

Interventionelle Diagnostik und minimal-invasive Chirurgie beim nichtkleinzelligen Bronchialcarcinom

Interventional diagnostics and minimal invasive surgery of lung cancer

Mir Alireza Hoda, MD PhD

Associate Professor of Surgery

Thoracic Surgery & Interventional Bronchoscopy

Wiener Privatklinik (WPK)



CENTRAL EUROPEAN
CANCER CENTER

Financial Disclosure

Lecture honoraria:

- AstraZeneca
- Boehringer Ingelheim
- Bristol–Myers Squibb
- F. Hoffmann–La Roche
- Medtronic
- Merck Sharp & Dohme
- Olympus

Consultancy and advisory boards:

- AstraZeneca
- Bristol–Myers Squibb
- Merck Sharp & Dohme

I will talk about.....

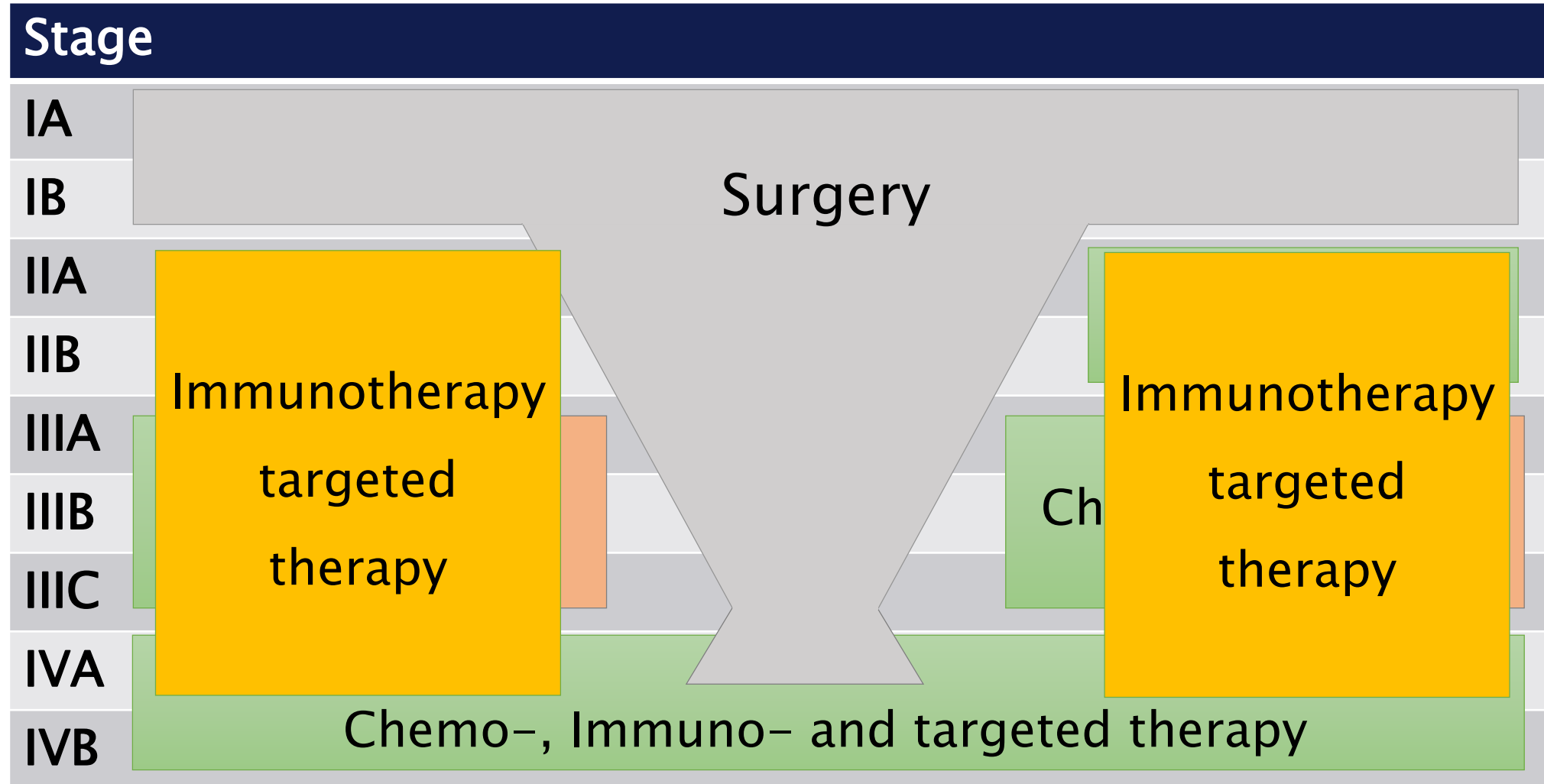
- Early diagnosis of lung cancer
 - Interventional tools for diagnosis of early stage lung cancer
- Surgery for lung cancer
 - Video–assisted Thoracic Surgery (VATS)
 - Robotic–assisted Thoracic Surgery (RATS)
 - Sublobar resections (less lung tissue removal)



Old paradigm

Stage		
I	Surgery	
II		
III	Radiotherapy	Chemotherapy
IV		

Surgical treatment NSCLC 2024



Early detection and modern diagnosis/staging



Lung cancer screening will change the landscape of detected lesions

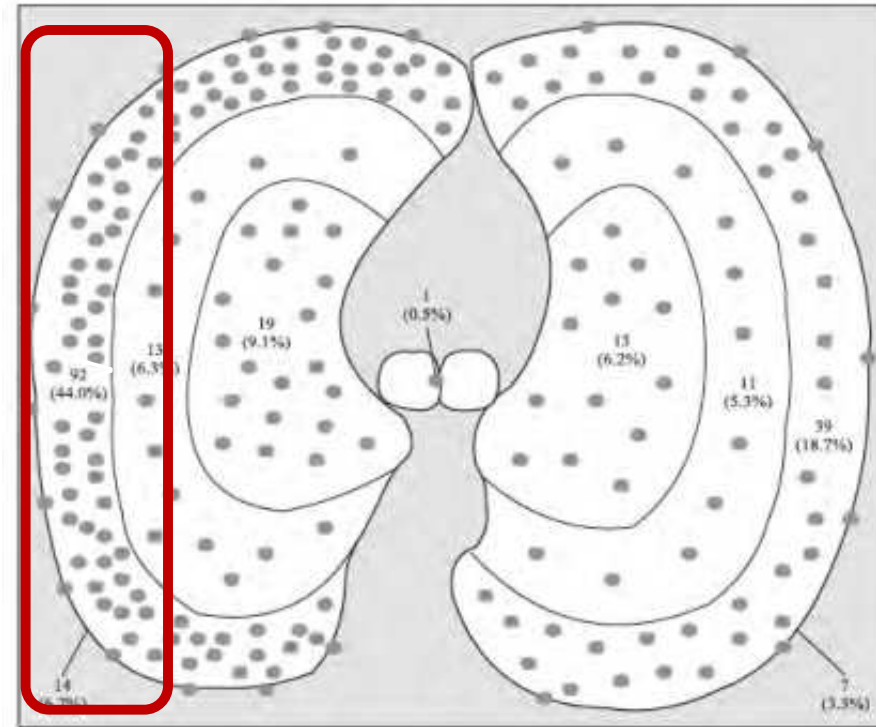
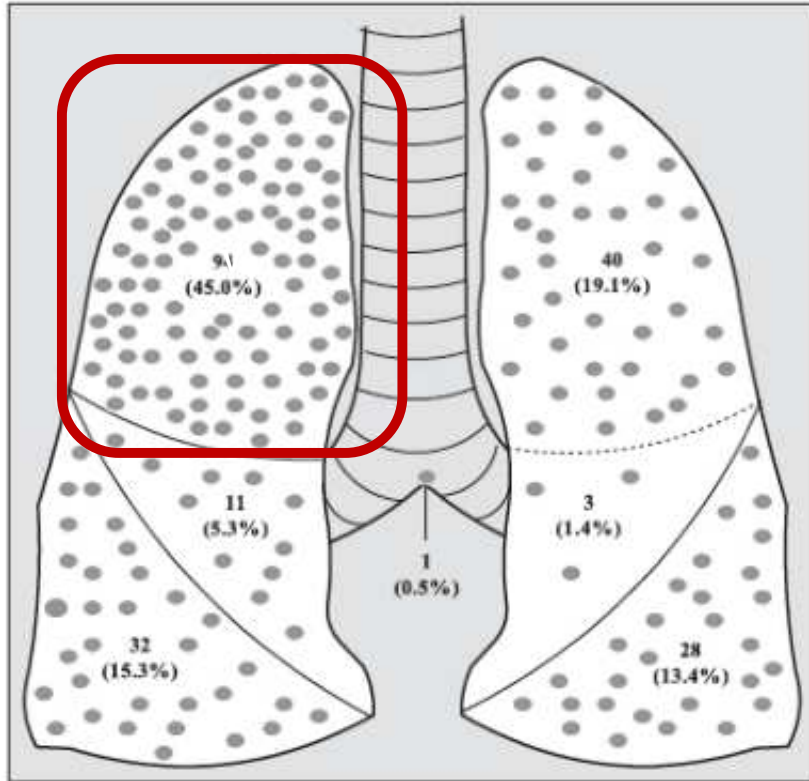


Results from RCTs of LDCT screening for LC

Trial	Year of report	Country	No. (n)	Eligibility			Intervention control arm	Mortality reduction	
				Age (y)	Pack year	Quit years		Lung cancer (%)	All cause (%)
NLST ⁹	2011	USA	53,454	55–74	≥30	<15	annual CXR	20	6.7
DANTE ¹⁰	2015	Italy	2,250	60–74	≥20	<10	annual clinical review	1	5
DLCST ¹¹	2015	Denmark	4,104	50–70	>20	<10	Nothing	0	0
NELSON ¹²	2018	Belgium and the Netherlands	15,822	50–75	≥15	<10	Nothing	26 (M) 61 (F)	N/R
LUSI ¹⁴	2019	Germany	4,052	50–69	≥15	<10	Nothing	24	1
MILD ¹³	2019	Italy	4,099	49–75	≥20	<10	Nothing	39	20

Characteristics of Lung Cancers Detected by Computer Tomography Screening in the Randomized NELSON Trial

Nanda Horeweg^{1,2}, Carlijn M. van der Aalst¹, Erik Thunnissen³, Kristiaan Nackaerts⁴,
 Carla Weenink⁵, Harry J. M. Groen⁶, Jan-Willem J. Lammers⁷, Joachim G. Aerts², Ernst T. Scholten⁸,
 Joost van Rosmalen¹, Willem Mali⁹, Matthijs Oudkerk¹⁰, and Harry J. de Koning¹



Surgical implications of the new IASLC/ATS/ERS adenocarcinoma classification

P.E. Van Schil⁺, H. Asamura[#], V.W. Rusch[†], T. Mitsudomi[‡], M. Tsuboi[§], E. Brambilla^{||} and W.D. Travis^{**}

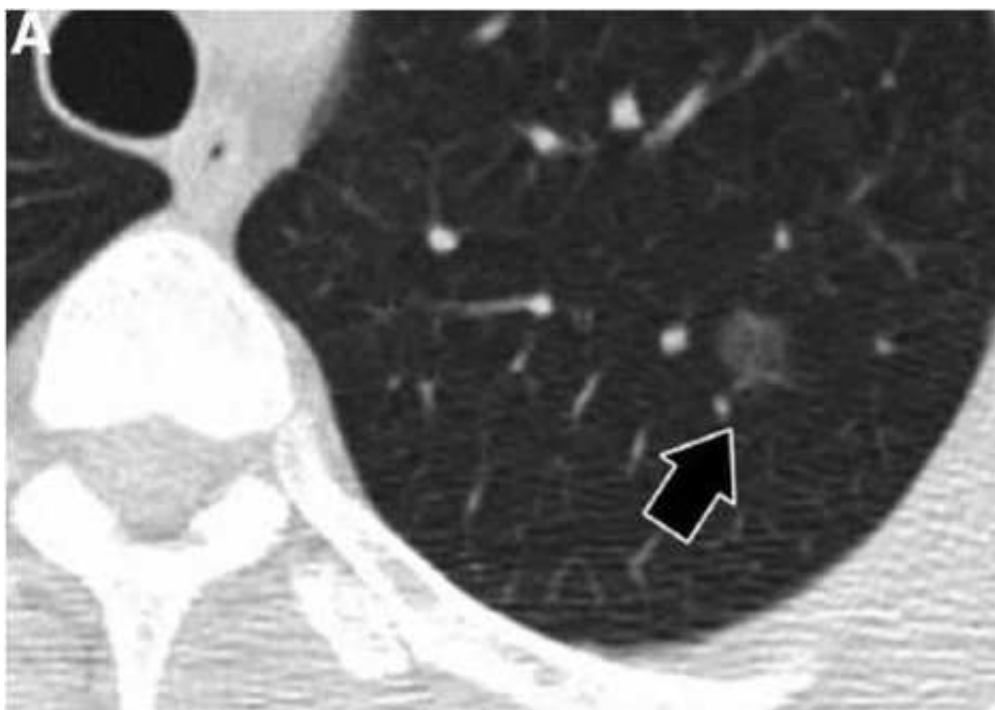


TABLE 1 International Association for the Study of Lung Cancer/American Thoracic Society/European Respiratory Society classification of lung adenocarcinoma in resection specimens

Pre-invasive lesions

- Atypical adenomatous hyperplasia
- Adenocarcinoma *in situ* (≤ 3 cm formerly BAC)
 - Nonmucinous
 - Mucinous
 - Mixed mucinous/nonmucinous

Minimally invasive adenocarcinoma

- (≤ 3 cm lepidic predominant tumour with ≤ 5 mm invasion)**
- Nonmucinous
 - Mucinous
 - Mixed mucinous/nonmucinous

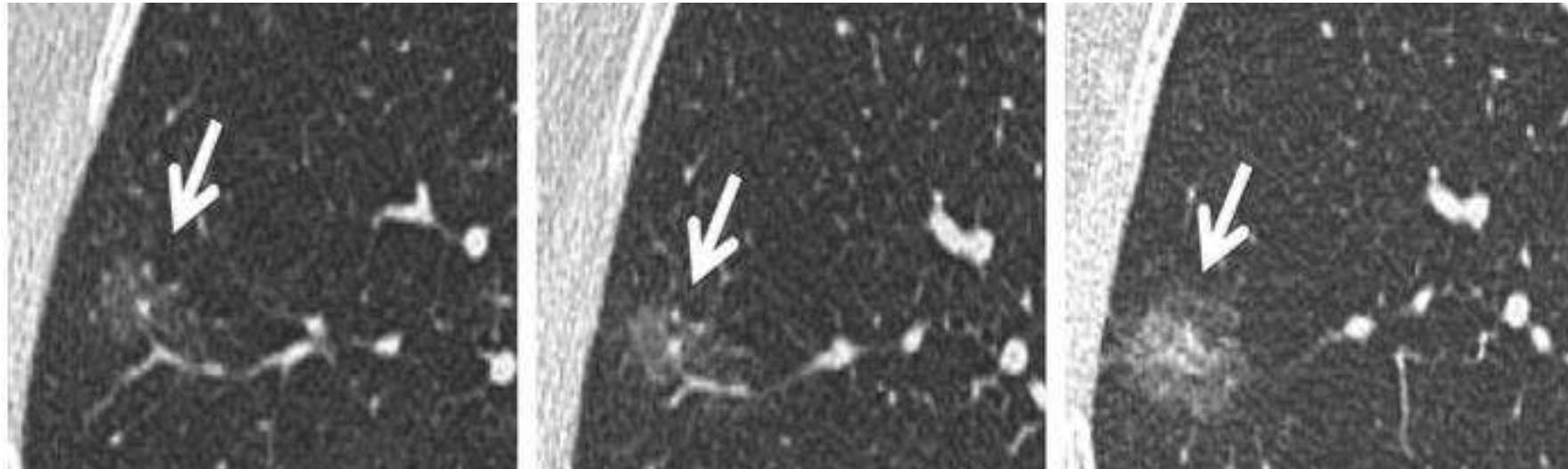
Invasive adenocarcinoma

- Lepidic predominant (formerly nonmucinous BAC pattern, with >5 mm invasion)
- Acinar predominant
- Papillary predominant
- Micropapillary predominant
- Solid predominant with mucin production
- Variants of invasive adenocarcinoma
 - Invasive mucinous adenocarcinoma (formerly mucinous BAC)
 - Colloid
 - Fetal (low and high grade)
 - Enteric

BAC: bronchioloalveolar carcinoma. Reproduced from [1] with permission from the publisher.



Ground glass opacities – changes over time



How should we ideally diagnose and treat such lesions?

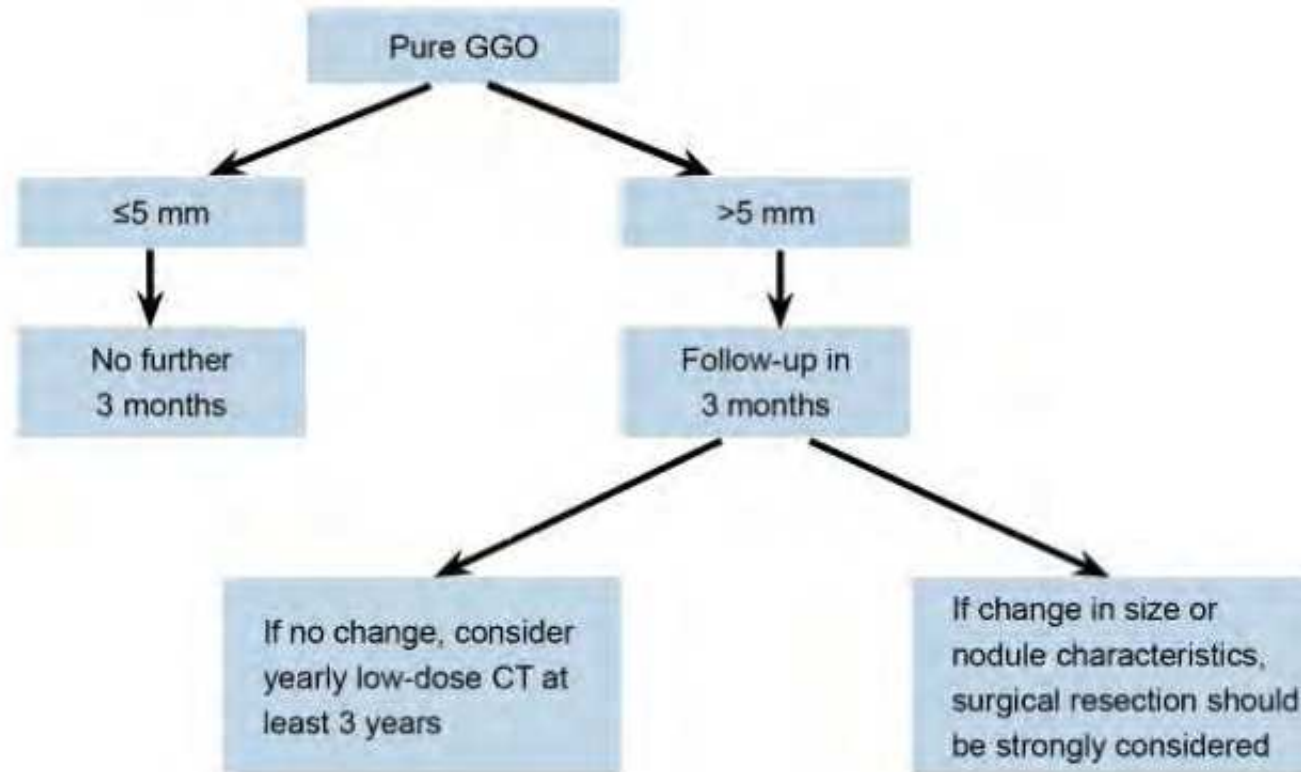
a.

b.

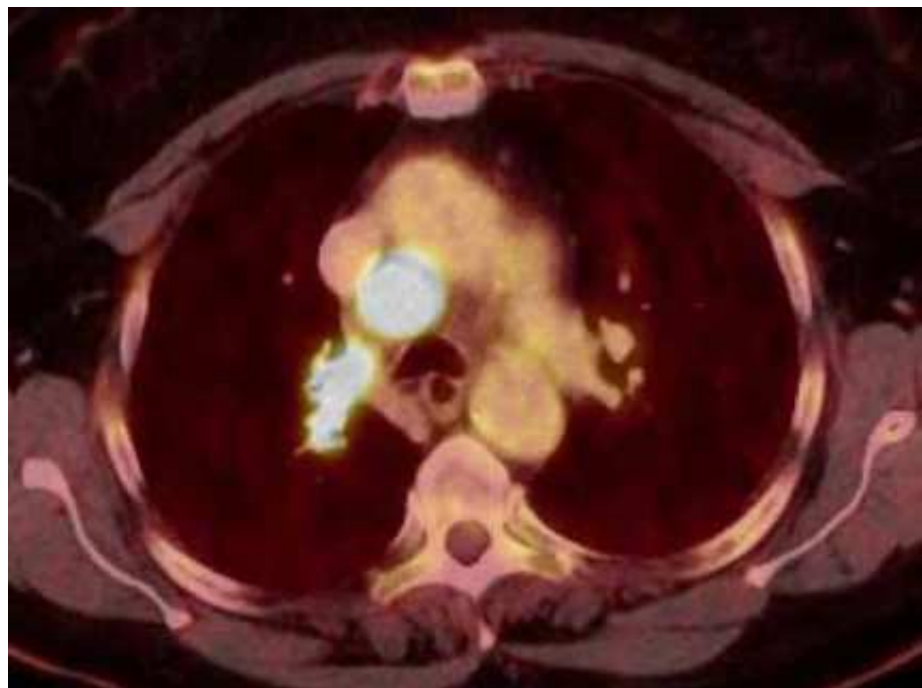
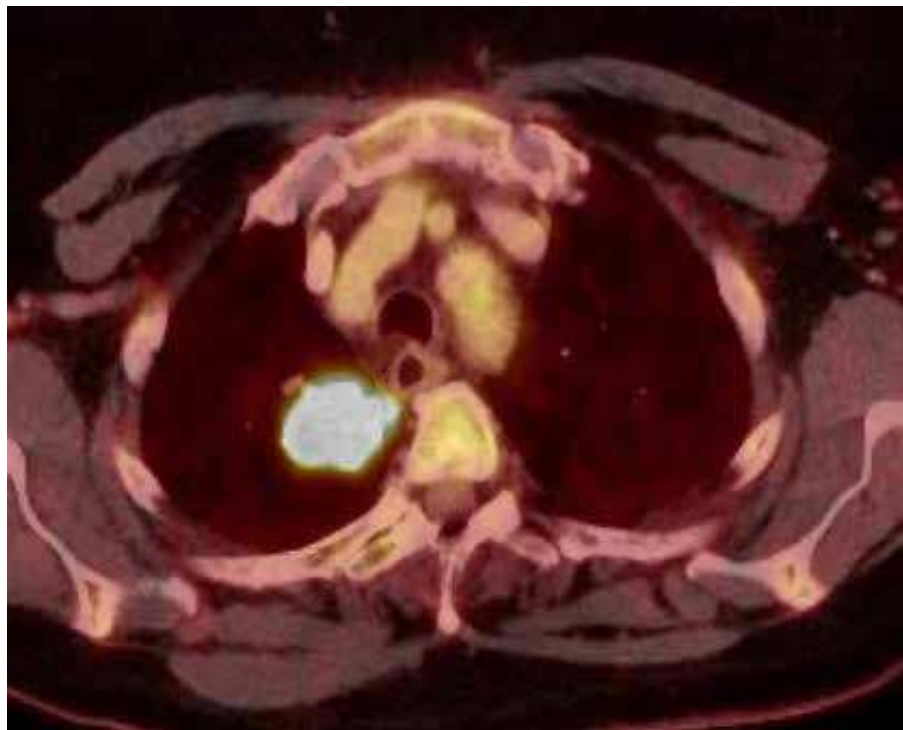
c.

Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017
MacMahon H et al, Radiology (2017)

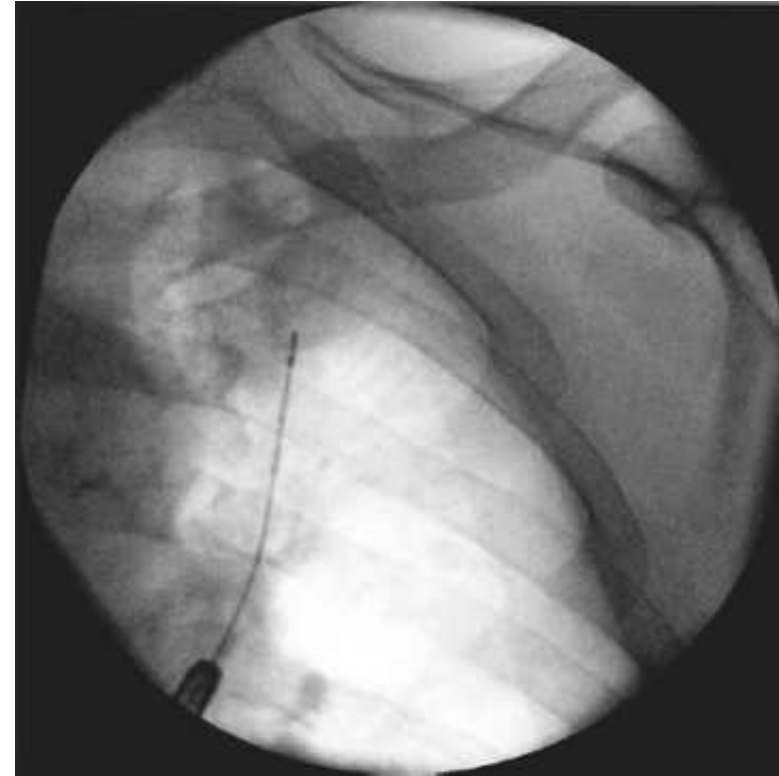
How to manage GGOs?



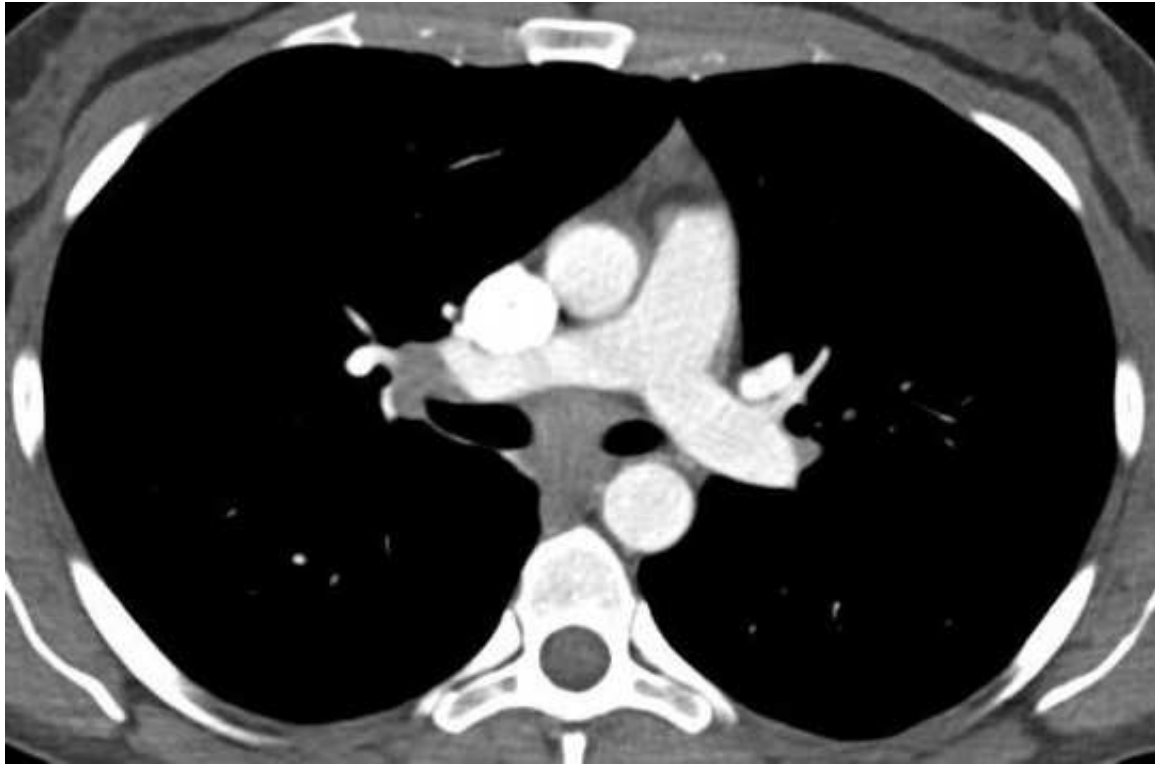
Zhan et al, JTD 2013



Bronchoscopy and Transbronchial Biopsy (TBB)



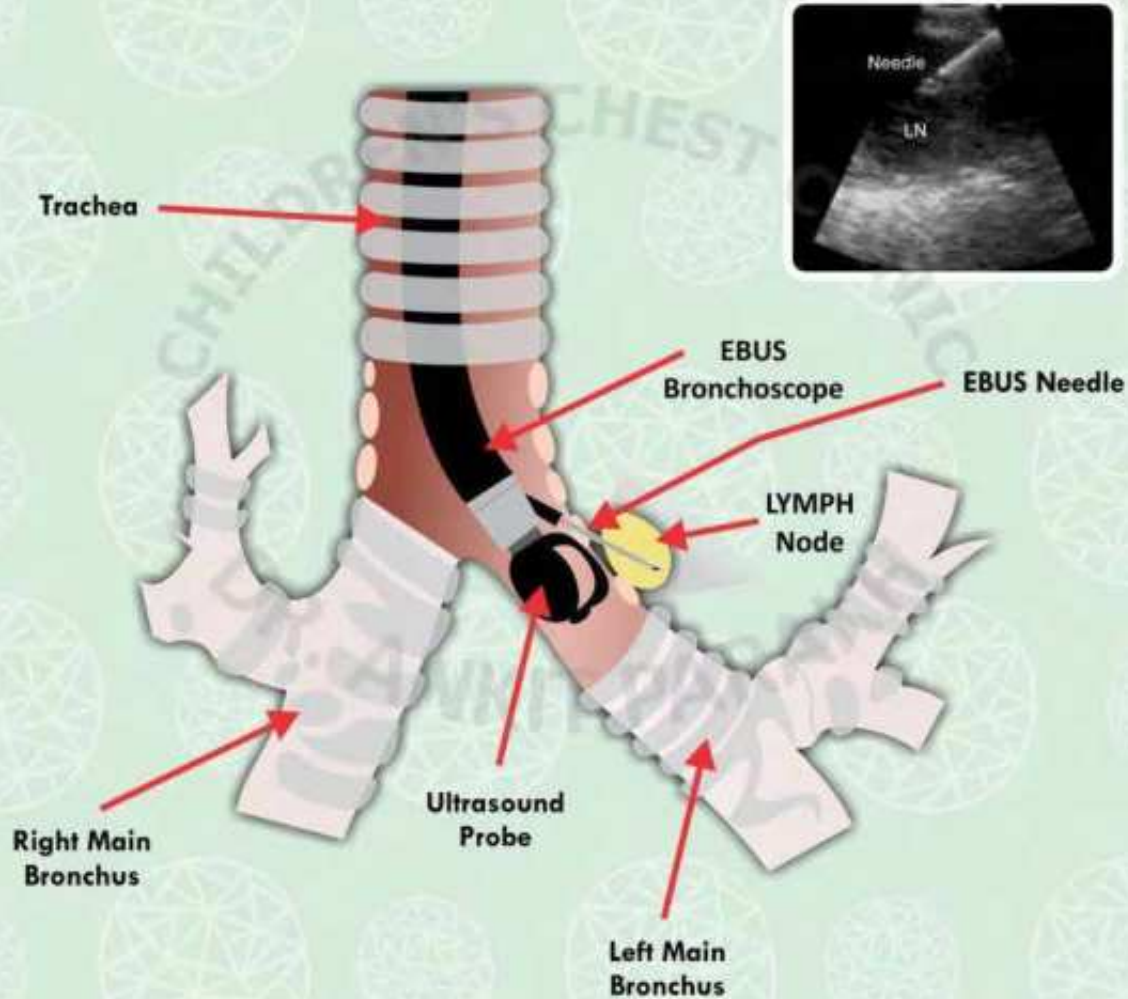




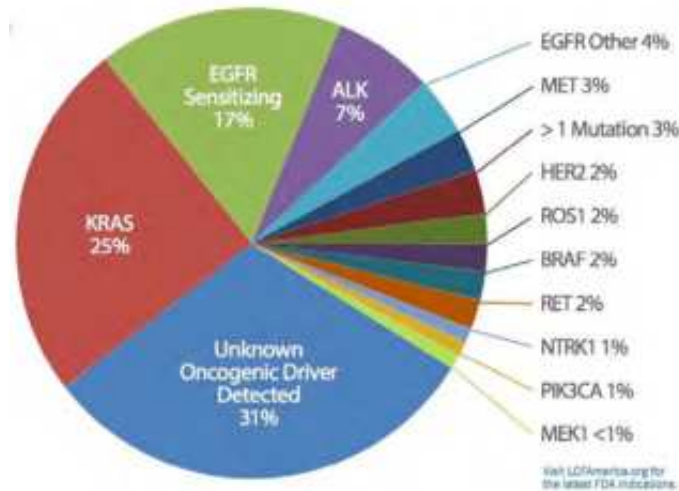
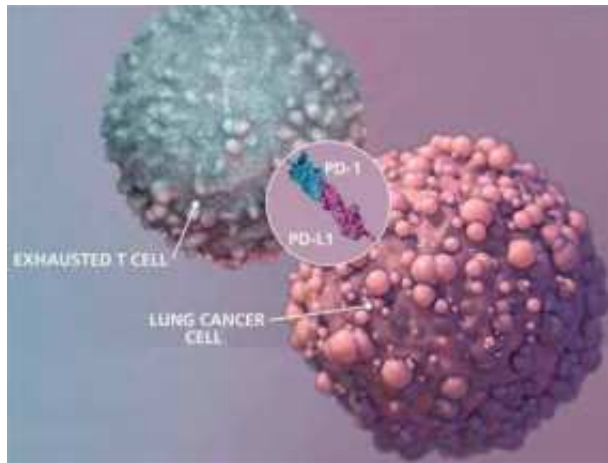
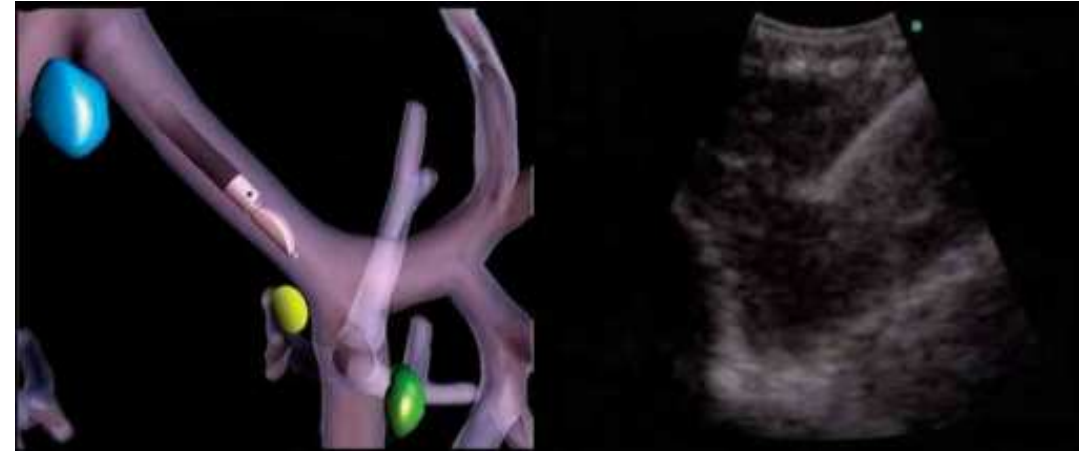
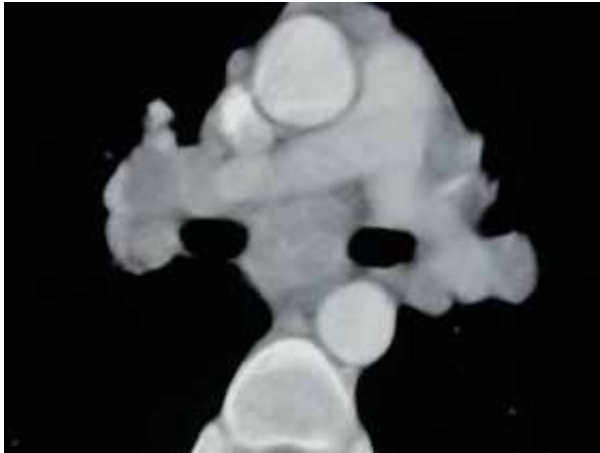


Endobronchial Ultrasound Guided Transbronchial Needle Aspiration

EBUS TBNA



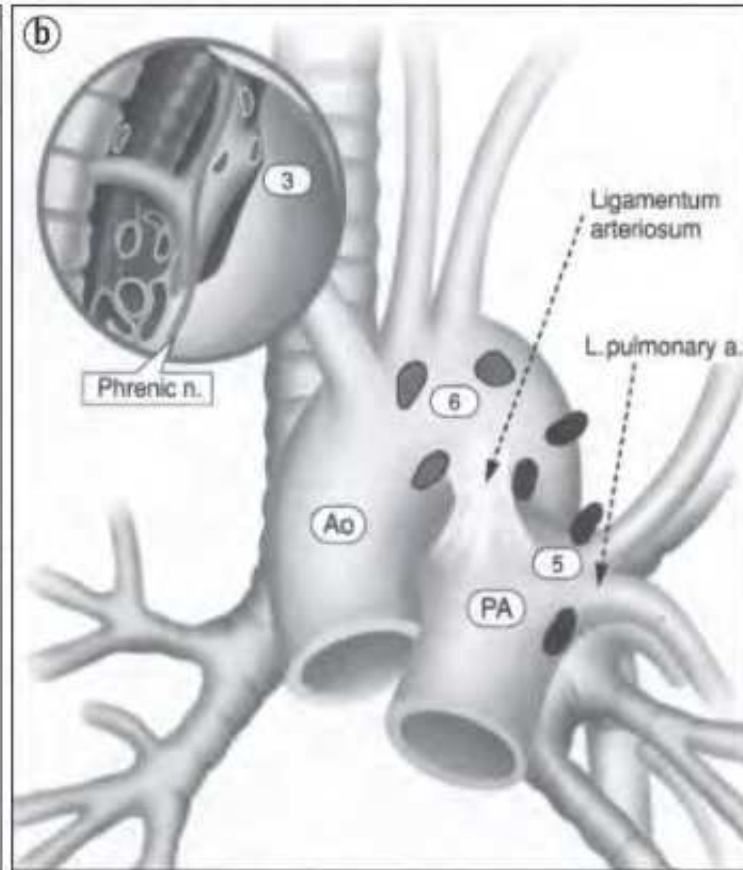
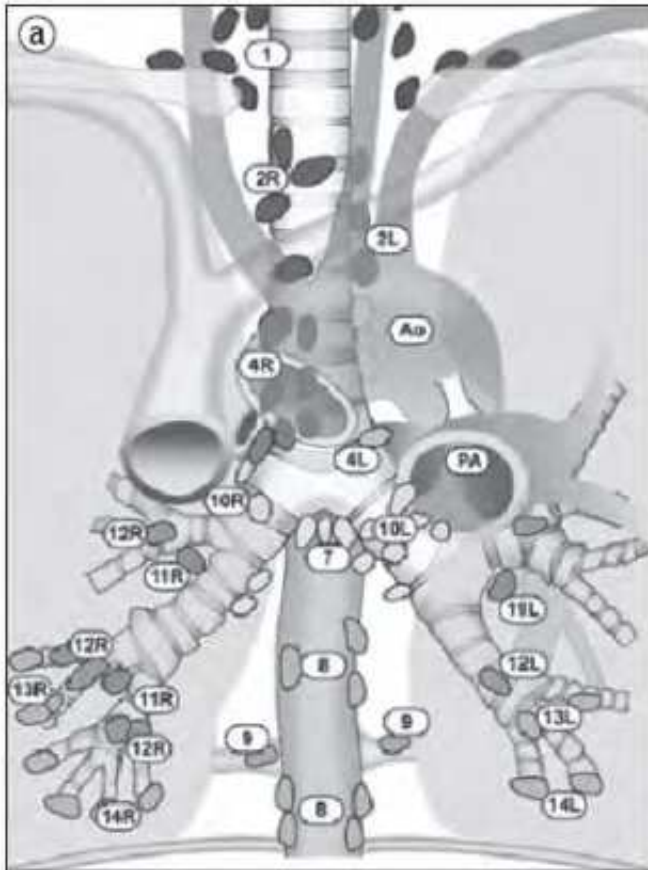
Endobronchial Ultrasound Bronchoscopy (EBUS)



→ enough biopsy material for **molecular analysis** and **PD-L1 testing 83-94%**

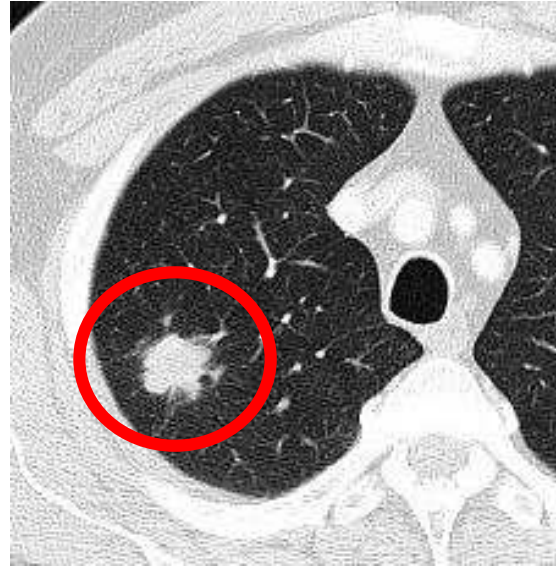
Labarca G et al. Ann Am Thorac Soc 2018.





Modern surgical treatment options





**Primary radical resection +
mediastinal lymphadenectomy**

Surgical options for Stage I NSCLC



Wedge Resection

Lesion < 2cm
Peripheral location
Marginal patient



Segmentectomy

Lesion < 2cm
More central location
(Marginal patient)



Lobectomy

Lesion > 2cm

Video-assisted Thoracic Surgery (VATS)



Uniportal VATS



Segmentectomy 2012
Lobectomy 2011

Pericardial Window & Mediastinal LN bx 2006
Pleurodesis 2005
Wedge resection 2004
Pleural diseases 2003
Sympathectomy 2002

Double sleeve uniportal VATS

Double sleeve uniportal video-assisted thoracoscopic lobectomy for non-small cell lung cancer

Diego Gonzalez-Rivas, María Delgado, Eva Fierro and Lucía Merino

Department of Thoracic Surgery, Central University Hospital of Asturias, Spain

Single-port video-assisted thoracoscopic lobectomy with pulmonary artery reconstruction

Diego Gonzalez-Rivas¹, María Delgado, Eva Fierro and Lucía Merino

Department of Thoracic Surgery, Central University Hospital of Asturias, Spain

¹ Corresponding author: Thoracic Surgery, Central University Hospital of Asturias, 33002 Oviedo, Spain. Tel: +34 985 10 0000. Fax: +34 985 10 0000. E-mail: diego.gonzalezrivas@uniovi.es

Received: 19 Aug 2014; Accepted: 19 Aug 2014; Published online: 12 Aug 2014

Uniportal video-assisted thoracoscopic bronchial sleeve lobectomy: First report

Diego Gonzalez-Rivas, MD, FECTS,^{1,2} Ricardo Fernandez, MD,^{3,4} Eva Fierro, MD,⁵ and Lluís Davinia Rellán, MD,⁶ Coruña, Spain

Key Words:
DOI: 10.1007/s00392-014-2277-6

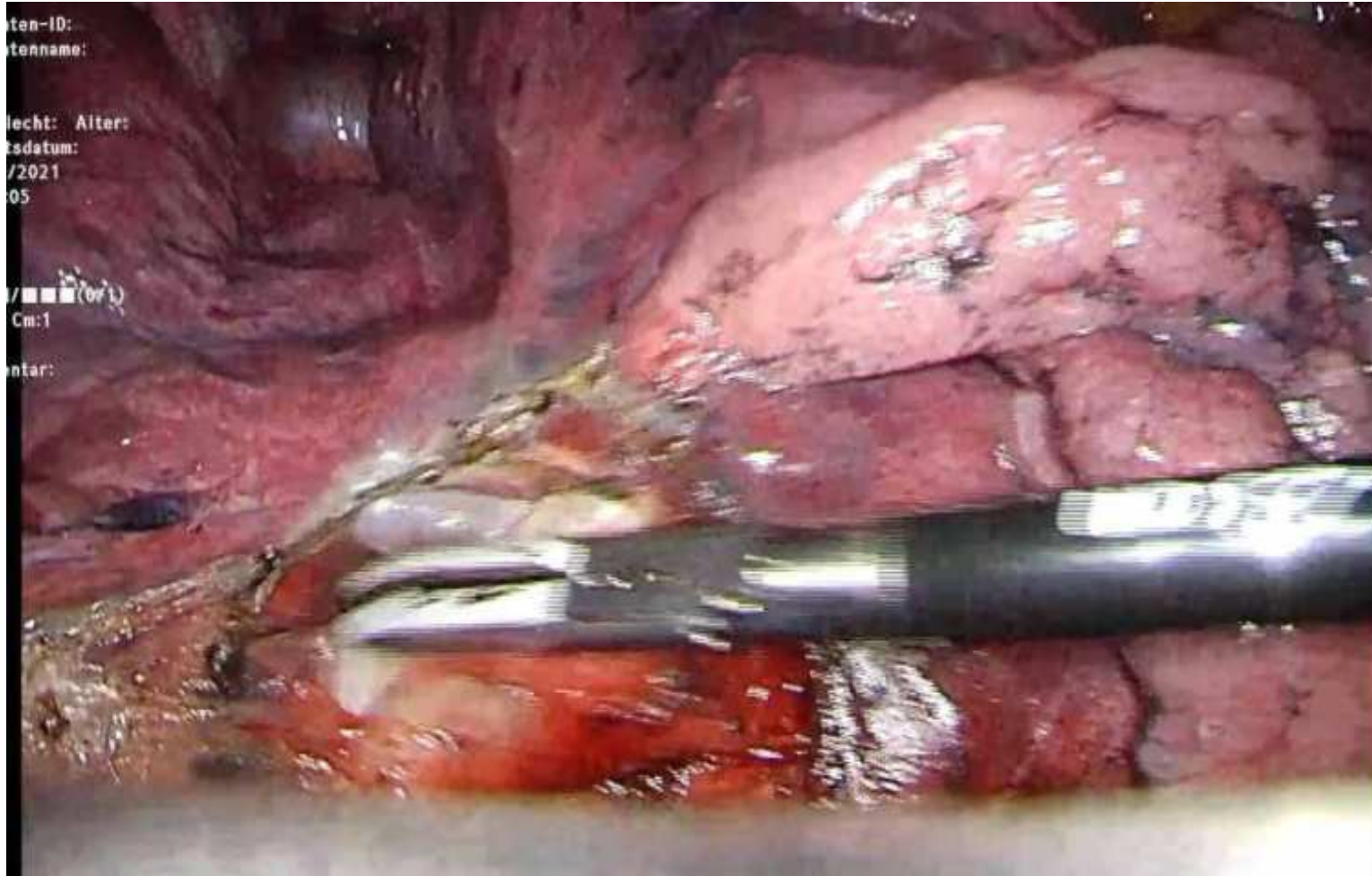
© 2014

Single-incision video-assisted thoracoscopic right pneumonectomy

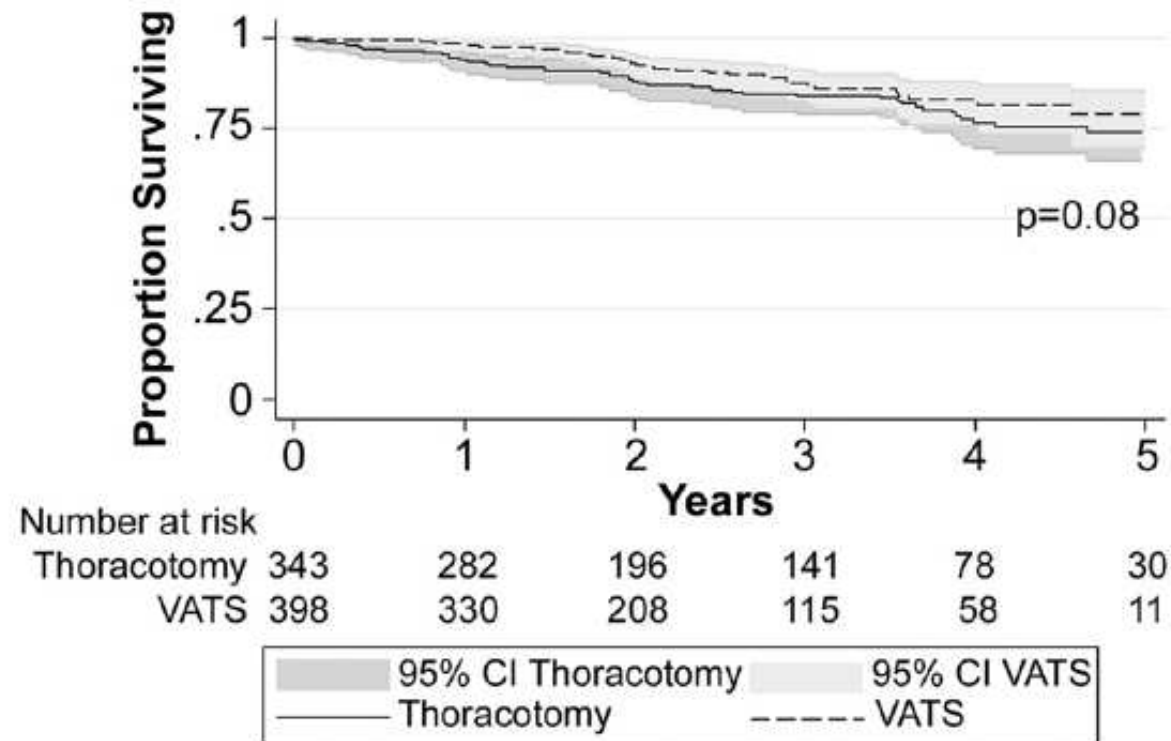
Diego Gonzalez-Rivas¹, Mercedes de la Torre², Ricardo Fernandez³, Juan Garcia



VATS anatomic resection – S6 right



Lobektomie: MIS vs. offene Chirurgie



Is VATS Lobectomy Better: Perioperatively, Biologically and Oncologically?

Natasha M. Rueth, MD, and Rafael S. Andrade, MD
Ann Thorac Surg 2010;89:S2107-11

ORIGINAL ARTICLE

Video-Assisted Thoracoscopic or Open Lobectomy in Early-Stage Lung Cancer

Eric Lim, F.R.C.S. (C-Th)^{1,2}, Tim J.P. Batchelor, F.R.C.S. (C-Th)³, Joel Dunning, F.R.C.S. (C-Th)⁴,
Michael Shackcloth, F.R.C.S. (C-Th)⁵, Vladimir Anikin, F.R.C.S. (C-Th)^{1,6}, Babu Naidu, F.C.R.S. (C-Th)⁷,
Elizabeth Belcher, F.C.R.S. (C-Th)⁸, Mahmoud Loubani, F.R.C.S. (C-Th)⁹, Vipin Zamvar, F.R.C.S. (C-Th)¹⁰,
Rosie A. Harris, M.Sc.¹¹, Lucy Dabner, M.Sc.¹¹, Holly E. McKeon, M.Res.¹¹, Sangeetha Paramasivani, Ph.D.¹²,
Alba Realpe, Ph.D.¹², Daisy Elliott, Ph.D.¹³, Paulo De Sousa, P.G.Dip.¹, Elizabeth A. Stokes, D.Phil.^{14,15},
Sarah Wordsworth, Ph.D.^{14,15}, Jane M. Blazeby, F.C.R.S. (Gen. Surg.)¹³, and Chris A. Rogers, Ph.D.¹¹,
on behalf of the VIOLET Trialists*

- 503 patients randomized (247 VATS; 256 open)
- Benign resection rate only 1.2%
- In-hospital mortality only 1.4%

VATS was associated with:

1. Less pain (pain score and analgesic units)
2. Fewer complications and serious adverse events
3. Better physical function at 5 weeks
4. Shorter chest tube duration and LOS
5. Superior LN # / stations; equivalent up-staging
6. Equivalent intra-operative blood loss

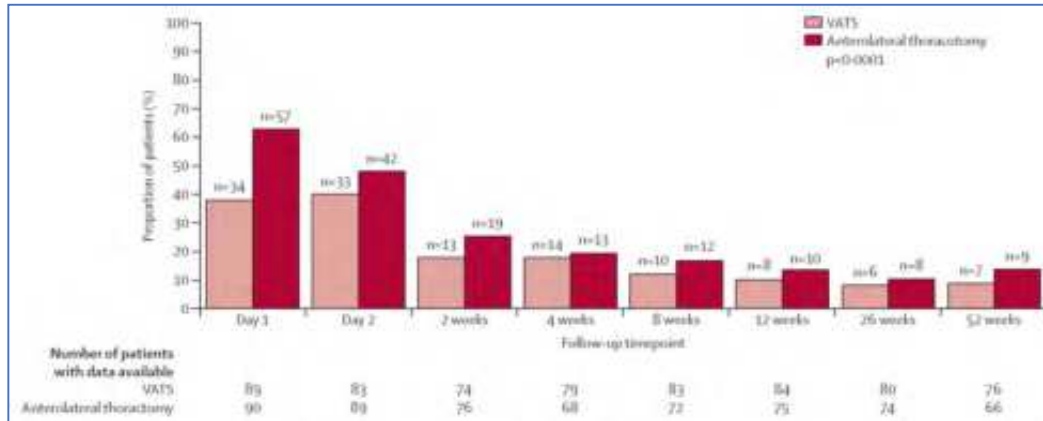




Postoperative pain and quality of life after lobectomy via video-assisted thoracoscopic surgery or anterolateral thoracotomy for early stage lung cancer: a randomised controlled trial

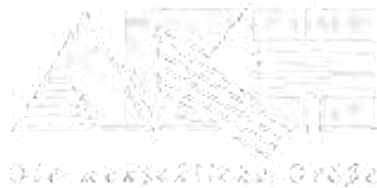
Lancet Oncol 2016; 17: 836-44

Morten Bendixen, Ole Dan Jørgensen, Christian Kronborg, Claus Andersen, Peter Bjørn Licht



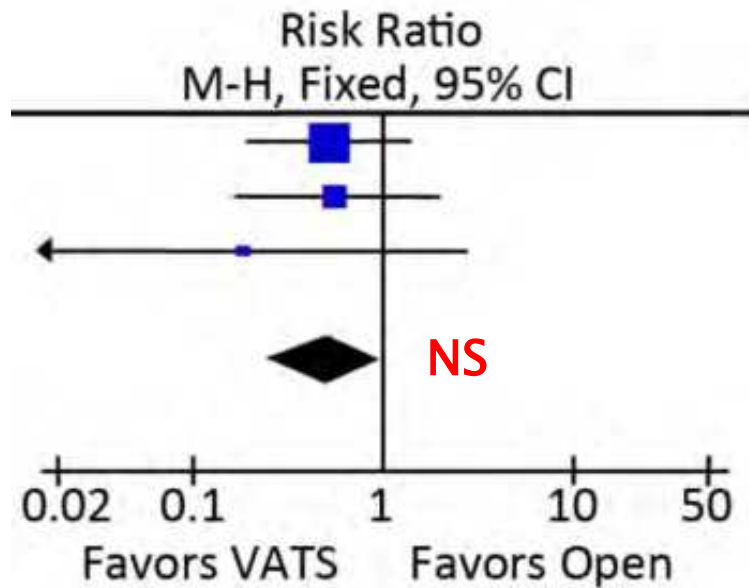
Post operative pain

Quality of life

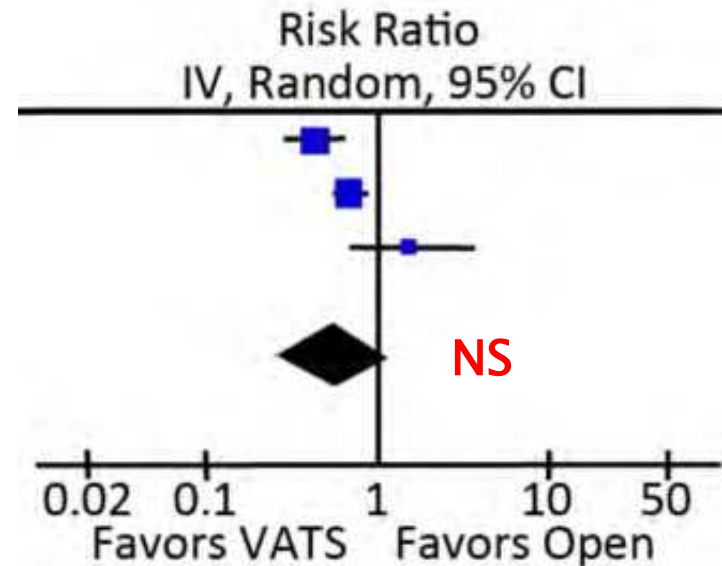


VATS lobectomy in patients with impaired lung function

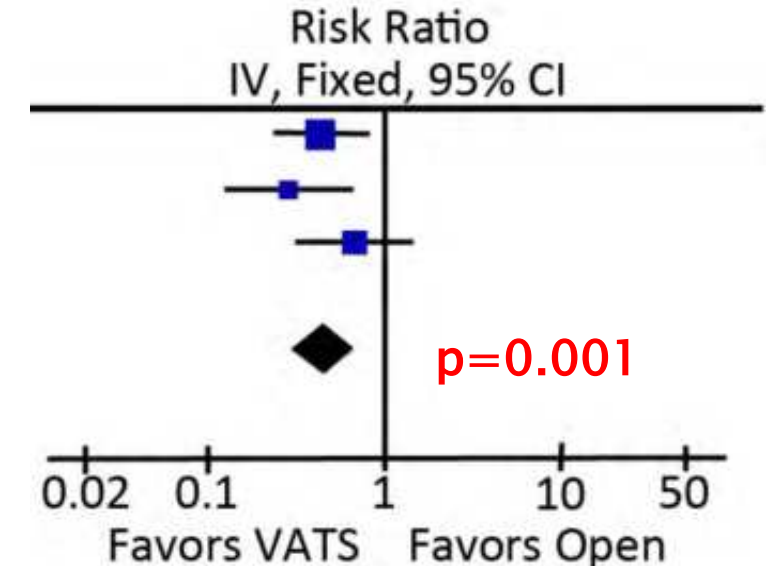
Mortality



Overall morbidity



Pulmonary morbidity



Zhang et al. PLOS one 2014



Thoracoscopic Lobectomy Facilitates the Delivery of Chemotherapy after Resection for Lung Cancer

Rebecca P. Petersen, MD, MS, DuyKhanh Pham, MD, William R. Burfeind, MD, Steven I. Hanish, MD, Eric M. Toloza, MD, PhD, David H. Harpole, Jr, MD, and Thomas A. D'Amico, MD
Ann Thorac Surg 2007; 83: 1245-1250

VATS lobectomy facilitates the delivery of adjuvant docetaxel-carboplatin chemotherapy in patients with non-small cell lung cancer

Zhi X, Gao W, Han B, et al J Thorac Dis 2013;5:578-84

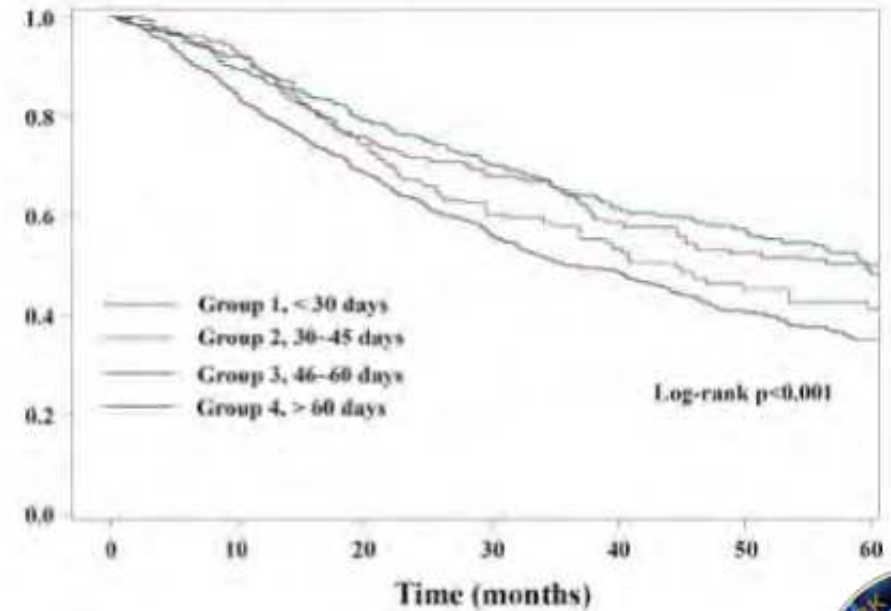


VS



Impact on Survival on Interval between Surgery and Adjuvant Chemotherapy in Completely Resected Stage IB-III A Lung Cancer

Wen et al.
PLoS ONE 2016; 11(11): e0163809.



DaVinci X Robot



Why better with Robot??

High-definition 3-D visualization

Exceptional maneuverability

Precise control



Well accepted R.A.T.S. surgical indications

- Anterior mediastinal surgery : mainly Myasthenia Gravis - tumors < 4 cm
- Anatomical segmental resections: lobectomy, also segmentectomy.
- Esophageal surgery (myotomy, esophagectomy)
- Diaphragm plication
- Posterior mediastinal surgery
- Limited chest wall resections (1st rib)

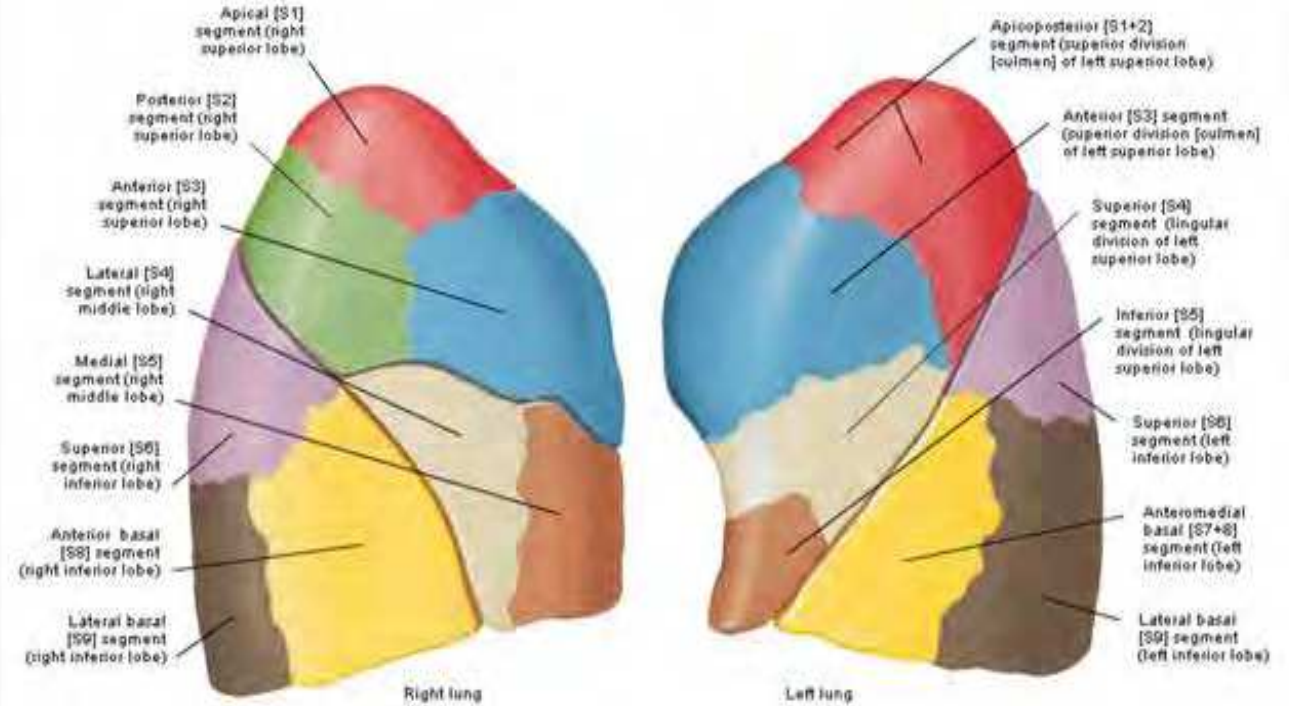
Robotic Anatomic Segmentectomy of the Lung: Technical Aspects and Initial Results

Alessandro Pardolesi, MD, Bernard Park, MD, Francesco Petrella, MD,
Alessandro Borri, MD, Roberto Gasparri, MD, and Giulia Veronesi, MD

Division of Thoracic Surgery, European Institute of Oncology, Milan, Italy; and Division of Thoracic Surgery, Hackensack
University Medical Center, Hackensack, New Jersey



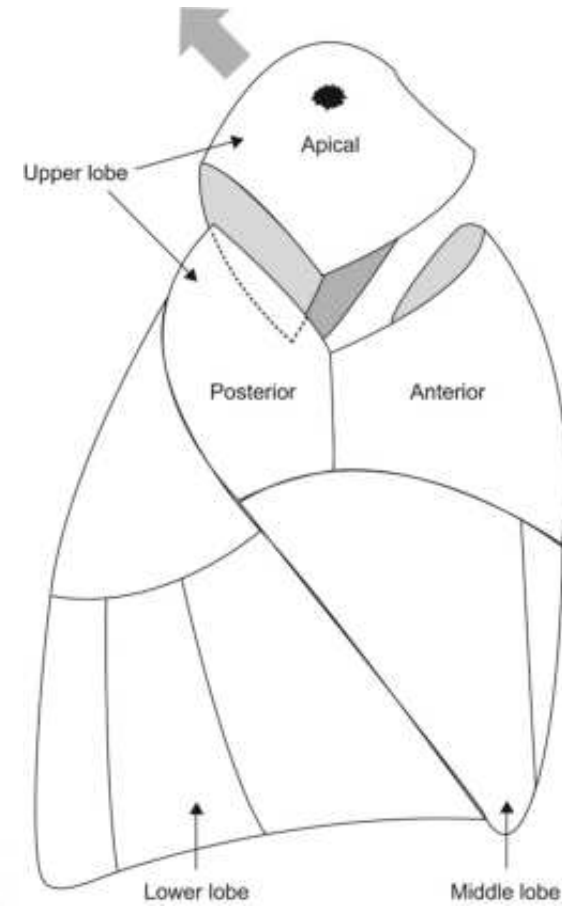
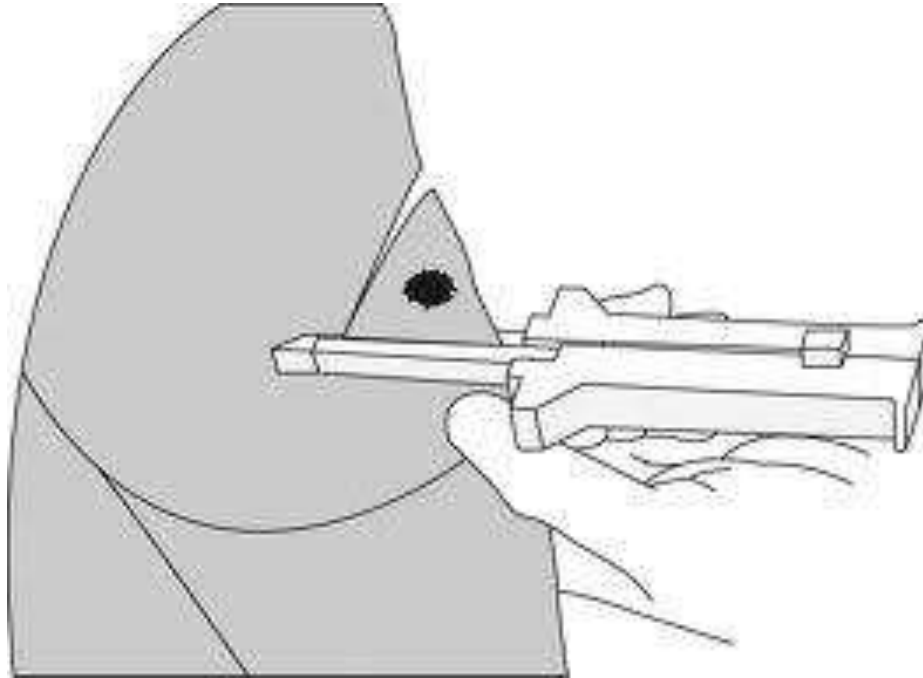
Bronchopulmonary Segments Lateral View



Robotic anatomic lung segmentectomy is feasible, safe and reproducible in different centres.

Robotic system, by improving ergonomic, surgeon view and precise movements, may make minimally invasive segmentectomy easier to adopt and perform.

Sublobar resections



Eur Respir J 2009; 38: 426-435
DOI: 10.1183/09031530.00099808
Copyright©ERS, Jun 2009

SERIES "LUNG CANCER"
Edited by C. Brambilla
Number 2 in this Series



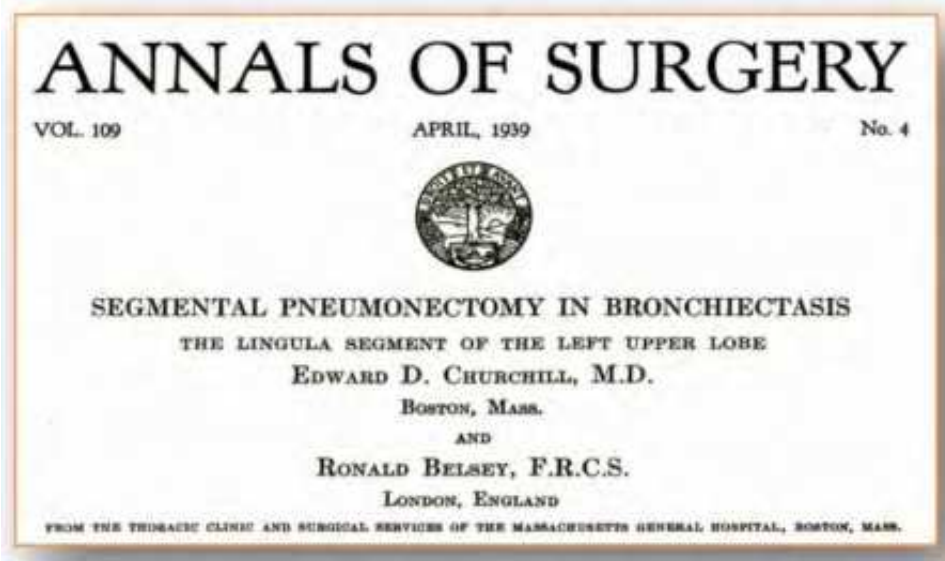
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Segmental resection for lung cancer

A fifteen-year experience

Robert J. Jensik, M.D., L. Penfield Faber, M.D., Frank J. Milloy, M.D.
(by invitation), and David O. Monson, M.D. (by invitation), Chicago, Ill.

Jensik RJ. *J Thorac Cardiovasc Surg* 1973; 66: 563-572



Churchill ED and Belsey R. *Ann Surg* 1939;109: 481-499

A report on 86 pts with lingulectomy for bronchiectasis

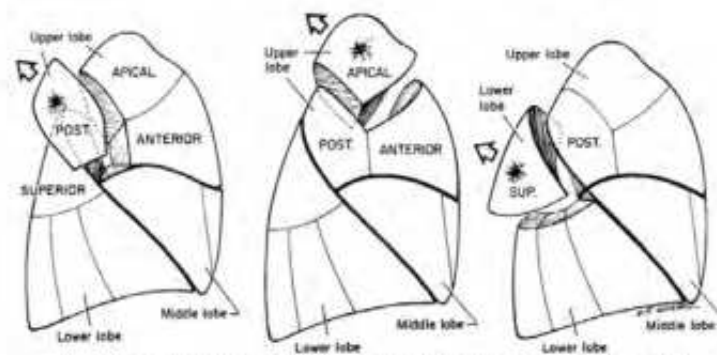


Fig. 1. Segmental resections in right lung. Upper lobe: posterior and apical. Lower lobe: superior.

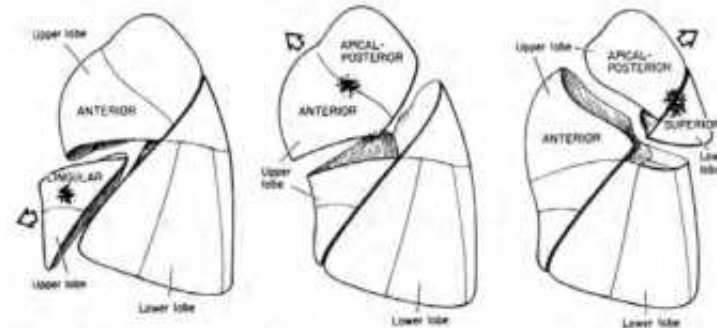
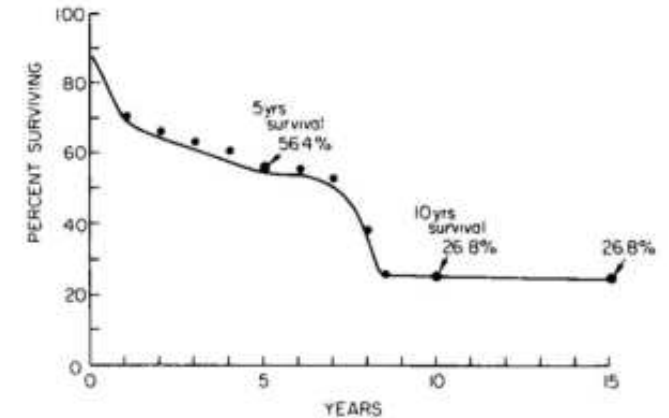


Fig. 2. Segmental resections in left lung. Upper lobe: Lingula and superior division. Combined apical posterior, left upper and superior, and left lower lobe.

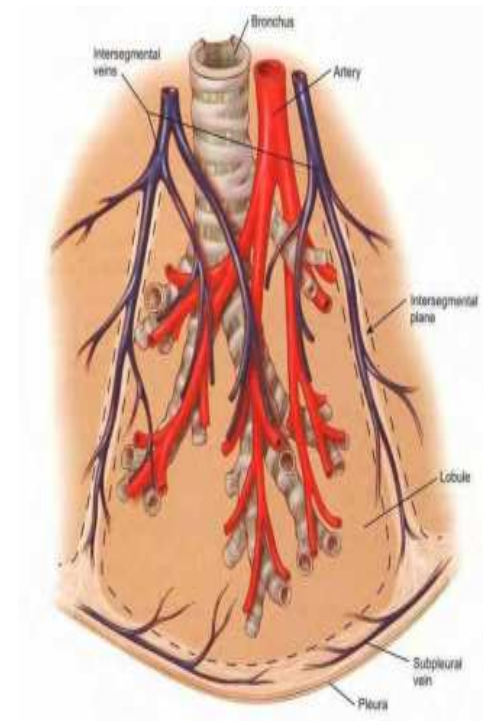


- 119 patients
- 5-y OS: 56%
- Local recurrence: 10%



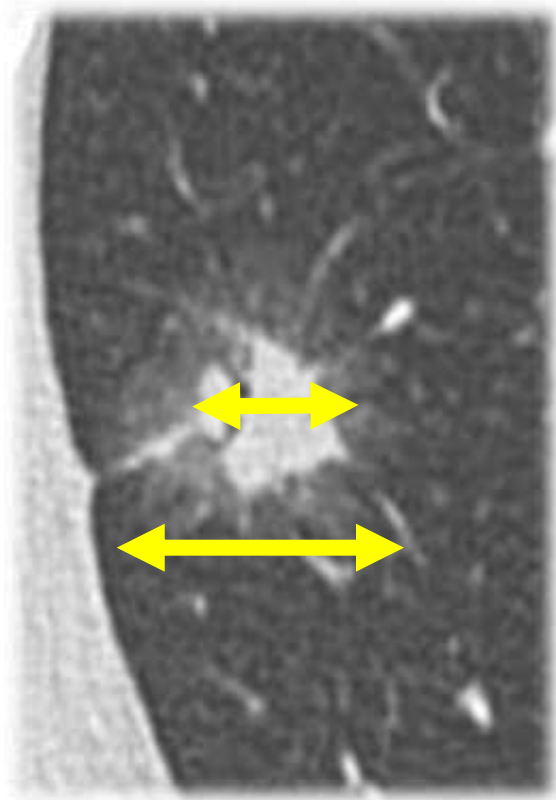
Limitationen von sublobären Resektionen – wichtige Faktoren

- **Tumorgröße: größer als 2cm – höheres Lokalrezidivrisiko**
- **Tumorlokalisation: in Relation zum Hilum/Pleura**
- **Histologischer Subtyp: ADC ist nicht gleich ADC!**
 - AIS, MIA haben ein besseres Outcome
- **Anatomie – preop 3D-Rekonstruktion**
- **Resektionsränder – parenchymal (korrekter intersegmentale Schicht, parenchymaler Rand) intraop LK Beurteilung**



Schuchert MJ. *Ann Thorac Surg* 2007;84:926-933.
Nishio W, et al. *Ann Thorac Surg* 2016;102:1702-10

Die Art der Resektion kann auch durch die Tumorgrösse und C/T ratio gewählt werden



C/T ratio =
Max. consolidation diameter / max.
tumor diameter

C/T ratio <0.25 were considered to be non-invasive in tumors < 2 cm.
(specificity 98.7%)

Maybe also important to determine
PET SUV
Serum CEA

Suzuki K, et al. *JTO* 2011;6:751-6.
Hennon et al. *Ann Surg Oncol* (2018) 25:59–63

Randomized Control Trials

**CALGB/Alliance
140503**

*Altorki, N. K. et al.
Lancet Respir Med. 2018
final results presented and in
preparation*

DRKS00004897

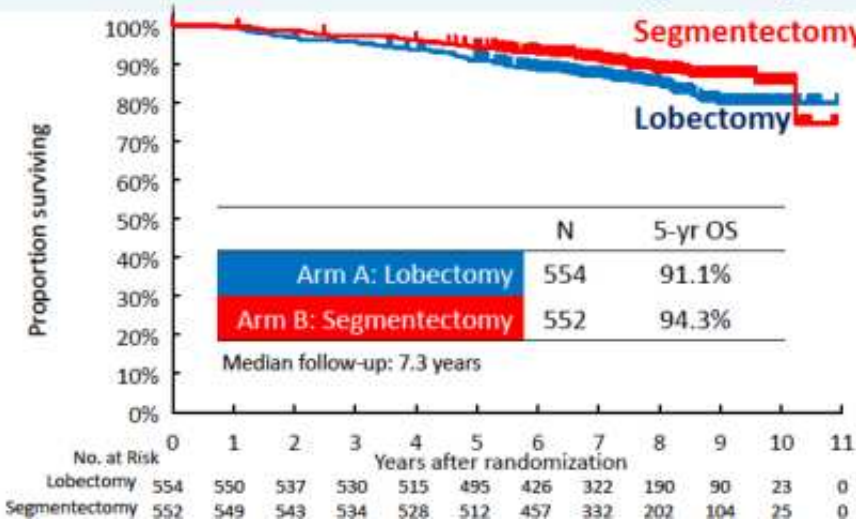
*Stamatis G. et al.
Lung Cancer. 2022*

JCOG0802
*Saji H, et al.
Lancet. 2022*



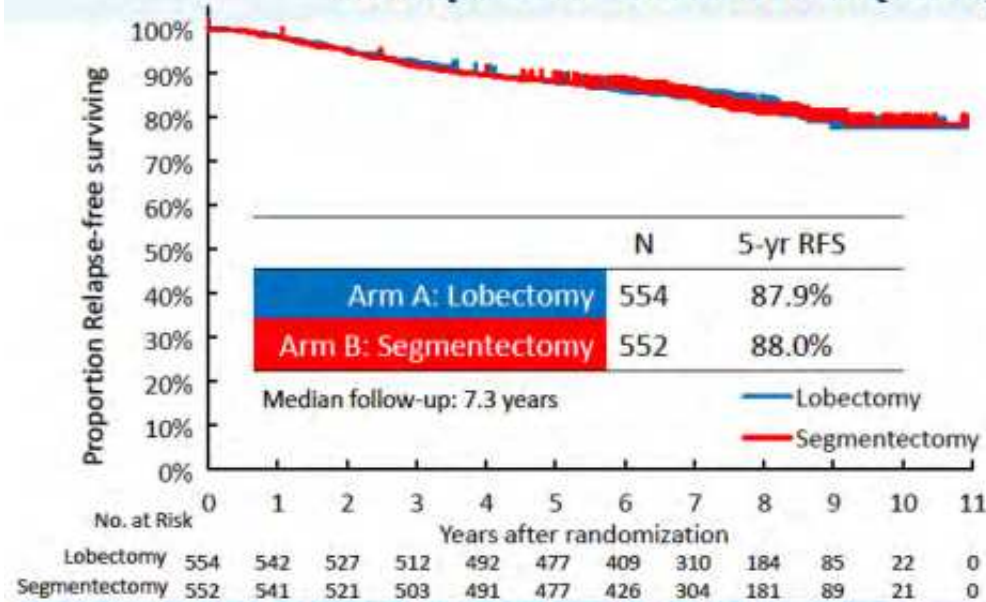
Results JCOG trial

Overall survival (primary endpoint)



HR: 0.663
 95% CI: 0.474–0.927
 one-sided
 P < 0.0001 for non-inferiority
 P = 0.0082 for superiority

Relapse-free survival (RFS)



HR: 0.998
 95% CI: 0.753–1.323
 P = 0.9889

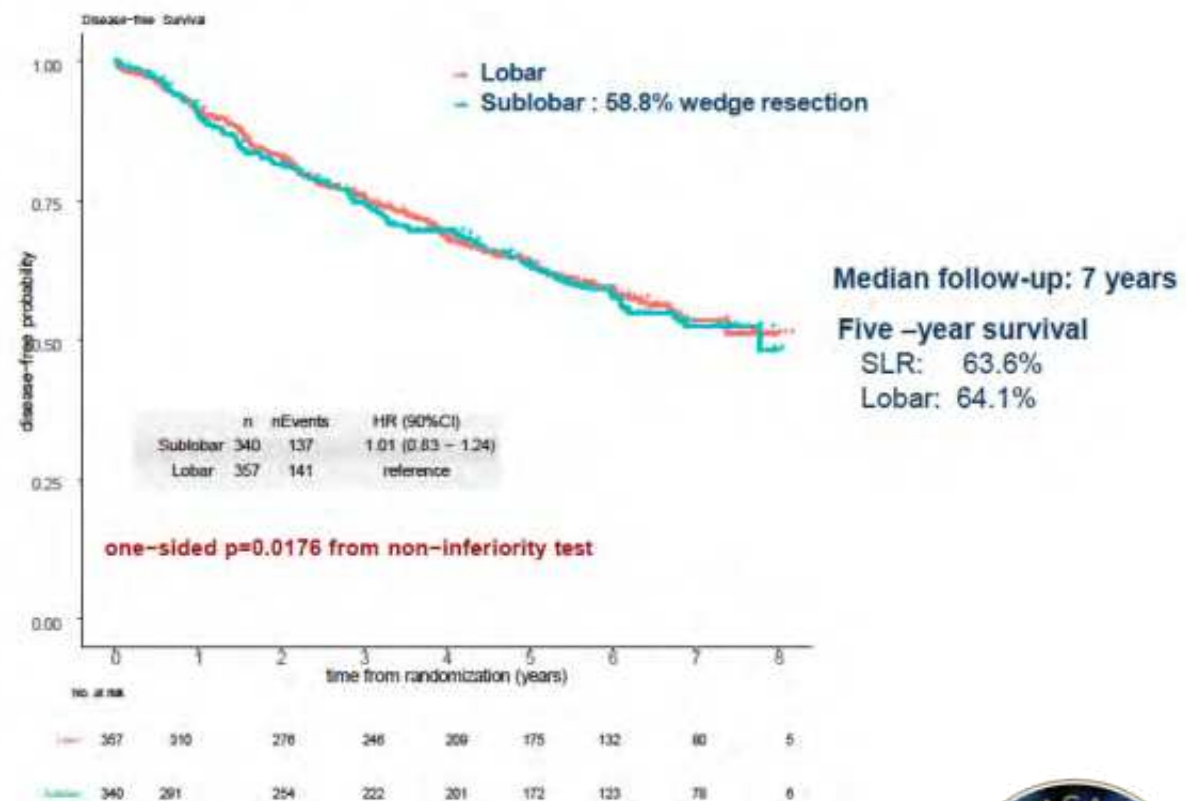


Results CALGB trial

Overall Survival

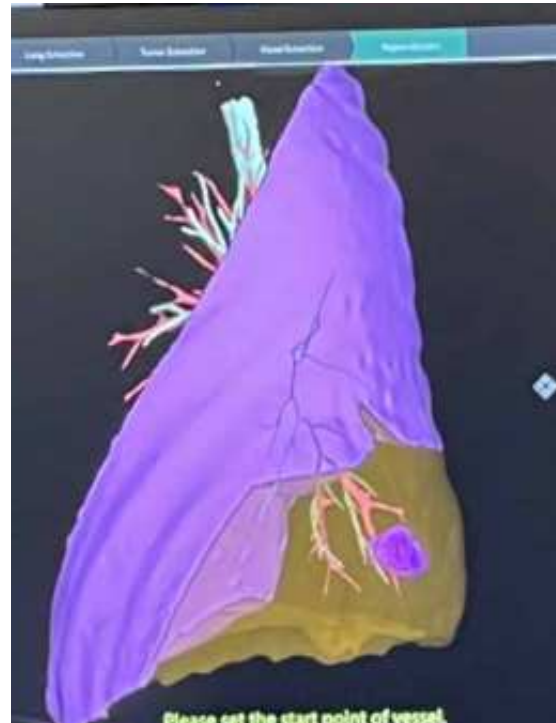
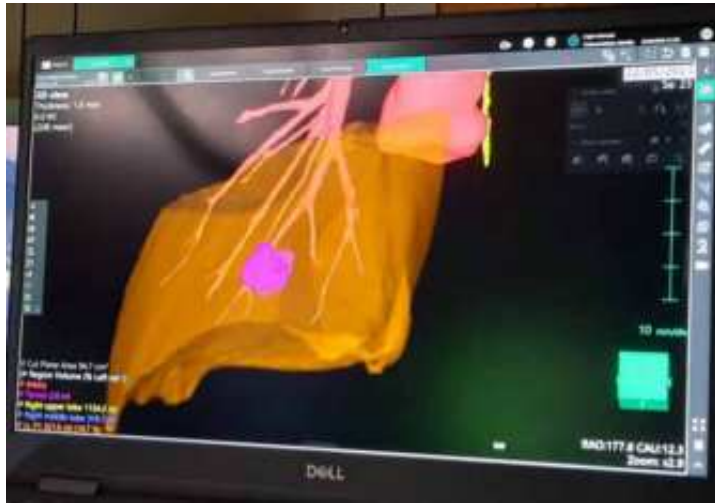


Disease-free Survival



....some tools needed to perform proper anatomic segmentectomies by VATS.....

3D-reconstructions for assessment of anatomic variations and planning



Indocyanine green (ICG) dye for intraoperative segmental border assessment



Summary

- Screening – will lead to increase of patients in (very) early stages?
- Diagnosis of lesions will remain a challenge: EBUS helps
- VATS: Safe, oncologically effective strategy
- Demonstrated advantages:
 1. Less pain and analgesic requirement
 2. Preserved pulmonary function
 3. Less postoperative morbidity
 4. Less chest tube drainage and shorter length of stay
 5. Early return to full activity
- RATS – the future?
- Sublobar resections might more indicated in the ages of screening

Thank you for your kind attention!

alireza.hoda@icloud.com



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