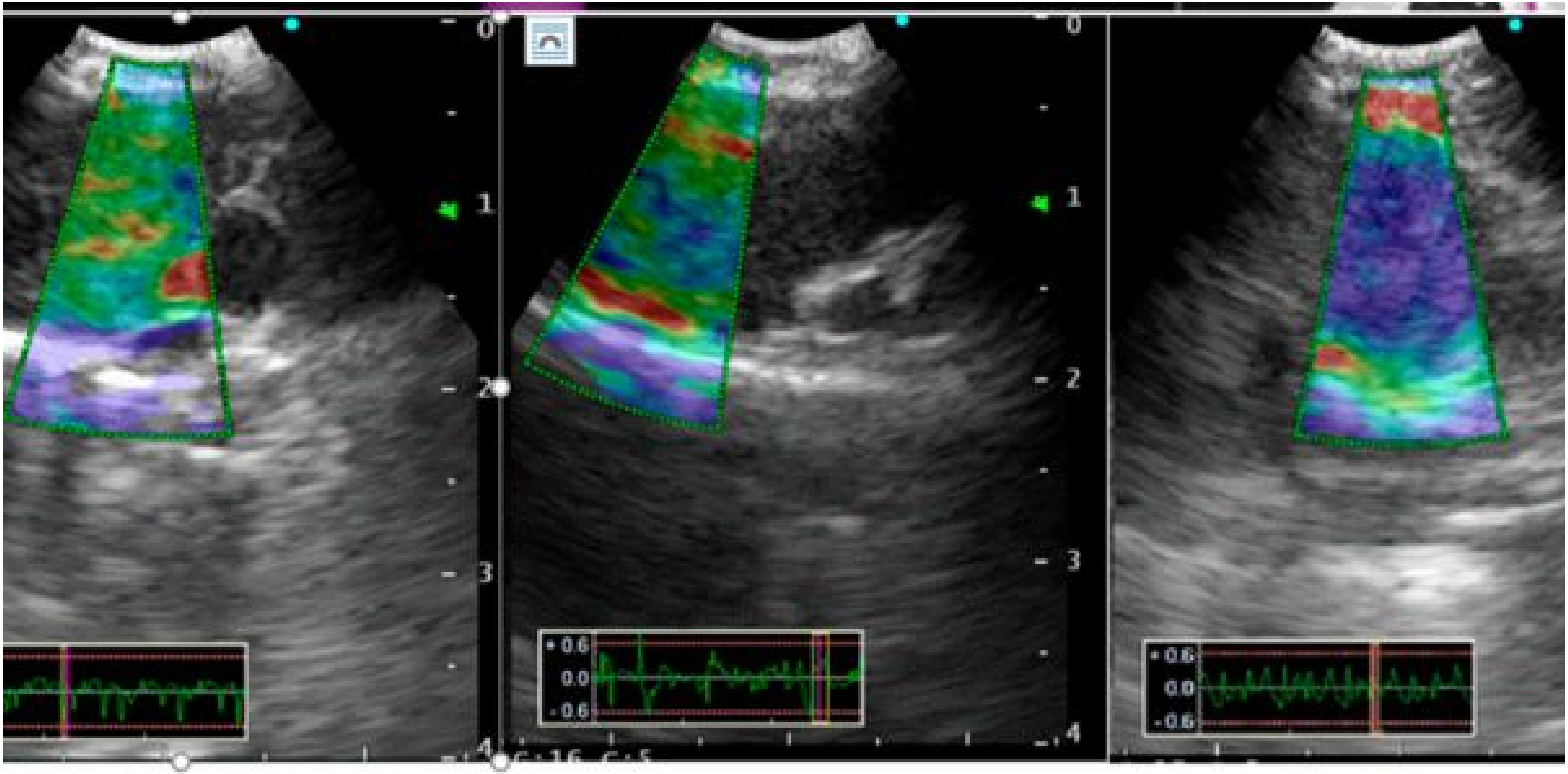
d to a color signal that is superimposed on the B-mode image). Colors associated with **hard, interme**

tissues **are blue, green and yellow/red** respectively.

al. published the first retrospective data on this modality, and classified lymph nodes into 3 types

predominantly non-blue, Type 2-part blue, and Type 3-predominantly blue), in the order of stiffness of t

ode. They found 94.6% of type 3 lymph nodes to be positive for lymph node metastasis



B C

1 elastography pattern (homogenous green) in a patient with tuberculosis. (B) Type 2 elastographypat
olor pattern) in a patient with sarcoidosis. (C) Type 3 elastography pattern (homogenous blue) in a pat
rcinoma.

Neither the ultrasound characteristics nor the **elastographic** appearance are likely to **replace** the need for **biopsy** of the LN. But, When performing EBUS for mediastinal staging, we often find several LN in a given nodal station and it is not always feasible to sample all of these. These ultrasound/ elastographic characteristics may help us determine our best targets.

tional systems can be virtual (virtual bronchoscopic navigation, usually non-contrast enhance

magnetic (ENB)

bronchoscopic navigation encompasses multi-row detector CT-derived images to create three-dimensi

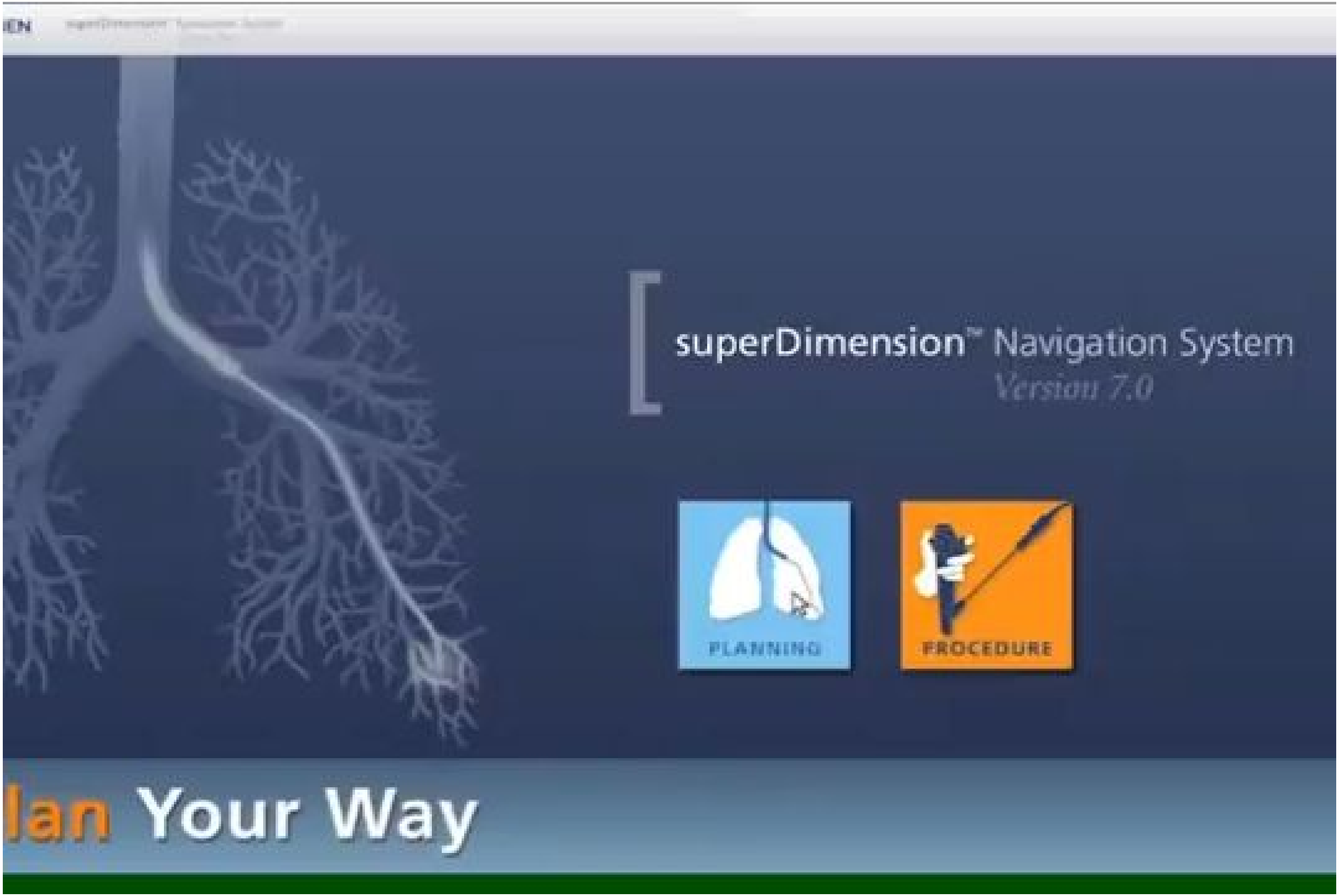
renderings of the bronchial tree, thereby mimicking the view of a real flexible bronchoscope, but virtual

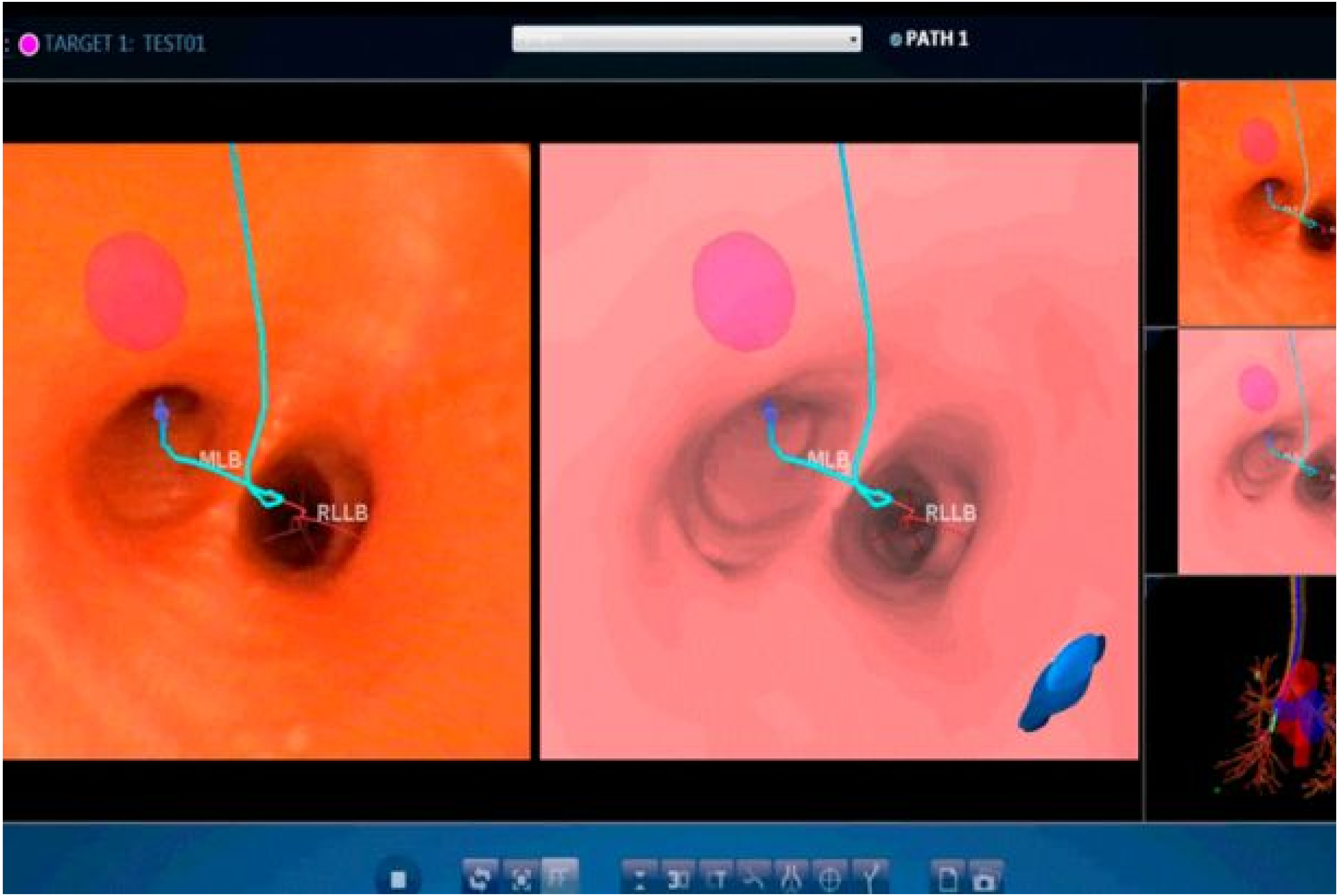
oscopy does not provide real-time positional guidance .

magnetic navigation (EMN) bronchoscopy relies on a pre-procedural CT of the chest to create a three-

ional virtual airway map, which is then linked to an electromagnetic field to provide spatial feedback in

lectromagnetic navigation bronchoscopy (ENB) was cleared for use in the United States via FDA in 20


superDimension™ Navigation System
Version 7.0
PLANNING
PROCEDURE
lan Your Way


TARGET 1: TEST01
PATH 1
MLB
RLLB
MLB
RLLB

scopic transparenchymal nodule access (BTPNA):

odules lack a bronchus sign and are so distant from a bronchus that bronchoscopic sampling technique
e situations, transparenchymal nodule access was developed.

access the nodule by creating a direct pathway that starts at the airway, goes through lung parenchym
eaches the lesion.

e CT scan data ,The procedure plan was uploaded to a virtual bronchoscopic navigation system that gu
scopist to the point-of-entry area. There, the airway wall was pierced by an 18-gauge needle and the o
ed by a small balloon catheter. Next, a 2.0 mm working channel sheath was inserted into the opening
a 15-gauge stylet and advanced together to the target lung lesion under fused CT scan-fluoroscopy g
mm sheath was then kept in place to allow various instruments to be used to sample the lesion

ROBOTIC ASSISTED BRONCHOSCOPY

robotic system to be introduced in the field of bronchoscopy was the MonarchTM platform by Auris He

FDA approval in March 2018. Subsequently another robotic bronchoscopy platform, IonTM Endolumi

developed by Intuitive Surgical received FDA approval in February 2019.

ystems use a small endoscope controlled by robotic steering devices under direct visualization by the

em still requires thin slice CT scan data to plan the pathway and navigate to the desired target.

cal advantages of such technology include continuous endobronchial visualization and greater maneu

of the bronchoscope with the ability to lock into a desired position

N BRONCHOSCOPY

size of the peripheral airways limits the ability of conventional bronchoscopes to navigate to peripheral lesions

hannel of conventional pediatric bronchoscopes limits the size of the tools needed to diagnose peripheral nodu

nent of ultrathin bronchoscopes (z2.8–3.5 mm outer diameter) allows for greater maneuverability to traverse sr

lthough no strict definition of “ultrathin” exists, most have outer dimensions of 3.2 mm or less. can be guided

on to a median of the sixth generation bronchi (range, fourth- to ninth-generation bronchi), allowing more dist

ion.

uorescence bronchoscopy (AFB):

s green- and red-spectrum light to detect mucosal alterations. Normal mucosa presents green co

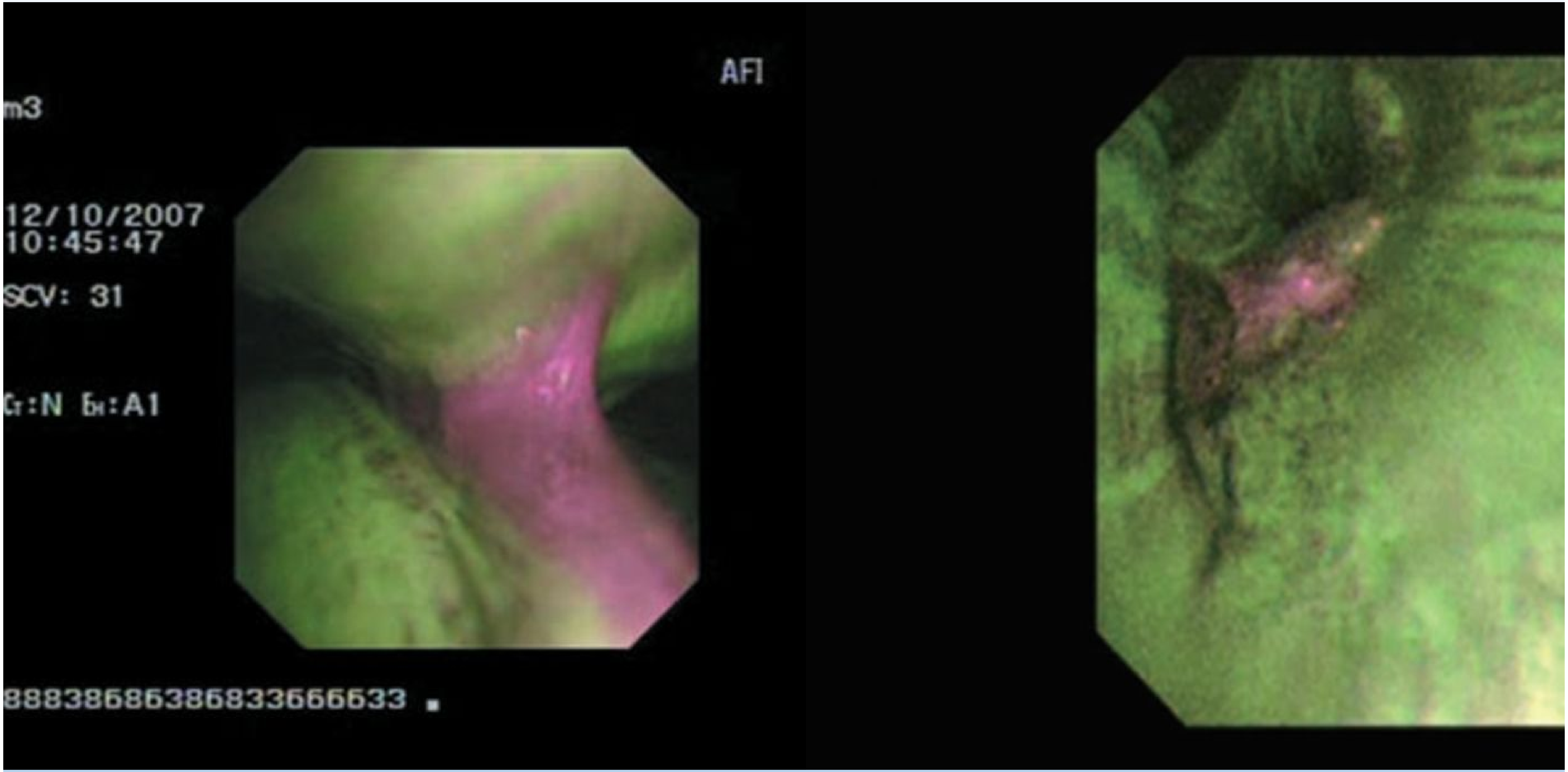
precancerous and cancerous lesions absorb the green spectrum and turn magenta.

ensitivity but low specificity exept when used in follow up of surgical margins after curative surgery or

on of lung cancer extension

he open issues on AFB is question of its usability in bronchoscopic lung cancer screening. Results of p

d not support the general use of AFB as a screening tool for lung cancer.


AFI
m3
12/10/2007
10:45:47
SCV: 31
88838686386833666633

W BAND IMAGING

band imaging removes all wavelengths except two that are absorbed by hemoglobin, thereby creating

the vasculature (cyan) and surrounding mucosa (brown)

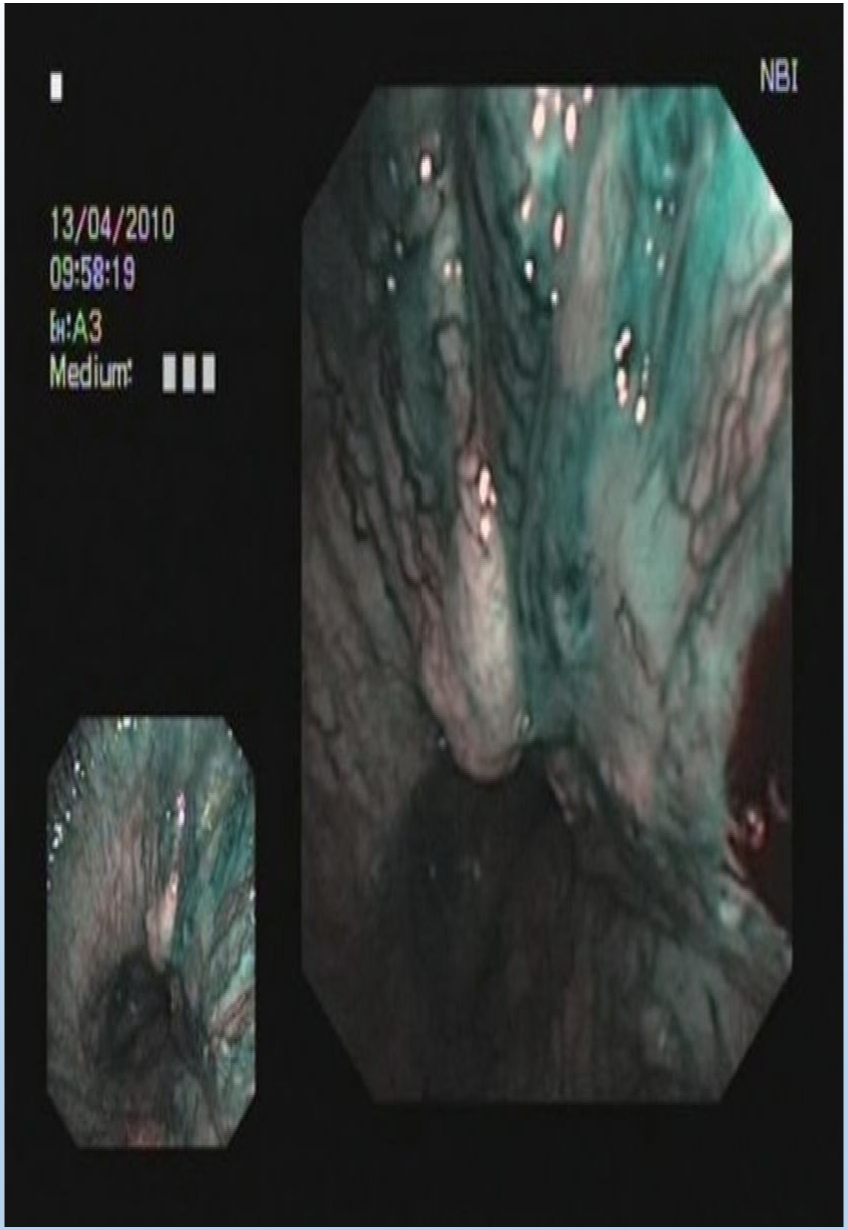
et al. first described the pathological patterns on bronchial mucosa that are known as Shibuya's descr

tortuous and abrupt ending vessels)

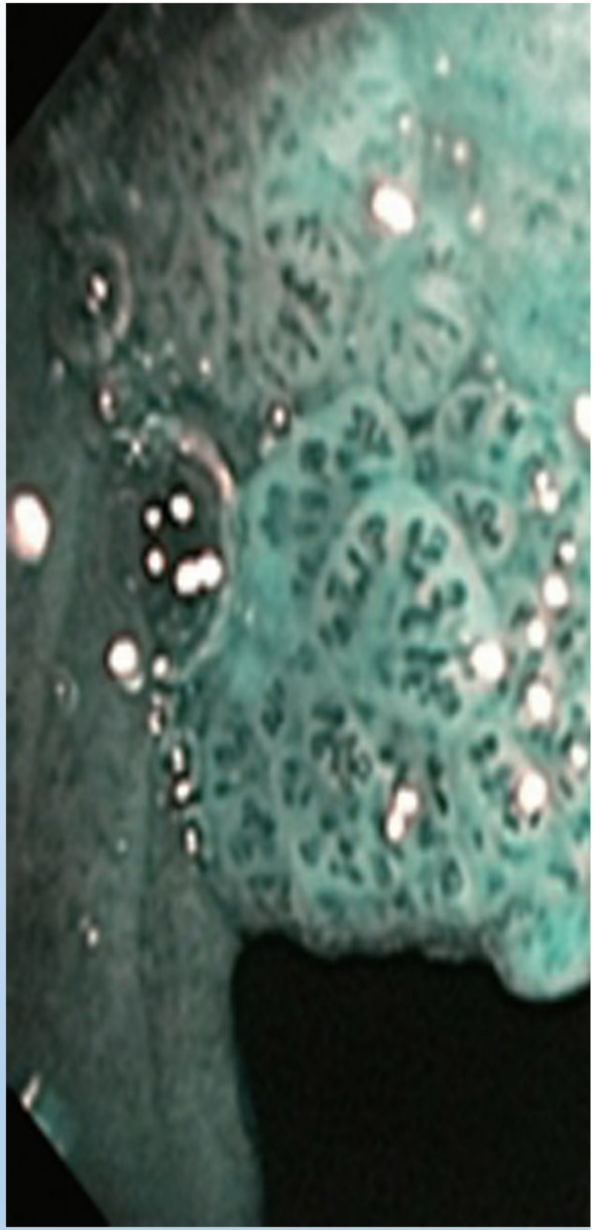
.

, this technology could be successfully used for evaluation of tumor margins, follow up after curative su

tortuous blood vessels-
quamous cell lung cancer



abrupt ending blood vessels-
squamous cell lung cancer



dotted vascular p
adenocarcinoma of th

coherence tomography (OCT) :

n imaging technique using near-infrared light to generate high-resolution images of tissue structures w

n of ±10–15 μm and depth of 2–3 mm .The conceptual idea of OCT is comparable to ultrasound, but in

the reflection of acoustic waves, OCT uses the scattering of near-infrared light to generate images

in OCT, an optical beam generates near-infrared light and focuses on the tissue.

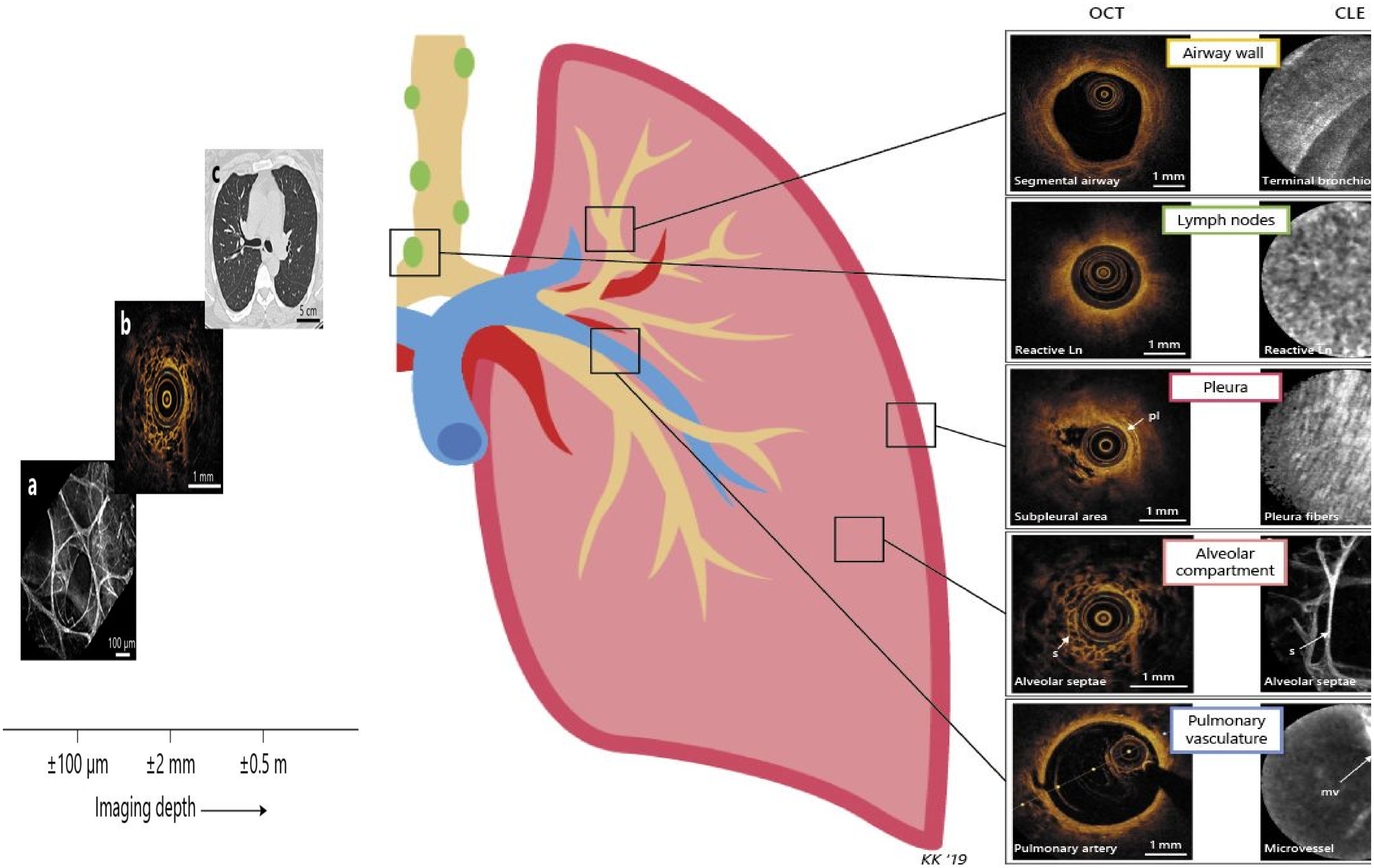
BASED CONFOCAL LASER ENDOMICROSCOPY "PCLE"

real-time images of the airways, alveoli, lung tumours, pleura and lymph nodes with a resolution up to

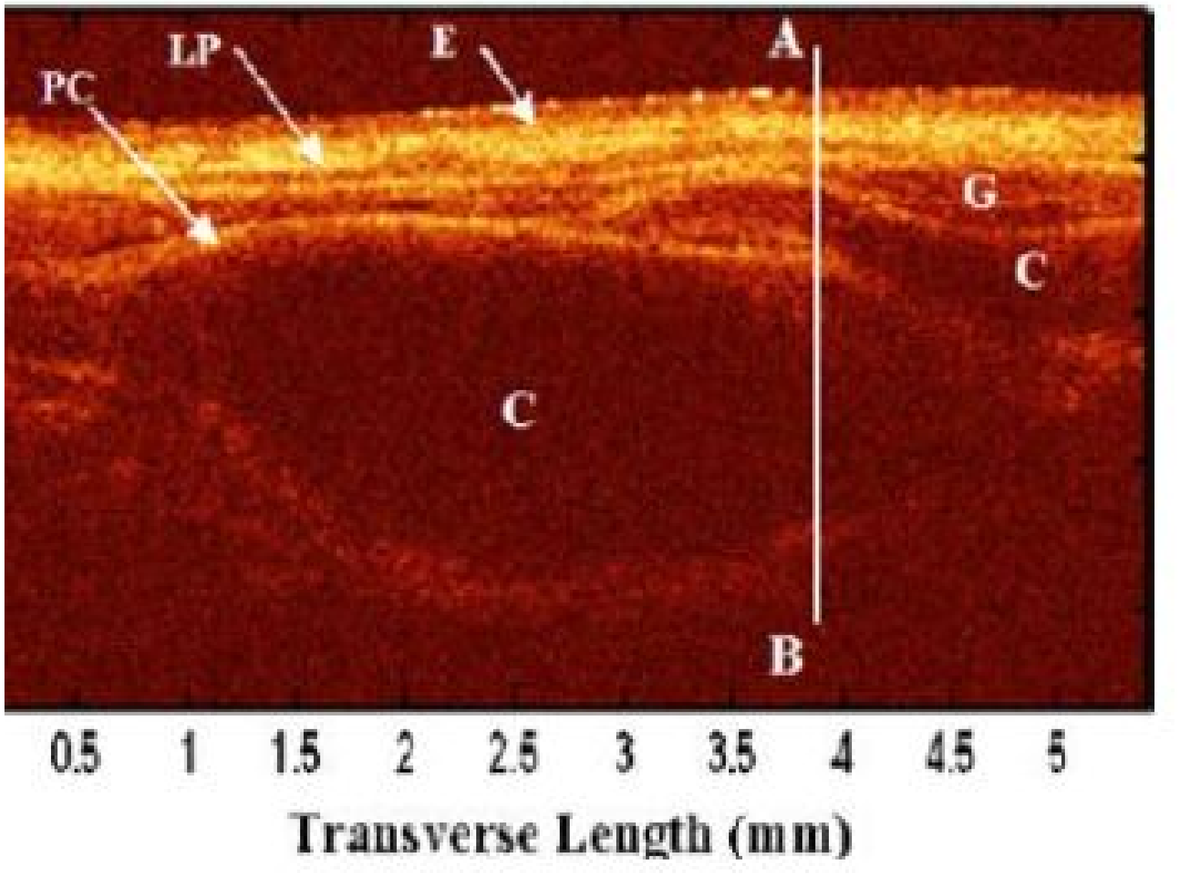
aximum depth of 70 μm and a maximum field of view of 600. A fibre-optic probe is advanced through th

channel of a bronchoscope directed to the area of interest where it illuminates tissue with laser light (m

ly used 488 nm). Reflected light is redirected back through a pinhole.



OCT
CLE
Airway wall
Segmental airway
1 mm
Terminal bronchio
Lymph nodes
Reactive Ln
1 mm
Reactive Ln
Pleura
pl
Subpleural area
1 mm
Pleura fibers
Alveolar compartment
s
Alveolar septae
1 mm
s
Alveolar septae
Pulmonary vasculature
Pulmonary artery
1 mm
mv
Microvessel
KK '19
a
100 µm
b
1 mm
c
5 cm
±100 µm
±2 mm
±0.5 m
Imaging depth



E: epithelium

LP: lamina propia

G: glandules

PC: pericondrium

C: cartilage

A-B: 500μm

ymal lung disease

psy Transbronchial cryobiopsy (TBCB) is gaining popularity in the diagnostic approach to diffuse

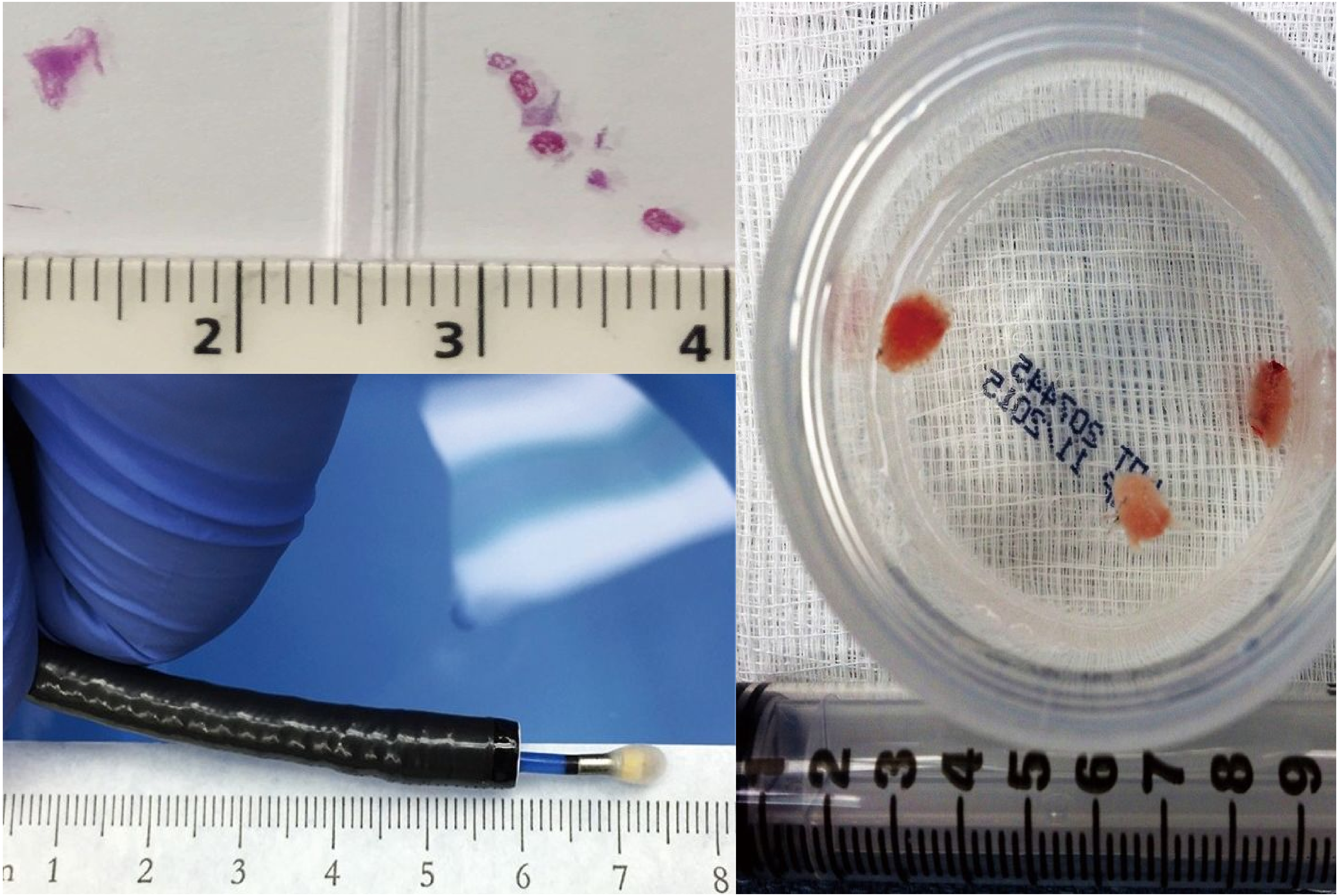
ymal lung diseases.

performing via bronchoscopic placement of a flexible cryoprobe inside the lung parenchyma, freezing

d shearing out the frozen lung tissue, providing larger specimens and more alveolar tissue (tend to b

mal positioning of the cryoprobe with a distance of 1 cm from the pleura is recommended to minimize

tions)



2 3 4
1 2 3 4 5 6 7 8
2 3 4 5 6 7 8 9

شكرا