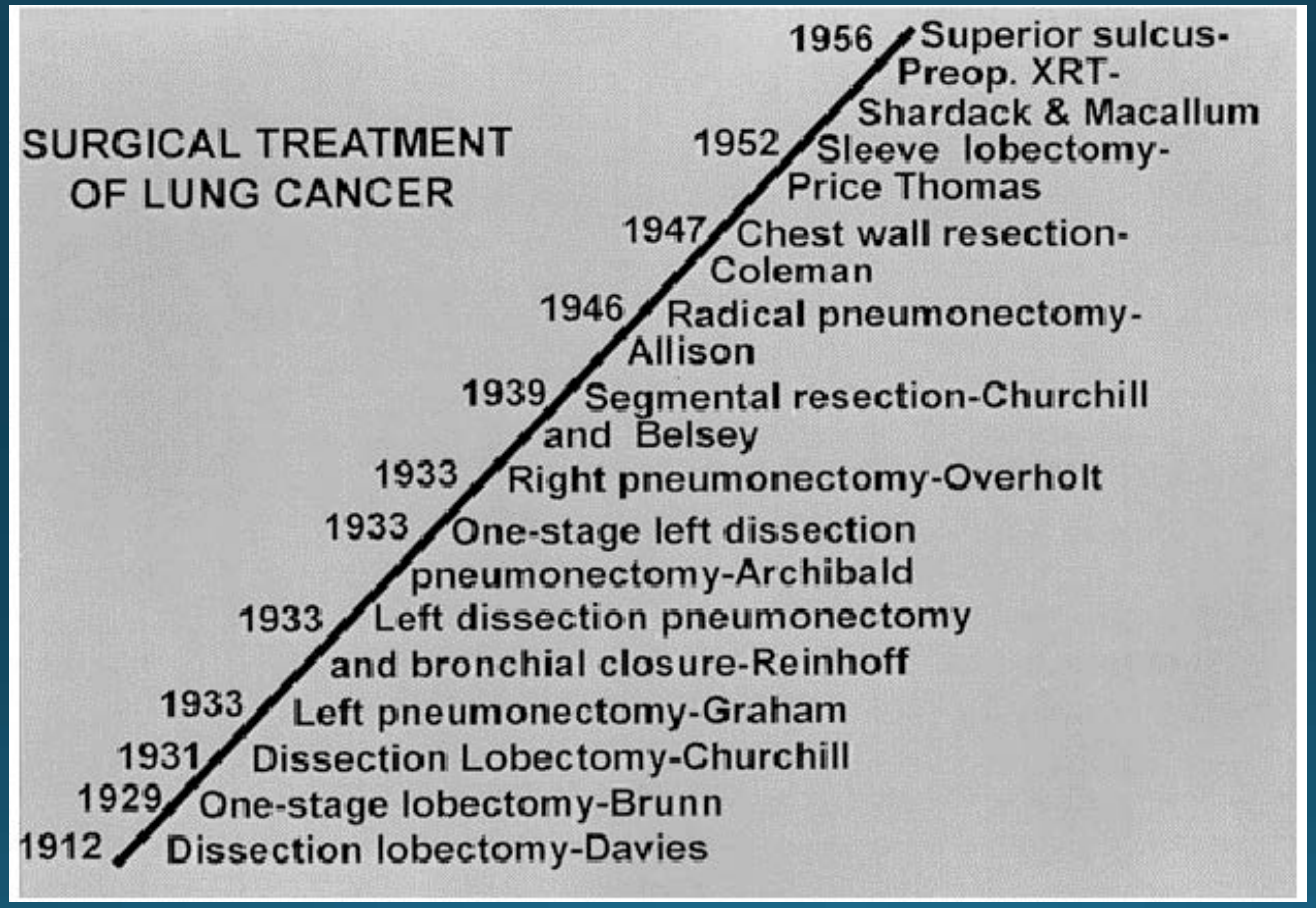
Colleen B. Gaughan, MD

11th Annual Focus on Lung Cancer

September 13, 2019

Intraoperative Imaging

Evolution of Surgical Treatment of Lung Cancer



Surgical treatment of lung cancer. Past and present. Methods Mol Med. 2003;75:453-87. Mountain CF, Hermes KE.

Lung Cancer

Non-small cell lung cancer (NSCLC)

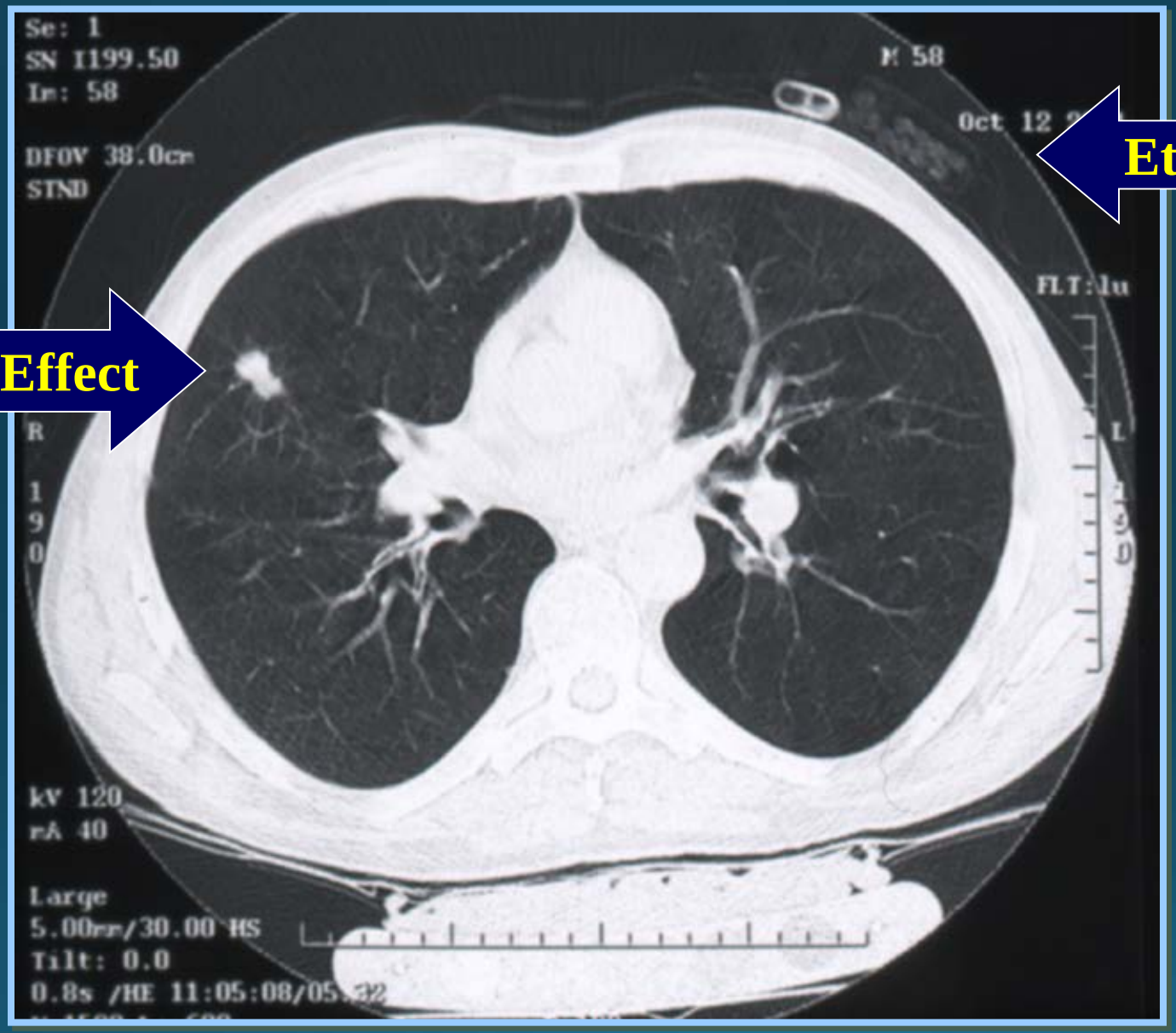
- 75% of all lung tumors
- Typically peripherally locatedAdenocarcinoma (predominant in US), squamous cell, large cell, bronchoalveolar carcinoma (BAC)

Small cell lung cancer (SCLC)

- 25% of all lung tumors
- Typically centrally located and expand against bronchus, causing compression
- Arises from neuroendocrine cells (Kultchitsky) lining deeper layers of epithelium
- Generally presents with distant metastatic disease

Surgery for Lung Cancer

- Lung Cancer was rare before the 1940
- Pneumonectomy was standard of care in the 1950
- 20-40% mortality
- Lobectomy become the Gold Standard for treatment of early stage lung cancer later on


Se: 1
SN I199.50
In: 58
DFOV 38.0cm
STND
M 58
Oct 12
FLT:lu
R
L
1
9
0
kV 120
mA 40
Large
5.00mm/30.00 HS
Tilt: 0.0
0.8s /HE 11:05:08/05
End Effect
Etiology

Lobectomy by Thoracotomy

- Intercostal incision with rib spreading/cutting and division of major muscles of the chest wall.
- Post-operative pain significant
- Possible post-thoracotomy pain
- Allows palpation of other lobes
- Conceived safer because of easy access to hilar vessels in case of bleeding.

Thoracotomy

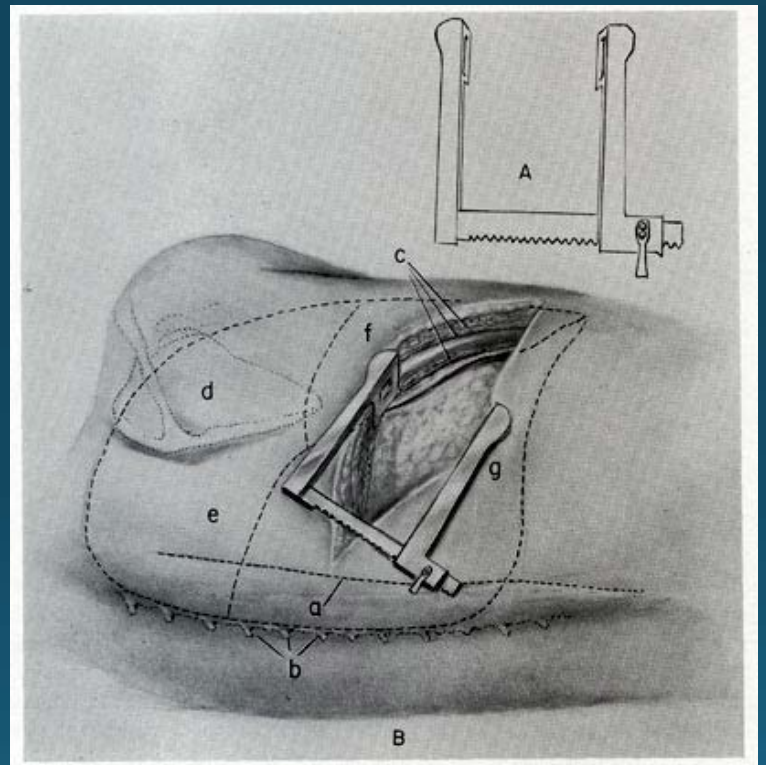
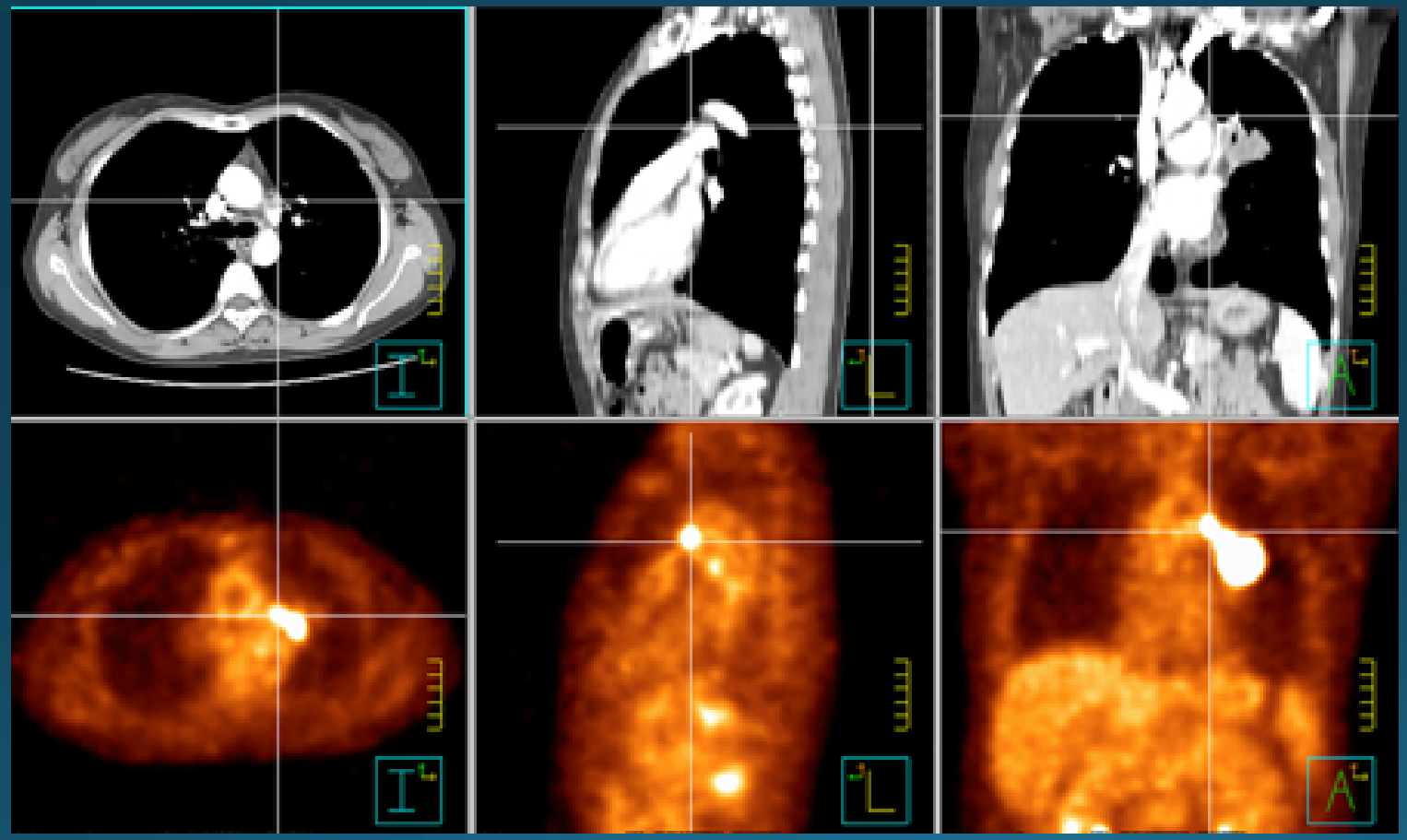


FIGURE 42.—Exposure of thoracic cavity with rib-spreader in posterolateral thoracotomy. A. Rib-spreader. B. Rib-spreader in situ, with gentle spreading of ribs, showing: Erector spinae muscle group (a), spinous processes (b), divided latissimus dorsi, serratus anterior, and intercostal muscles (c), scapula (d), right upper pulmonary lobe (e), right middle pulmonary lobe (f), and right lower pulmonary lobe (g).

Conventional Thoracotomy

Pros	Cons
Optimum exposure	Muscle division
Safe access to hilum	Rib spreading
Ability to palpate lung	Impaired PFTs
	Increase morbidity
	Increased mortality

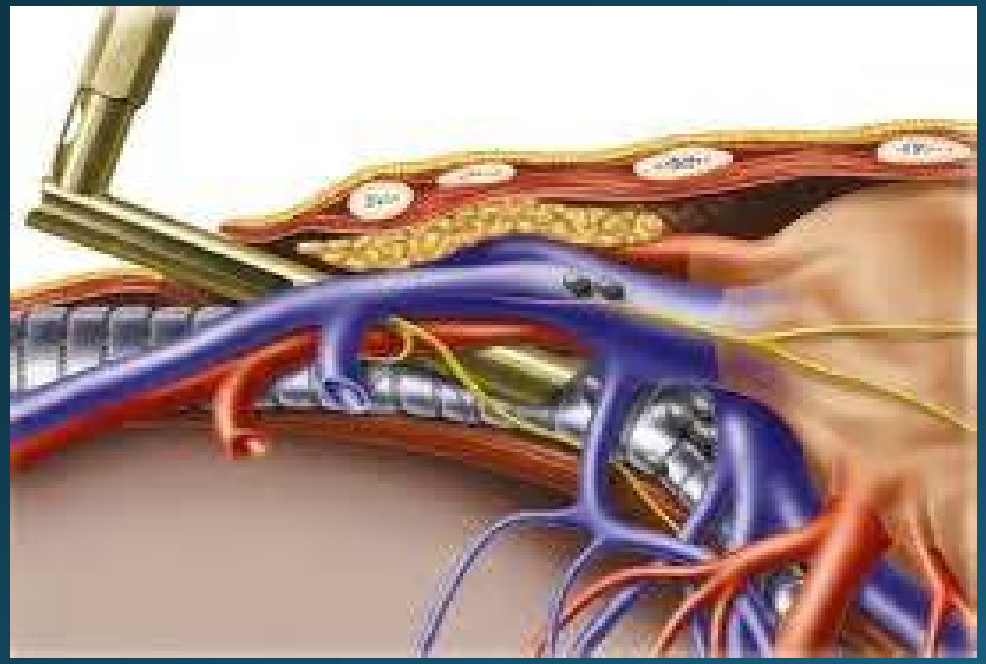
Milestones in Thoracic Oncology



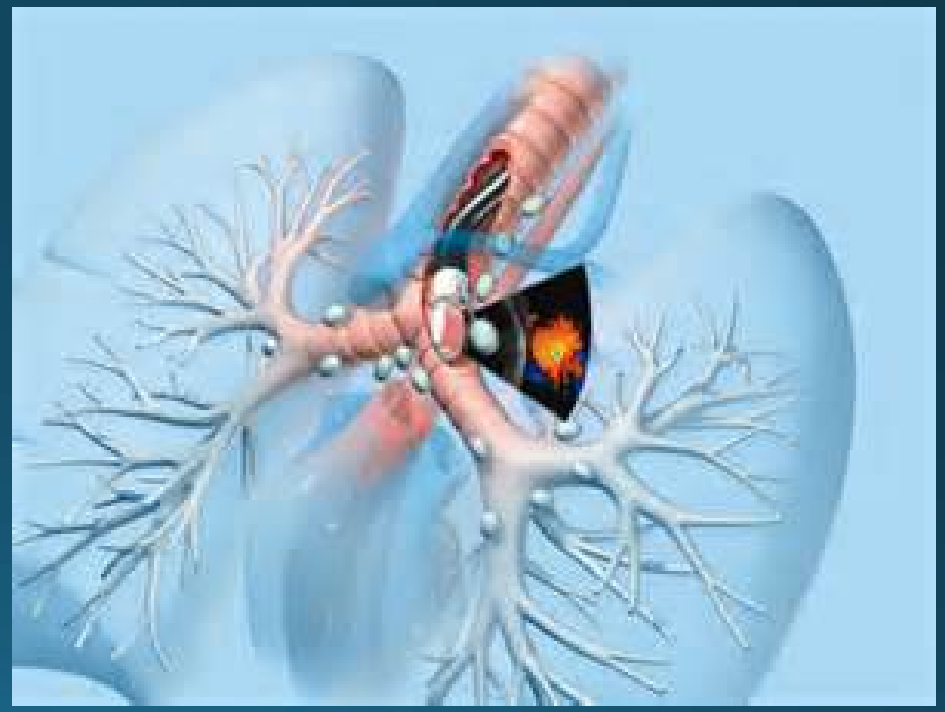
Better pretreatment staging including the avoidance of unnecessary surgery in 20% of patients

Milestones in Thoracic Oncology

Mediastinoscopy: invasive staging

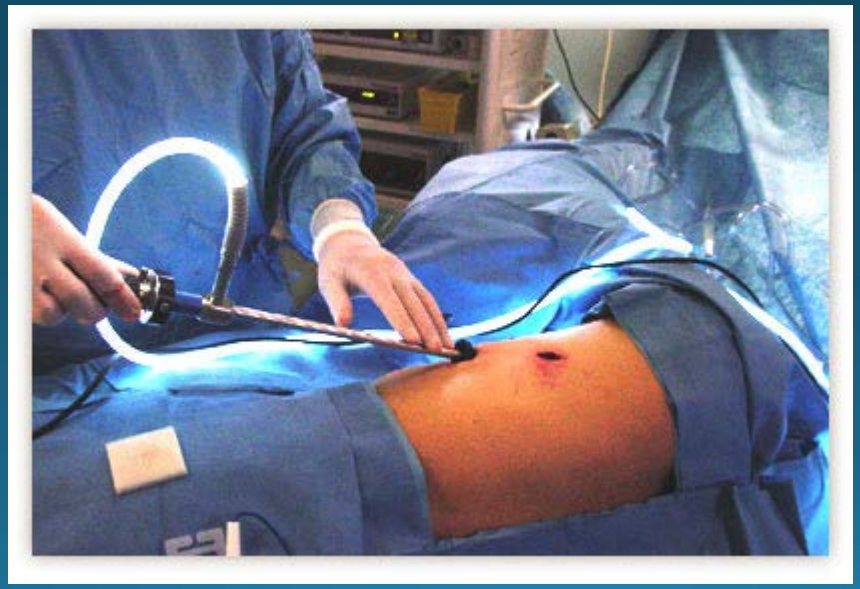


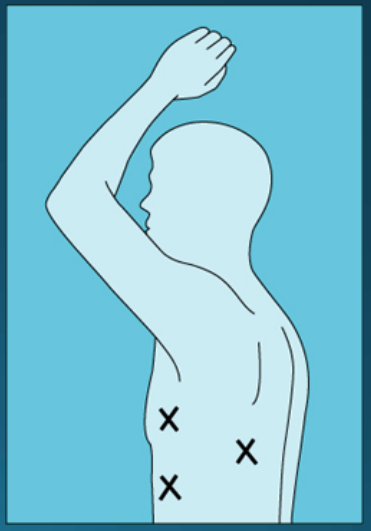
Endobronchial Ultrasound:



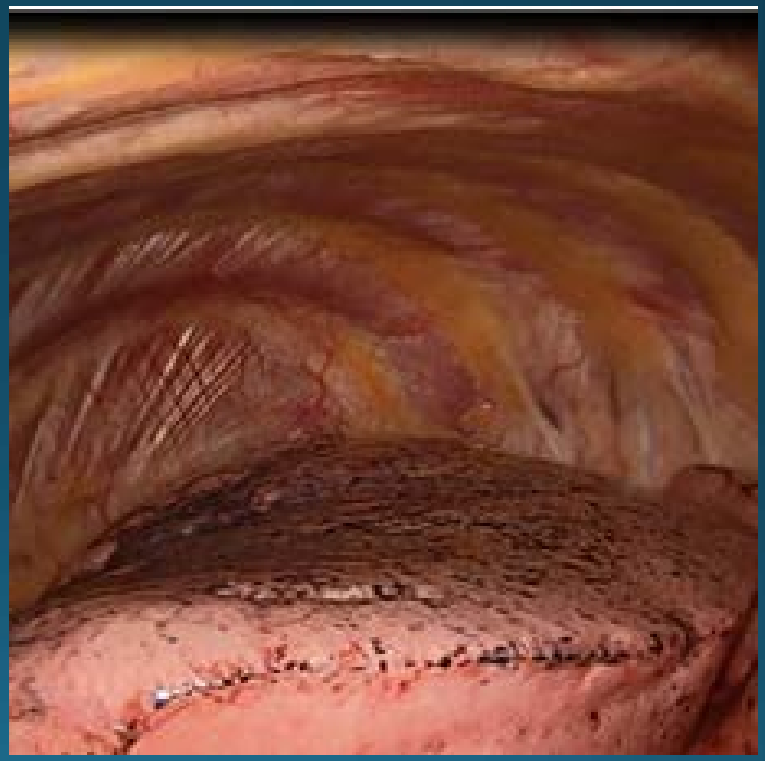
Video-Assisted Thoracoscopic Surgery VATS

- Camera and instruments inserted through small incisions/ports
- **No rib spreading**
- First described by Robert McKenna
- VATS allows other procedures such as lung biopsy, pleurodesis, pleural biopsy.





1980-1990's: Modern Era of VATS



VATS Lobectomy

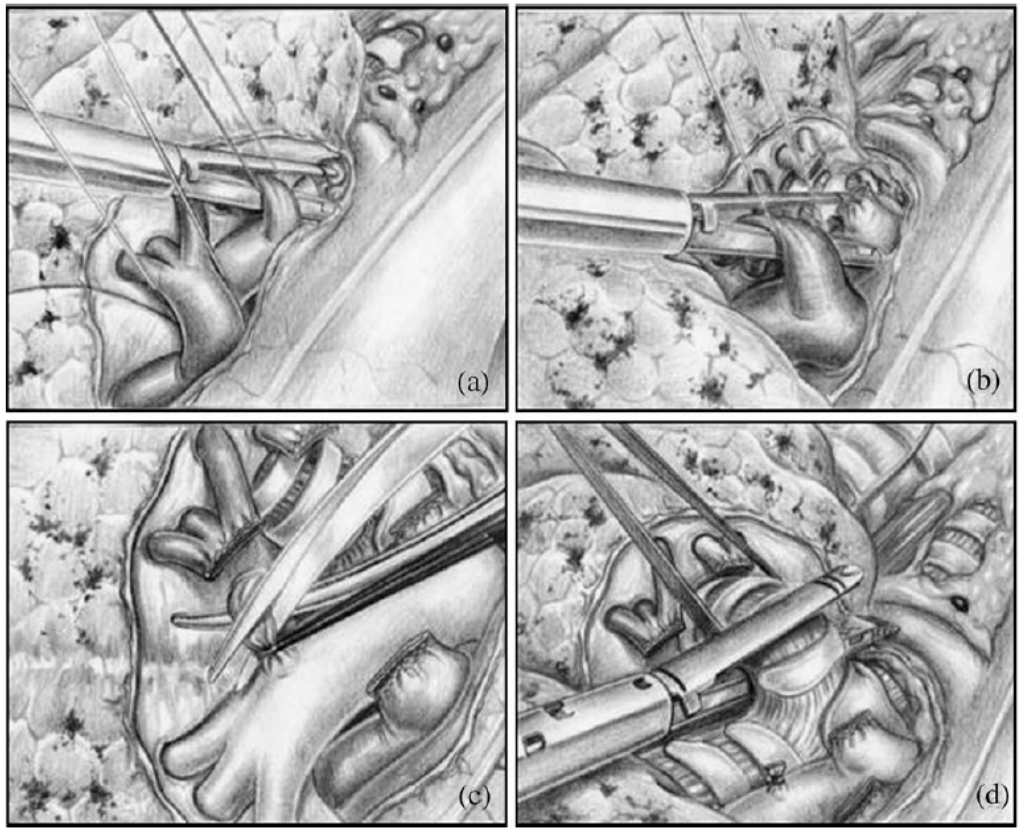


Fig. 1. Surgical techniques of VATS: (a) Pulmonary artery is identified at right upper lobe and retracted before positioning the endovascular. (b) Pulmonary vein is stapled separately. (c) Branch of the pulmonary artery is sometimes ligated and dissected by scissors. (d) Right upper bronchus is subsequently retracted and stapled.

Video-Assisted Thoracic Surgery Lobectomy: Experience With 1,100 Cases

Robert J. McKenna, Jr, MD, Ward Houck, MD, and Clark Beeman Fuller, MD

Cedars Sinai Medical Center, Los Angeles, California

Ann Thorac Surg 2006: 81)

- 1100 VATS Lobectomies
- Mean age: 71.2 years
- Mortality: 0.8%
- No complications: 932 patients (84.7%)
- LOS: Median 3 days (Mean 4.78 days)
- 180 patients (20%) discharged on day 1 or 2
- Conversion to thoracotomy in 28 patients (2.5%).

Thoracotomy/Thoracoscopy

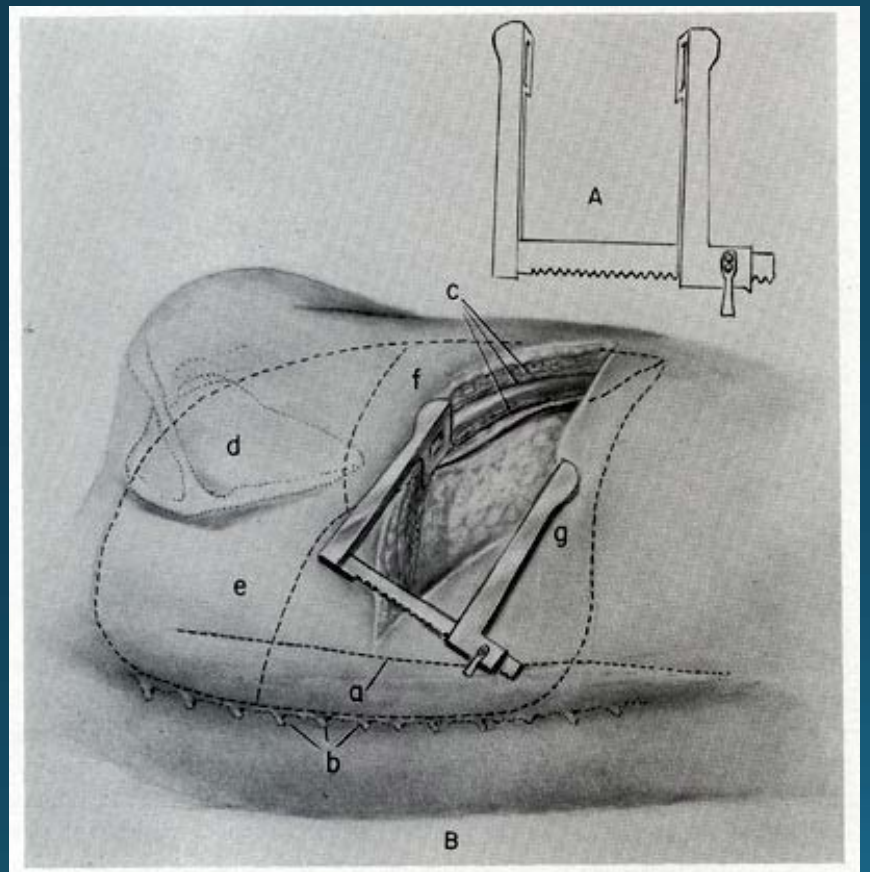
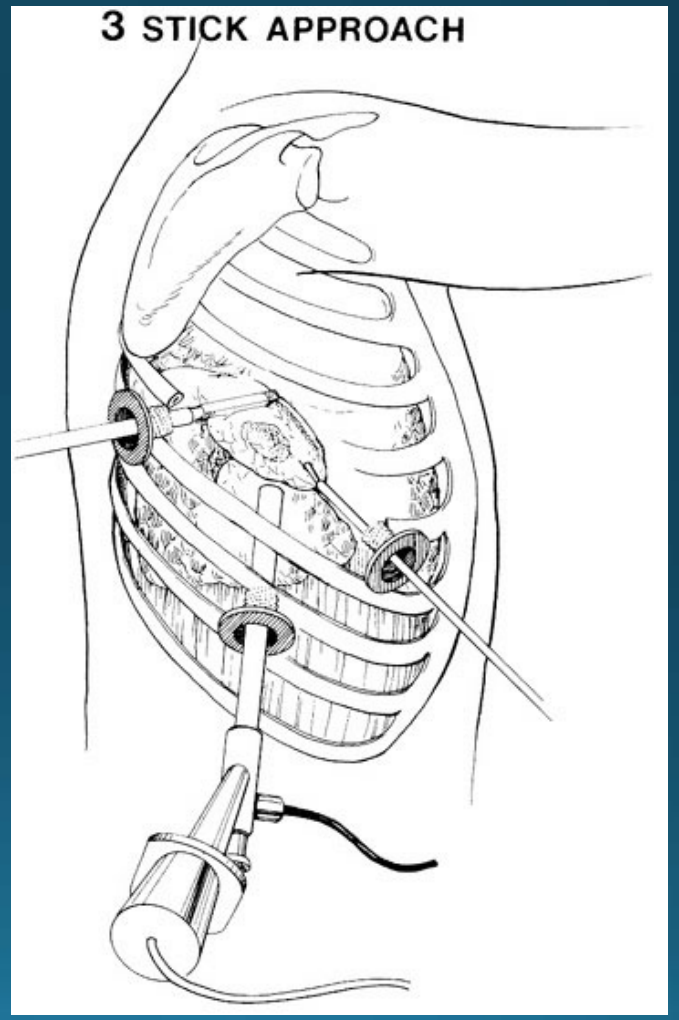


FIGURE 42.—Exposure of thoracic cavity with rib-spreader in posterolateral thoracotomy. A. Rib-spreader. B. Rib-spreader in situ, with gentle spreading of ribs, showing: Erector spinae muscle group (a), spinous processes (b), divided latissimus dorsi, serratus anterior, and intercostal muscles (c), scapula (d), right upper pulmonary lobe (e), right middle pulmonary lobe (f), and right lower pulmonary lobe (g).



Potential Advantages of Minimally Invasive Lobectomy

- Less postoperative pain
- Faster return to normal activities
- Shorter chest tube duration
- Shorter hospital stay
- Preservation of pulmonary function
- Lower inflammatory cytokine response
- Consistent delivery of adjuvant chemotherapy
- Reduced hospital costs

Technical Limitations of VATS

- Counter-intuitive orientation
- 2-dimensional imaging
- Reduced depth perception
- Limited instrument maneuverability
- Restricted access to hilar structure

Da Vinci System

Technical Advantages of Robotic-Assisted Lung Surgery

- Intuitive orientation
- 3D/HD visualization
- 10x magnification
- Endo-wrist technology allows safe complex dissection
- Two free hands at all time to perform the procedure
- Tremor eradication

- Inability to palpate lung

Progress in Thoracic Surgery

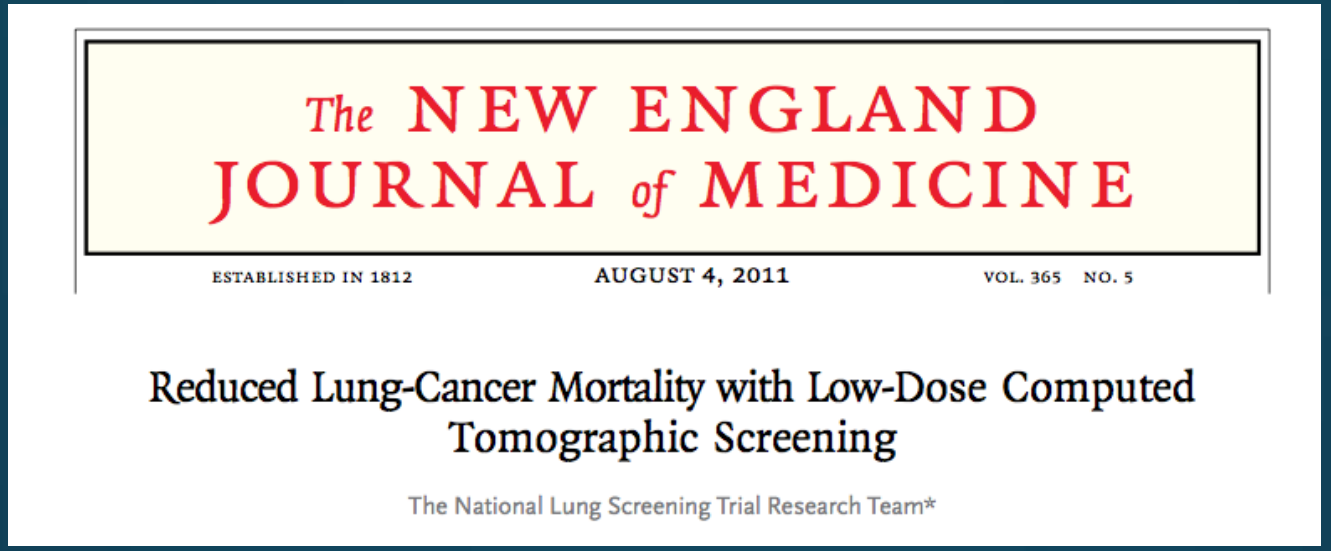
- Pneumonectomy → Lobectomy → Segmentectomy
- Mortality 20-40% → 1-2%
- Thoracotomy → VATS lobectomy → Lesser Resections
- Length of Stay weeks → 2-3 days
- Robotic Surgery = VATS
- Surgery safe in the elderly, i.e., octogenarians

Surgical Options for Lung Cancer

- Anatomic Resection, i.e. lobectomy
- Lesser Resections:
  - Segmentectomy
  - Wedge Resection

Non-Surgical Treatment

- Radiotherapy
  - Stereotactic radiation
- Radiofrequency ablation



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 4, 2011 VOL. 365 NO. 5

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

- Low dose CT in high risk patients (> 30 pack years) compared to single AP Chest Radiography
- Relative reduction in death rate from lung cancer of 20%
- 320 persons to be screened with low-dose CT to prevent one death (Mammography: 2000 woman to be screened)
- The rate death from any cause was reduced in the low-dose CT group by 6.7%

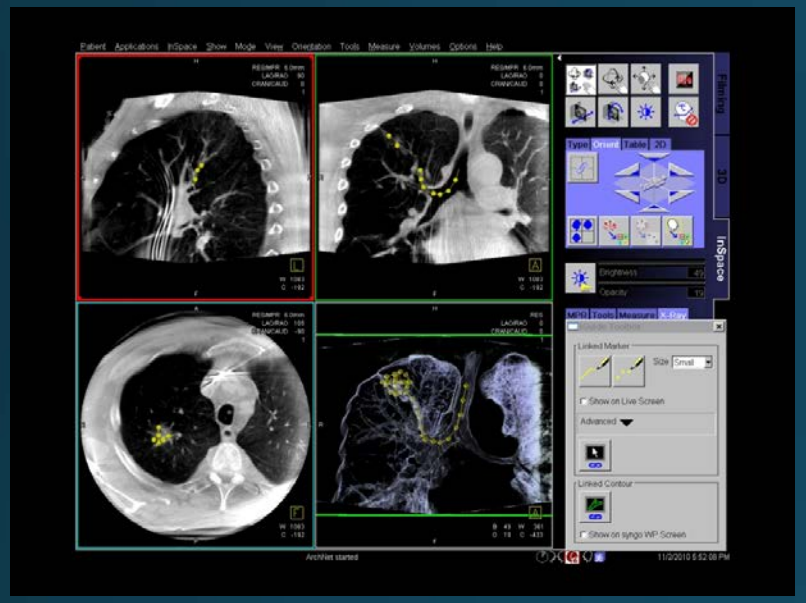
Ultimate goal: Most accurate staging before treatments: clinical versus pathologic staging

- Better Imaging:
  - High resolution CT chest
  - PET CT
- Non-invasive, procedural staging
  - Needle biopsy
  - Bronchoscopy
  - EBUS

Dilemma: With better scans we find additional small nodules and groundglass opacities.

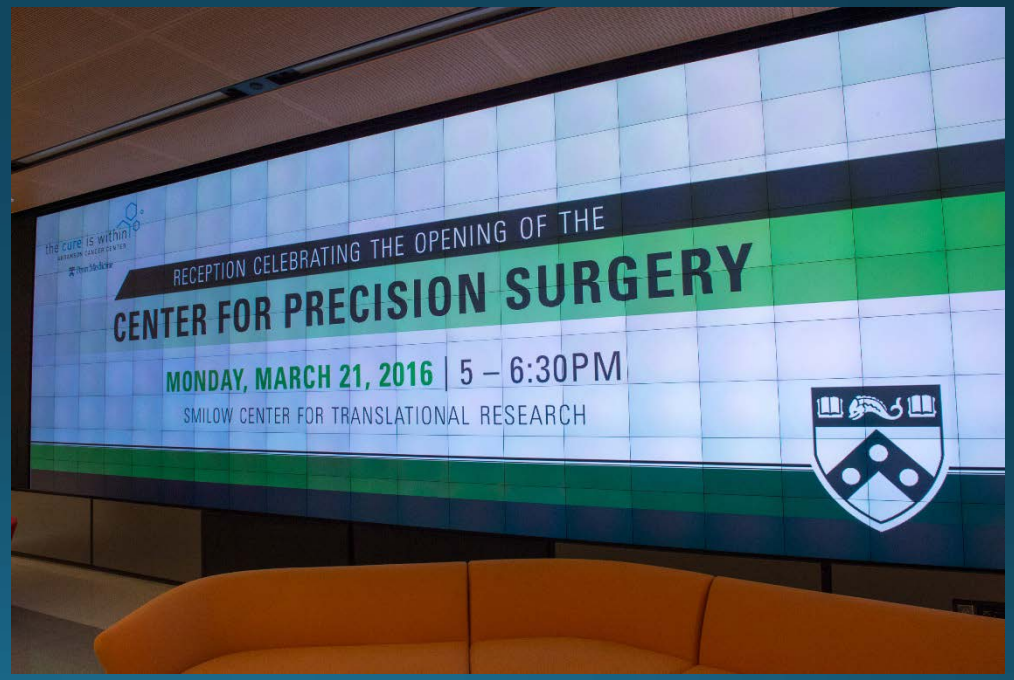
The Future

Intraoperative Imaging



"Overlay " vision

Single Largest Center for Intraoperative Imaging in world



Courtesy of Dr. Sunil Singhal

Methods

Prior to surgery

Courtesy of Dr. Sunil Singhal

Pulmonary nodules

Goal of the operation:

Locate and remove pulmonary nodules

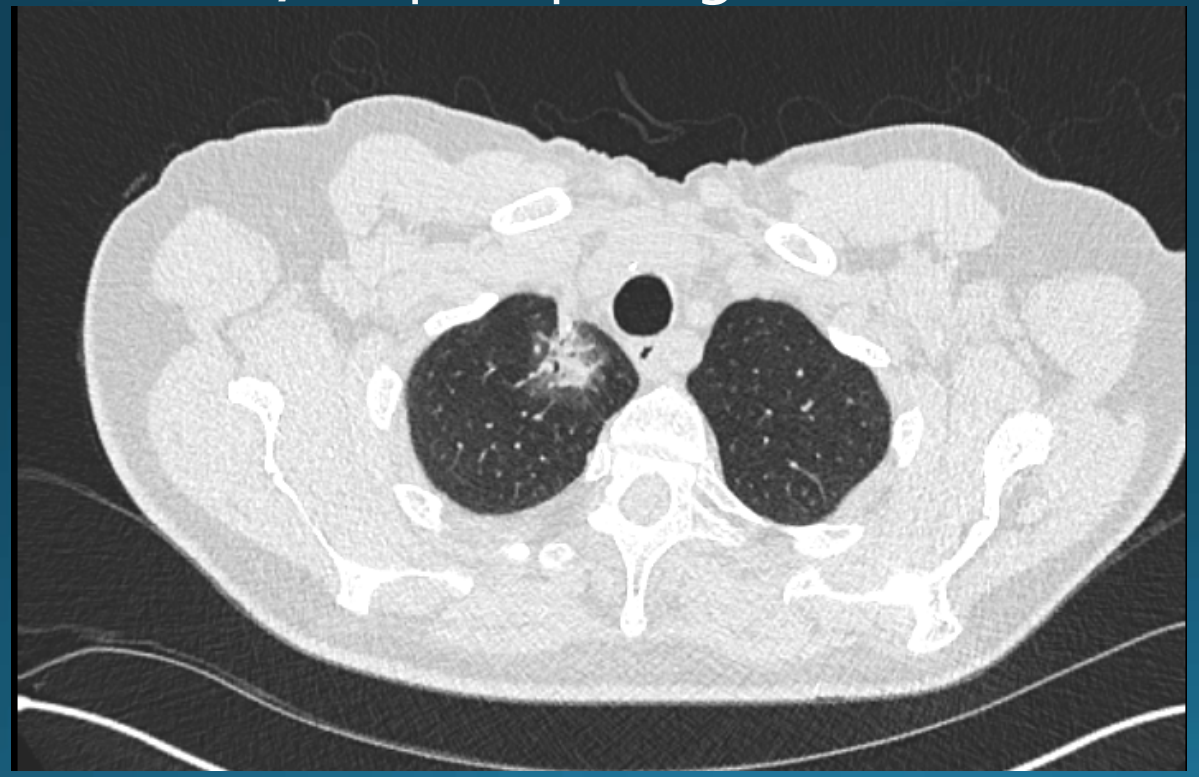
Challenges:

1. Find small GGOs
2. Frozen section is not accurate
3. Confirm surgical margins negative
4. Identify synchronous primaries

Courtesy of Dr. Sunil Singhal

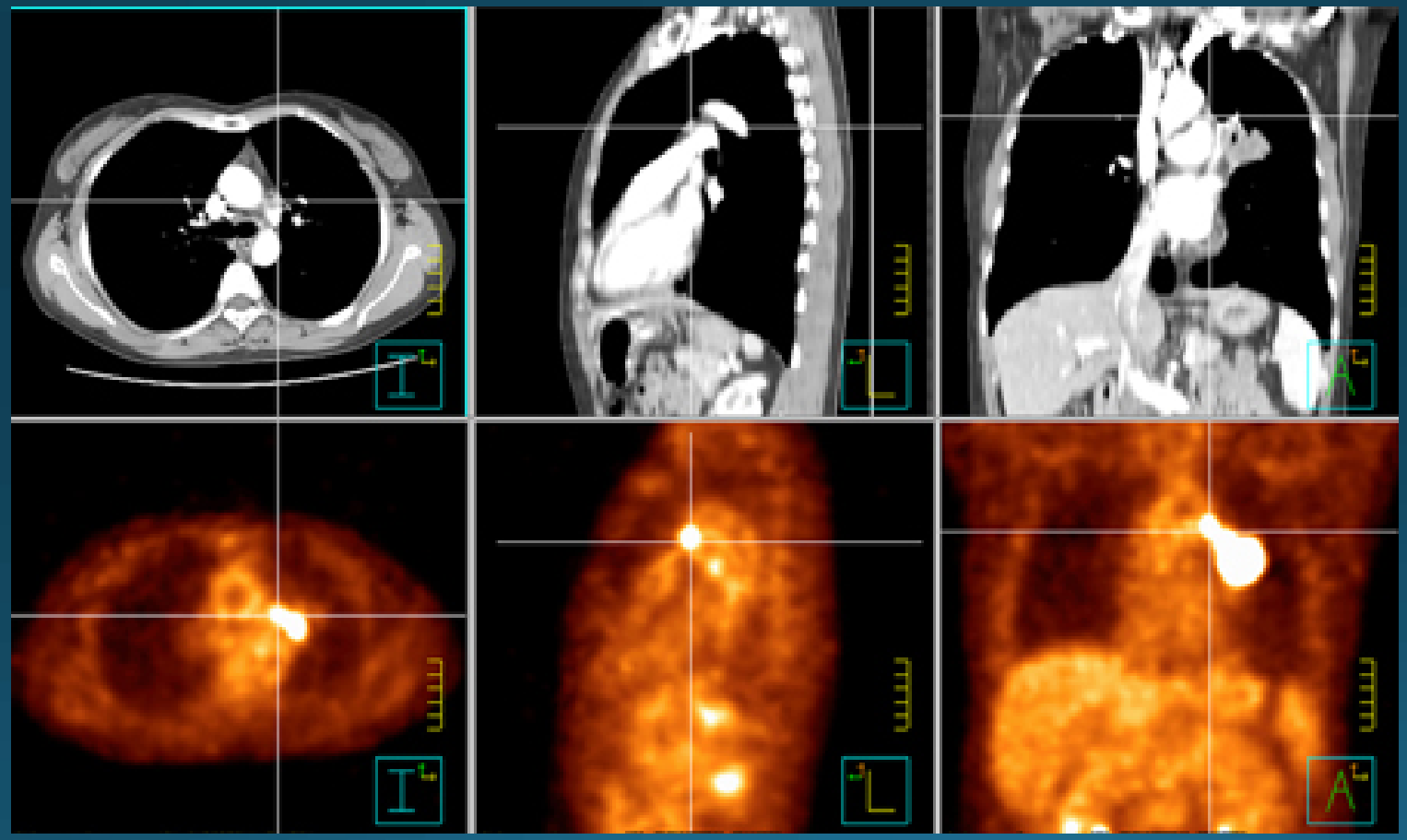
Carlo

- 79 year old, retired police officer
- Growing GGO in RUL, no preop diagnosis



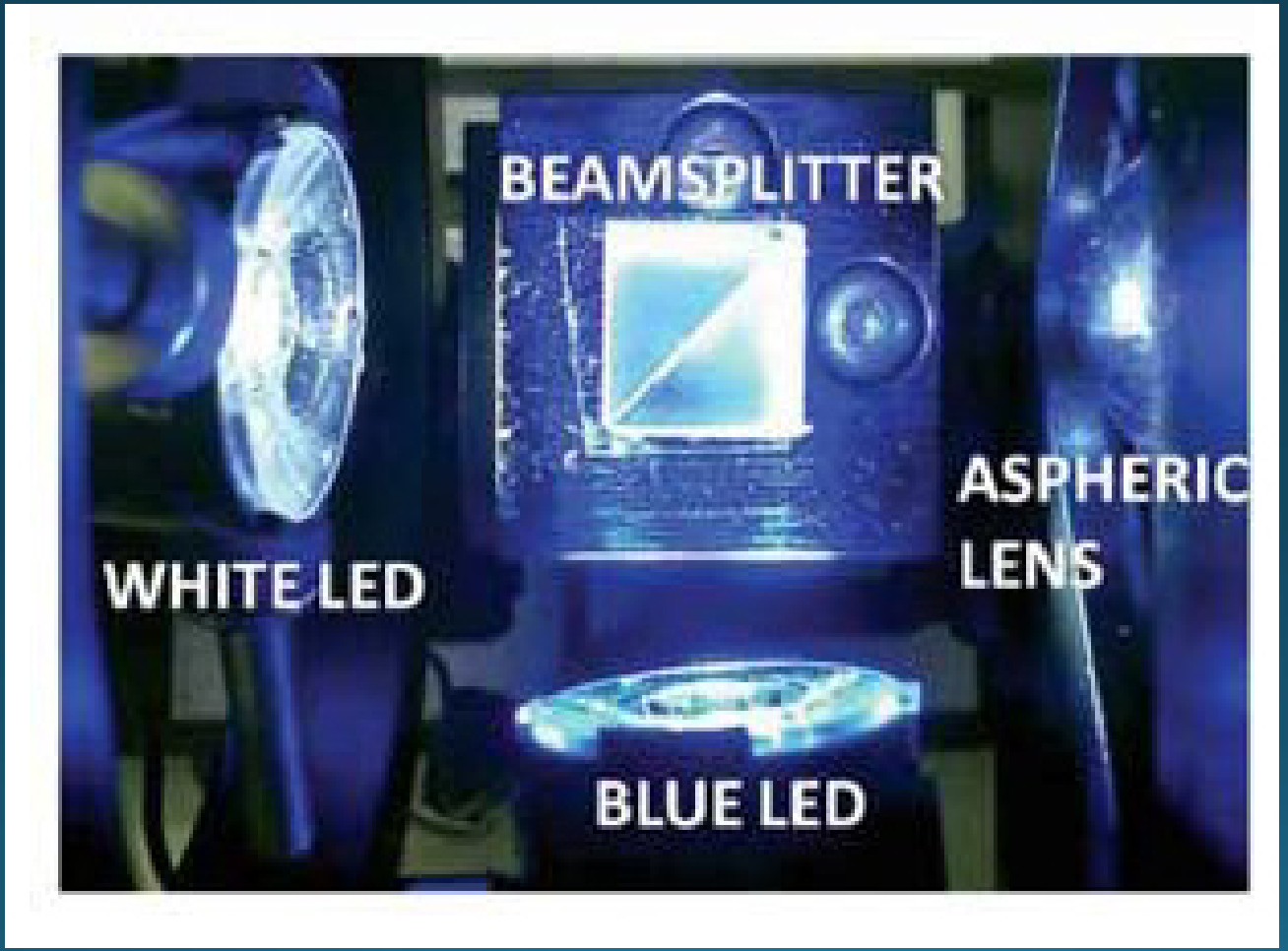
Courtesy of Dr. Sunil Singhal

Milestones in Thoracic Oncology

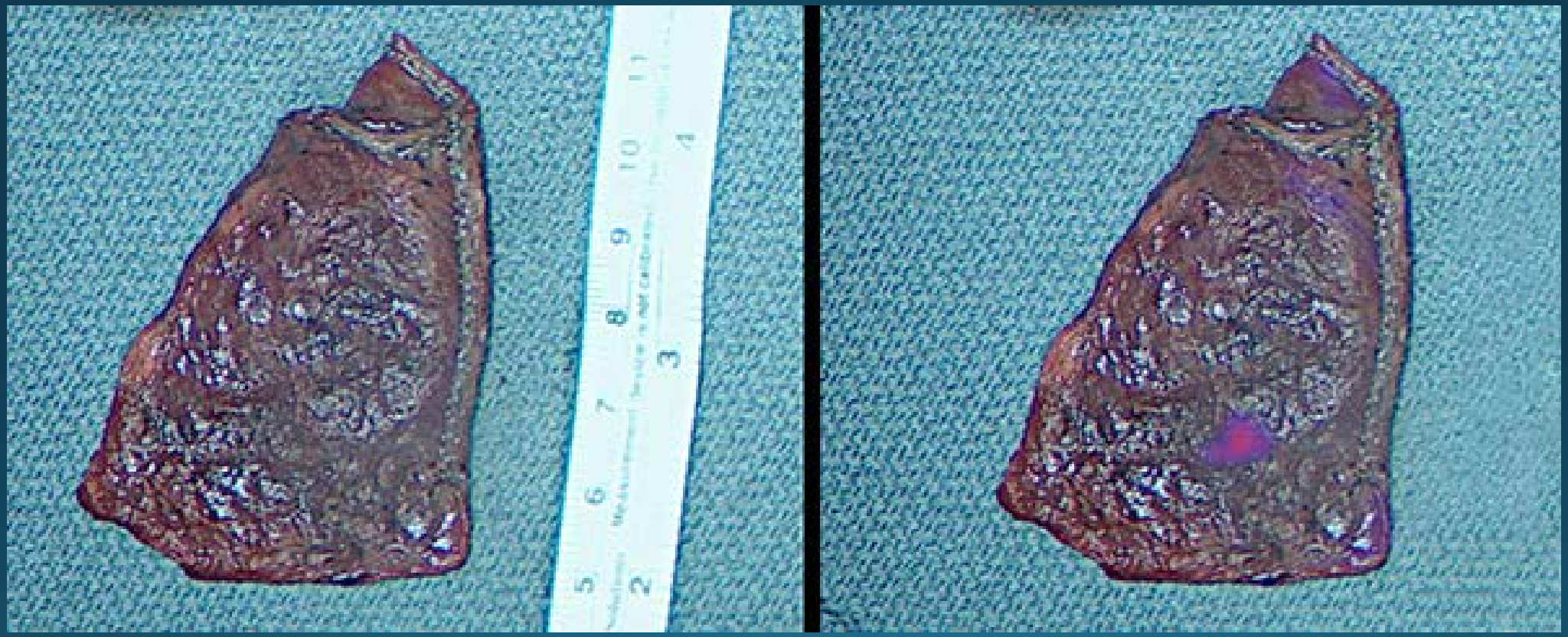


Better pretreatment staging including the avoidance of unnecessary surgery in 20% of patients

Molecular Imaging



Tumor Glow



Summary

- CT-scan and PET-CT have made pretreatment staging more accurate
- However, preoperative imaging might be quickly outdated
- Intraoperative “dynamic imaging” is the next step to allow for more precise surgery

Division of Thoracic Surgery
Abramson Cancer Center

the cure is within
ABRAMSON CANCER CENTER