



# *LUNG CANCER SURGICAL ASPECTS*

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# Lung Cancer

Lung cancer is the leading cause of cancer-related death in Europe and in the United States

Overall 5-year survival rates: 14%-15%

NSCLC comprises 80%-90% of lung cancers

More than 70% of patients present with advanced disease (stages IIIB or IV) at diagnosis that is considered to be incurable

Median survival is approx. 4-5 months

Chemotherapy extends life

QoL is an important consideration in determining value of treatment



# Pathology

## 1- small- cell carcinoma:

- accounts for 20% of all lung cancers
- aggressive tumor
- arise in cells derived from the embryonic neural cells
- usually occur near the hilum (centrally located)
- almost exclusive to smokers
- rarely amenable to surgery because of wide dissemination by the time of diagnosis
- 5 year survival less than 10%



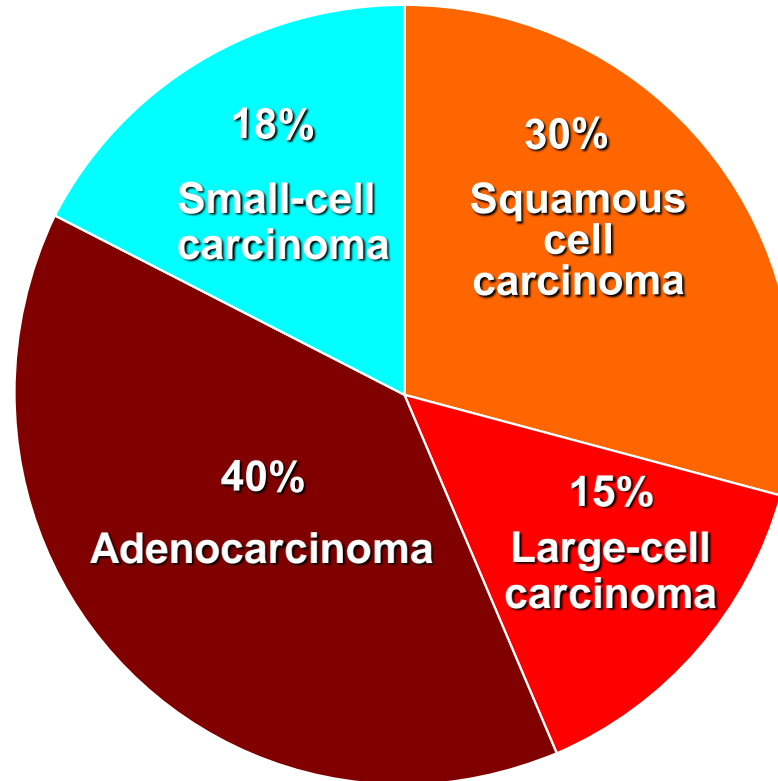
## 2- non-small-cell carcinoma:

- accounts for 80% of all lung cancers
- make up the vast majority of those treated by surgery
- three main subtypes:
  - \*adenocarcinoma 30-50%
  - \* squamous cell carcinoma 20-35%
  - \* large cell carcinoma 4-15%



# LUNG CANCER

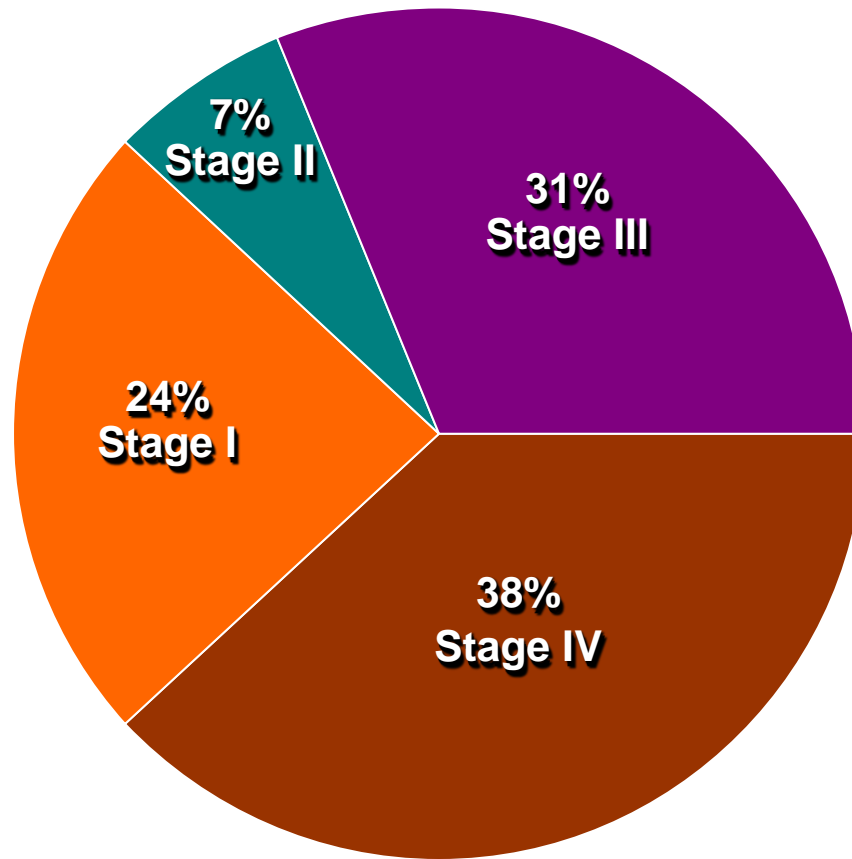
## Incidence of major histologic types





# NON-SMALL CELL LUNG CANCER

## Stages at presentation





# Presentation

- 1– bronchopulmonary symptoms
- 2– extra pulmonary thoracic symptoms
- 3– Para neoplastic syndrome
- 4– distant metastasis



# Presentation

## Symptoms/signs

Cough (80%)

Dyspnea (60%)

Pneumonia (post-obstructive)

Hemoptysis

Weight loss

Effusion

Advanced

Pancoasts/Superior Sulcus  
Syndrome

Horner's Syndrome

Hoarseness/Dysphagia

## Paraneoplastic Syndromes

More common with SCLC

Hypercalcemia

Ectopic PTH

Cushings

SIADH

Eaton Lambert

Hypertrophic

Osteoarthropathy





# LUNG CANCER Screening

- Early NCI trial in high-risk population
  - sputum cytology every 4 months
  - chest radiograph annually
  - Low dose CT Scan
  
- cancers identified in screened population were more often early-stage (40% versus 15% in unscreened)
- 5-year survival of 35% versus 13% in general population



# Radiographic presentation:

1-solitary pulmonary nodules

2- CT scan

3- positron emission tomography (PET) scanning

Tissue biopsy: the gold standard



# Work-Up for staging

- H&P
- Labs (CBC, KFT LFT)
- CxR - spiculated, non-calcified, notched
- CT chest/abd - assess adrenals and liver
  - (sensitivity/specificity  $\approx 65\%$ )
- PET scan (sensitivity/specificity  $\approx 90\%$ )
- MRI Brain for stage  $\geq$  IIb
- PFT's (cut-offs for surgery FEV1  $< 800$  ml, DLCO  $< 60\%$  predicted)
- Bronchoscopy
- CT guided needle biopsy
- Mediastinoscopy/otomy
- Thoracoscopy/otomy



# Pretreatment assessment: NSCLC

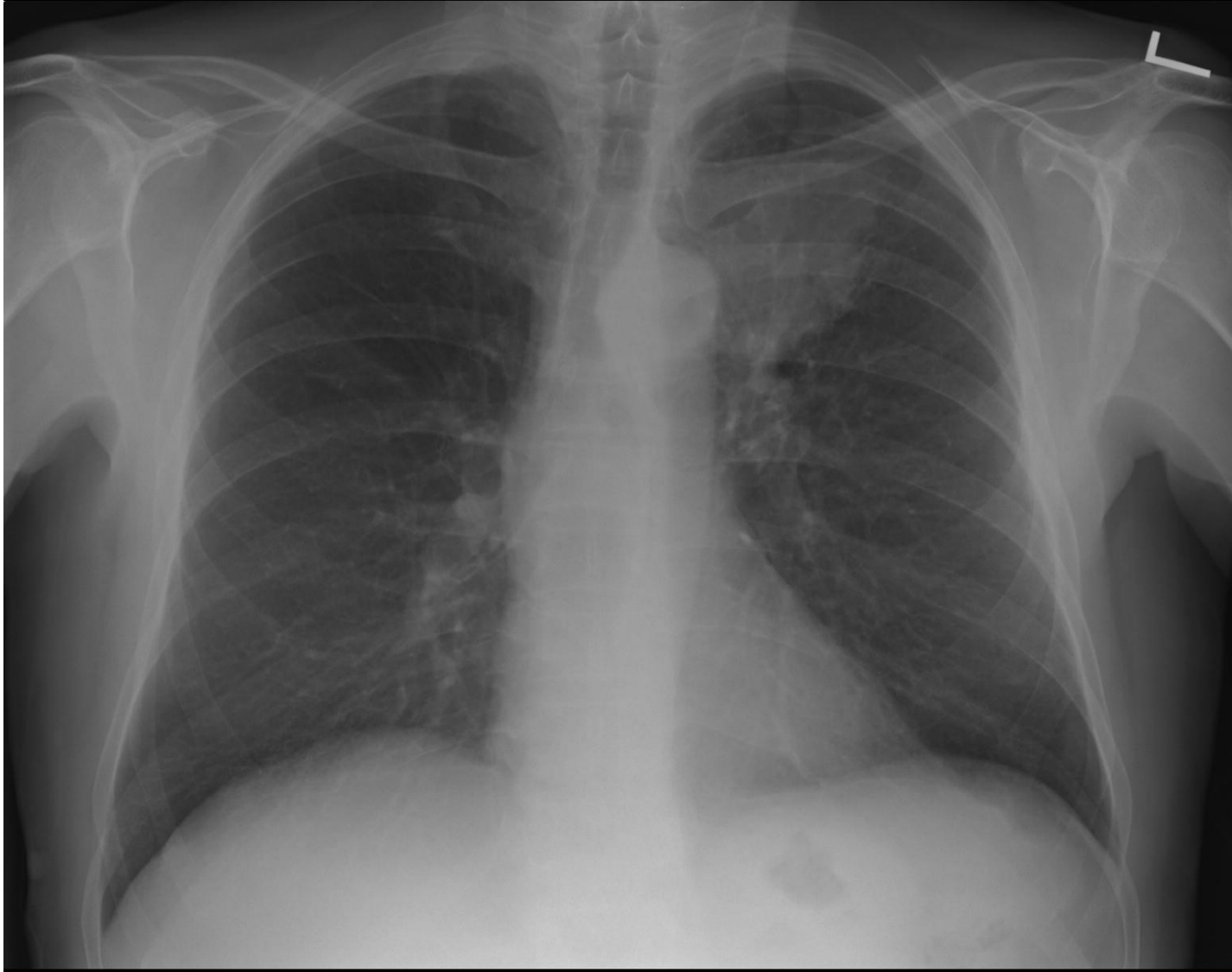
## Is the patient fit for resection ?

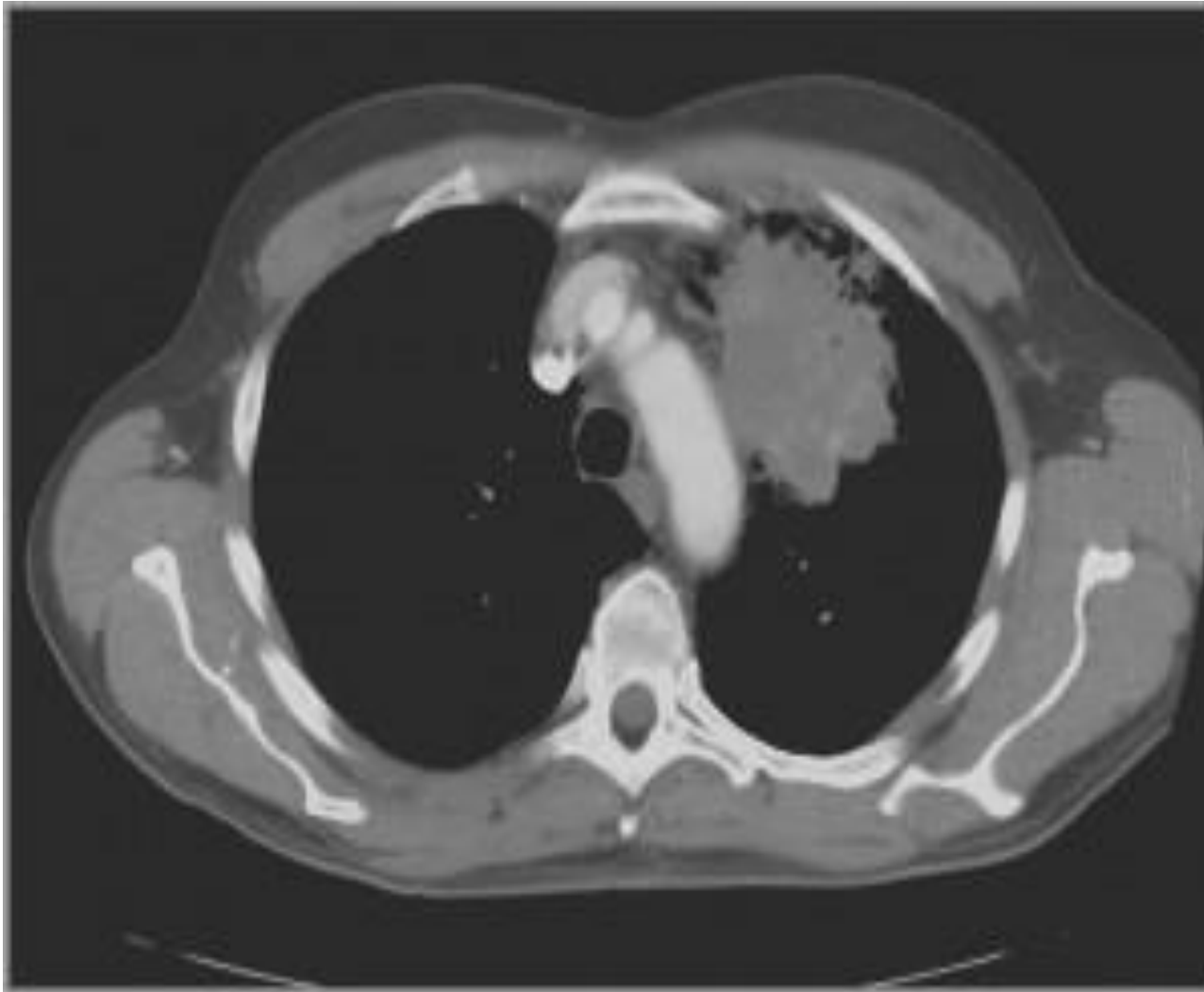
### ASSESSMENT OF EXTENSION

- Chest radiograph
- Fiberoptic bronchoscopy
- CT scan: Chest + Suprarenals
- Abdominal ultrasound
- ± brain MRI
- ± bone scintigraphy
- Lab : serum calcium+.....
- ± other exams → PET-scan if operable (if possible!)

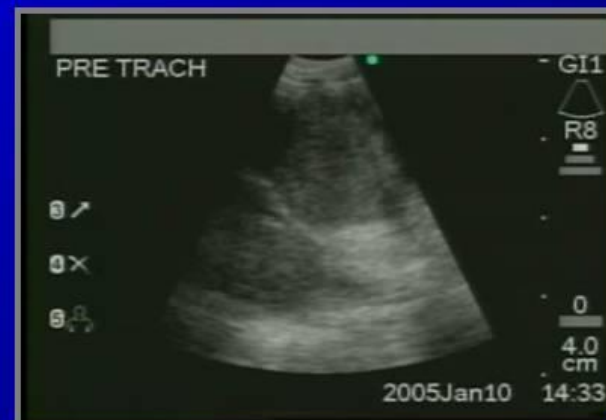
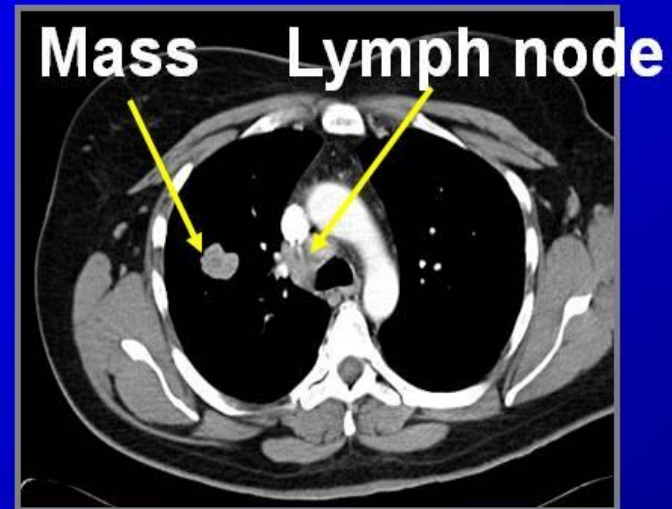
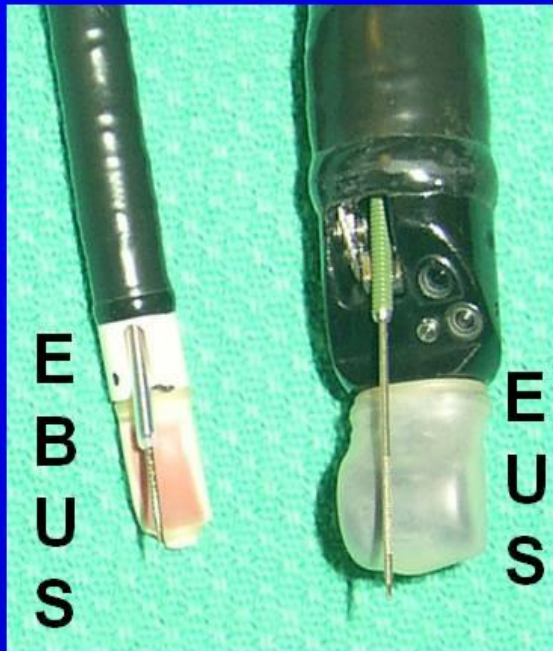
### ASSESSMENT OF RESECTABILITY

- Biological age
- General health status
- Associated diseases
- Pulm. Function test ± Blood gas analysis
- ± quantification by perfusion lung scintigraphy
- Goal : FEV1 post-op  $\geq$  1000 ml



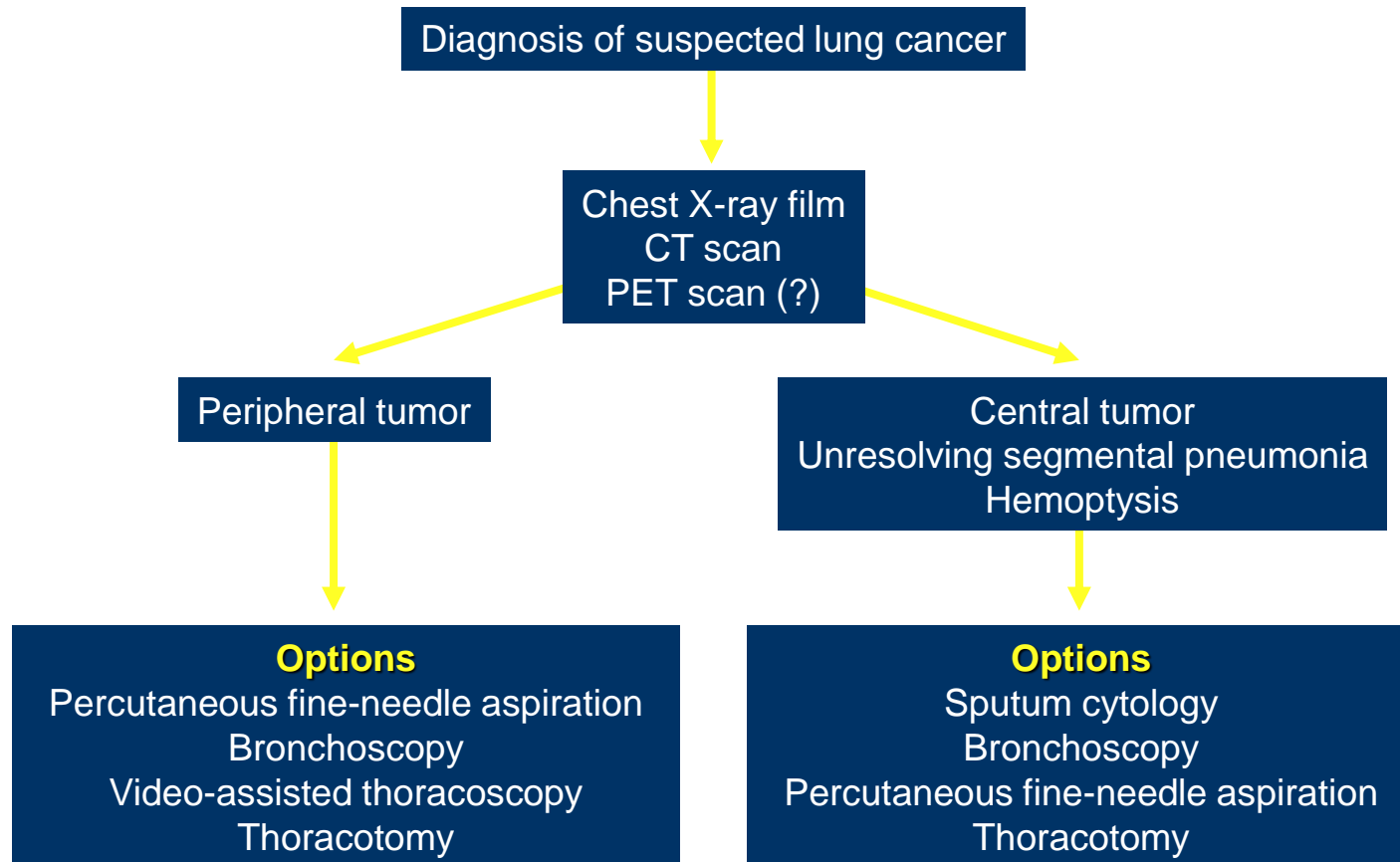


# Endobronchial Ultrasound (EBUS)





# LUNG CANCER Diagnosis







## **Histological classification is necessary for decision making**

A diagnosis of “non-small cell lung cancer”  
is no longer acceptable as sufficient basis for treatment  
decisions:

Histology will help guide decision about which molecular  
analysis is performed



# **Molecular classification: Present necessities and future directions**

Adenocarcinoma of the lung is not a uniform disease and needs to be classified by additional molecular analysis

Present needs include EGFR mutation status and determination of EML4-ALK fusion gene

Knowledge about resistance mechanisms to available agents and the opportunity of agents against new molecular targets mandate change in the trial design

Potential driver mutations are also being identified in squamous cell lung cancer



# TNM : classification by stage and prognosis

Stage	TNM	Survival at 1 year (%) : c-p	Survival at 5 years (%) : c-p
IA	T1 N0 M0	94-91	61-67
IB	T2 N0 M0	72-87	38-57
IIA	T1 N1 M0	79-89	34-55
IIB	T2 N1 M0	61-78	24-39
	T3 N0 M0	55-76	22-38
IIIA	T3 N1 M0	56-65	9-25
	T1-2-3 N2 M0	50-64	13-23
IIIB	T4 N0-1-2-3 M0	37	7
	T1-2-3 N3 M0	32	3
IV	All T all N M1	20	1

# Staging



- T1
  - $\leq 3$  cm
  - Surrounded by lung or visceral pleura
  - Limited to lobar bronchus
  
- T2
  - $> 3$  cm and  $< 7$  cm
  - Involves main bronchus
    - 2 cm or more distal to carina
  - Invades visceral pleura
  - Ass. with atelectasis or obstructive pneumonitis that extends to hilar region but does not involve the entire lung



# Staging

- T3:
  - >7 cm
  - Chest wall invasion (superior sulcus tumors)
  - Diaphragm
  - Mediastinal pleura
  - Parietal pleura
  - < 2 cm distal from carina (no carinal inv.)
  - Atelectasis or obstructive pneumonitis of the entire lung

Separate tumor nodules in same lobe T4 → T3

# Staging



- T4:
  - Invades mediastinum
  - Heart
  - Great vessels
  - Trachea
  - Esophagus
  - Vertebral body
  - Carina
  - Malignant pleural effusion
  
- A separate tumor nodules in a different lobe M1→T4

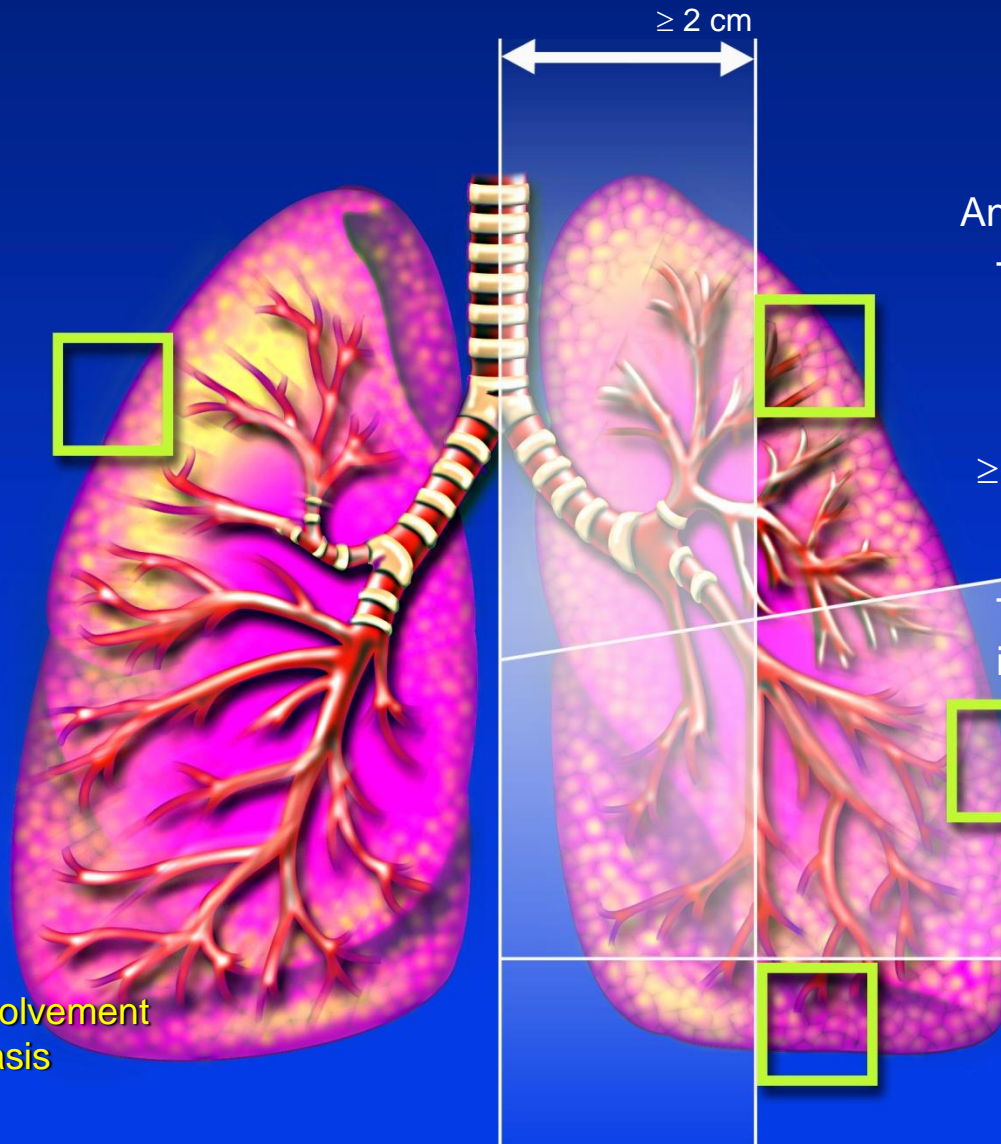
# NSCLC Stage I

Ia  
M0 N0 T1

$T \leq 3$  cm

No lobar  
bronchus  
involvement

N0: no lymph node involvement  
M0: no distant metastasis



Ib  
M0 N0 T2

Any of the following:

$T > 3$  cm

T = main bronchial  
involvement  
 $\geq 2$  cm distal to carina

T + visceral pleural  
involvement

T + distal atelectasis

# NSCLC Stage II

IIa  
M0 N1 T1

IIb  
M0 N1 T2

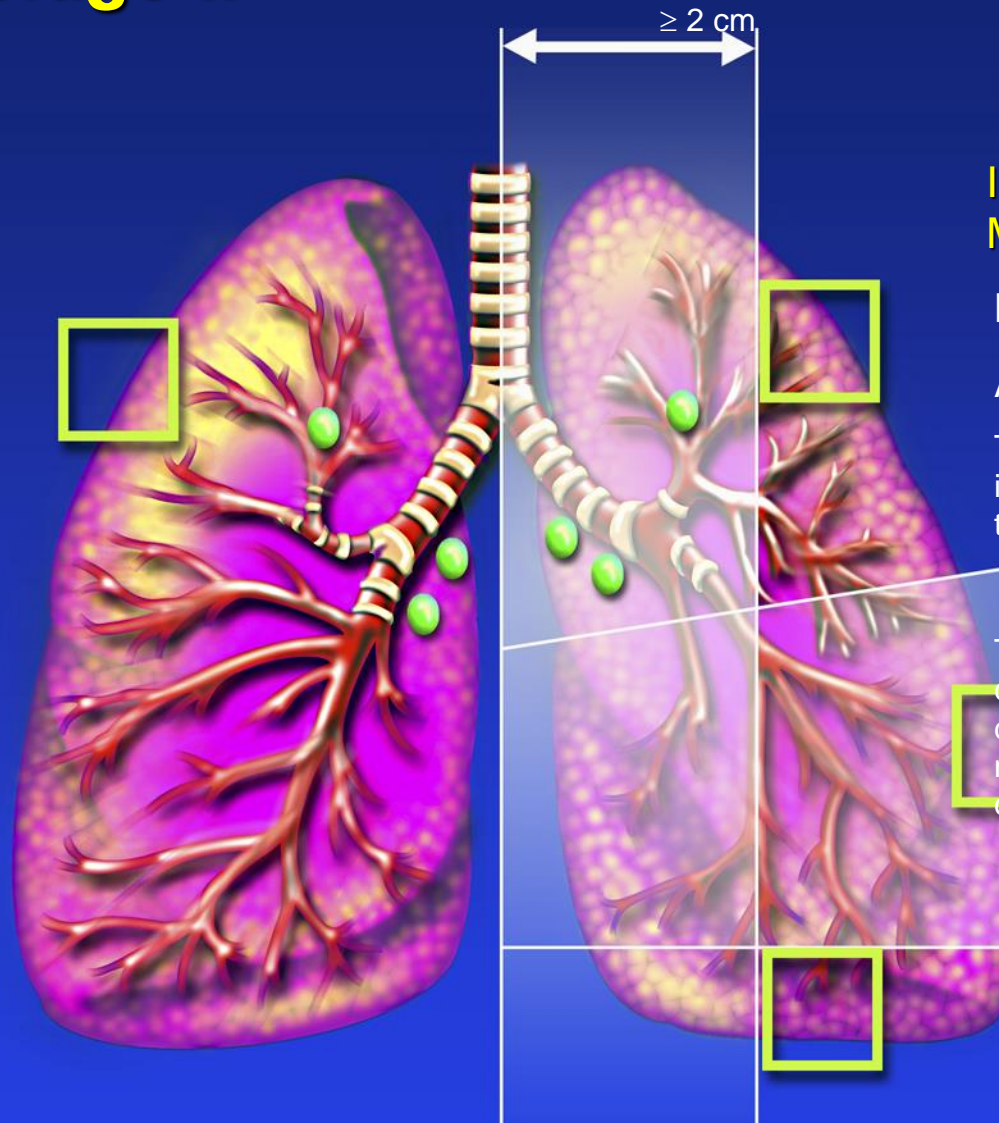
M0 N0 T3

Any of the following:

T+ main bronchial involvement < 2 cm distal to carina

T (any size) invading chest wall, diaphragm, mediastinal pleura, or pericardium

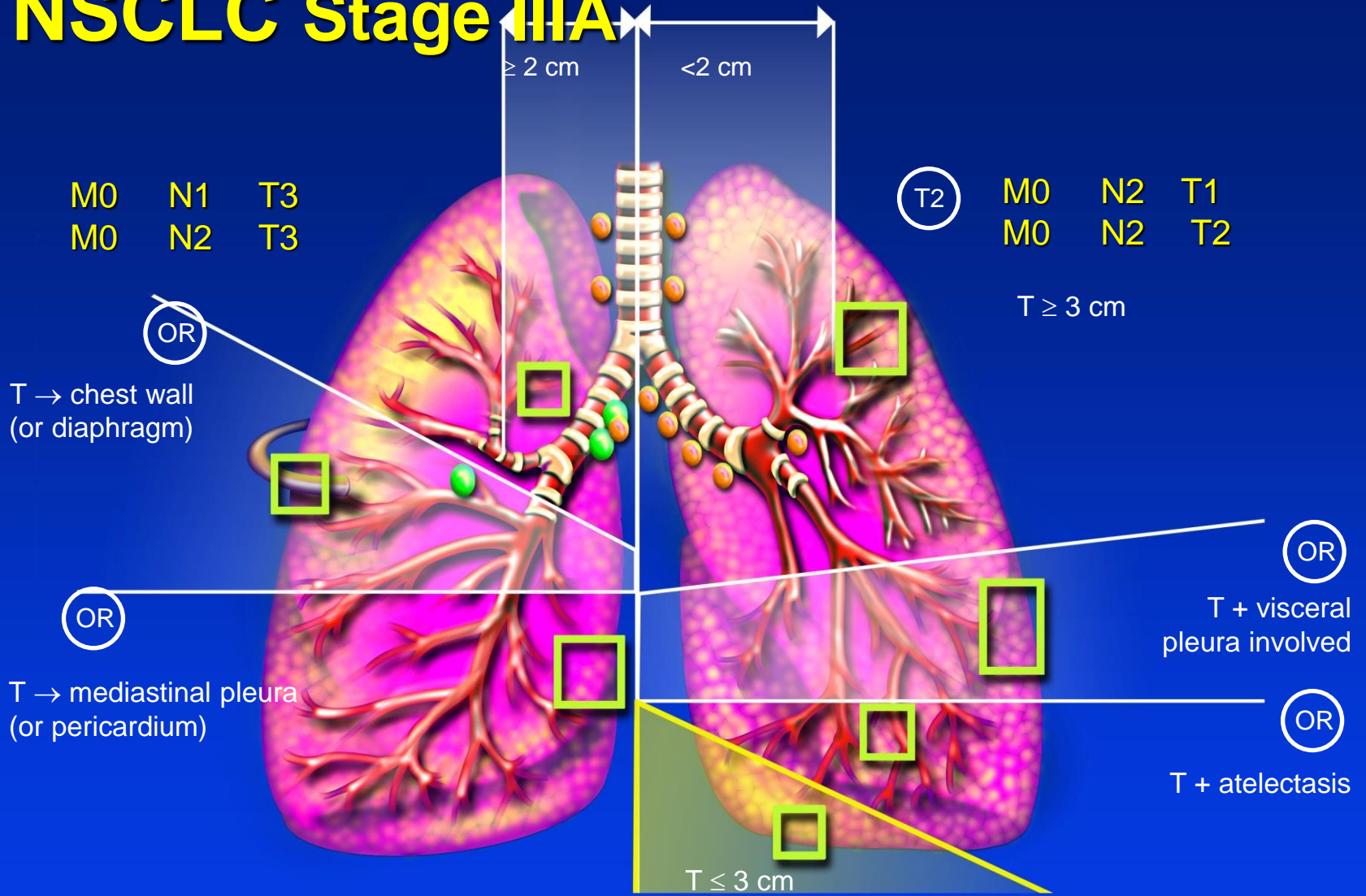
T + total atelectasis



● N1: ipsilateral peribronchial and/or ipsilateral hilar nodes involved  
M0: no distant metastasis



# NSCLC Stage IIIA



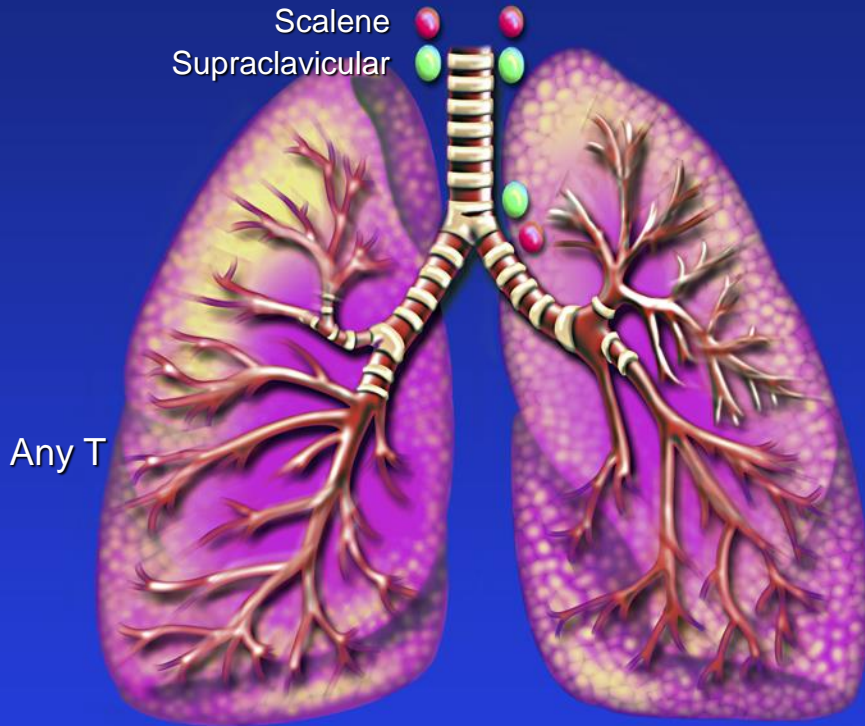
- N1: ipsilateral peribronchial and/or ipsilateral hilar nodes involved
- N2: ipsilateral mediastinal and/or subcarinal nodes involved
- M0: no distant metastasis

No lobar-bronchus involvement

# NSCLC Stage IIIB

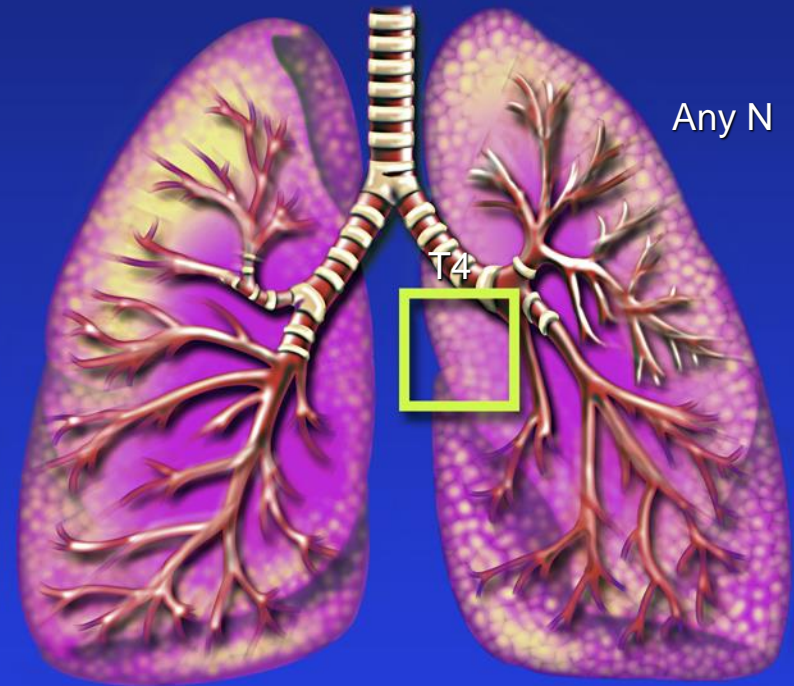
T4, Any N, M0

Scalene  
Supraclavicular



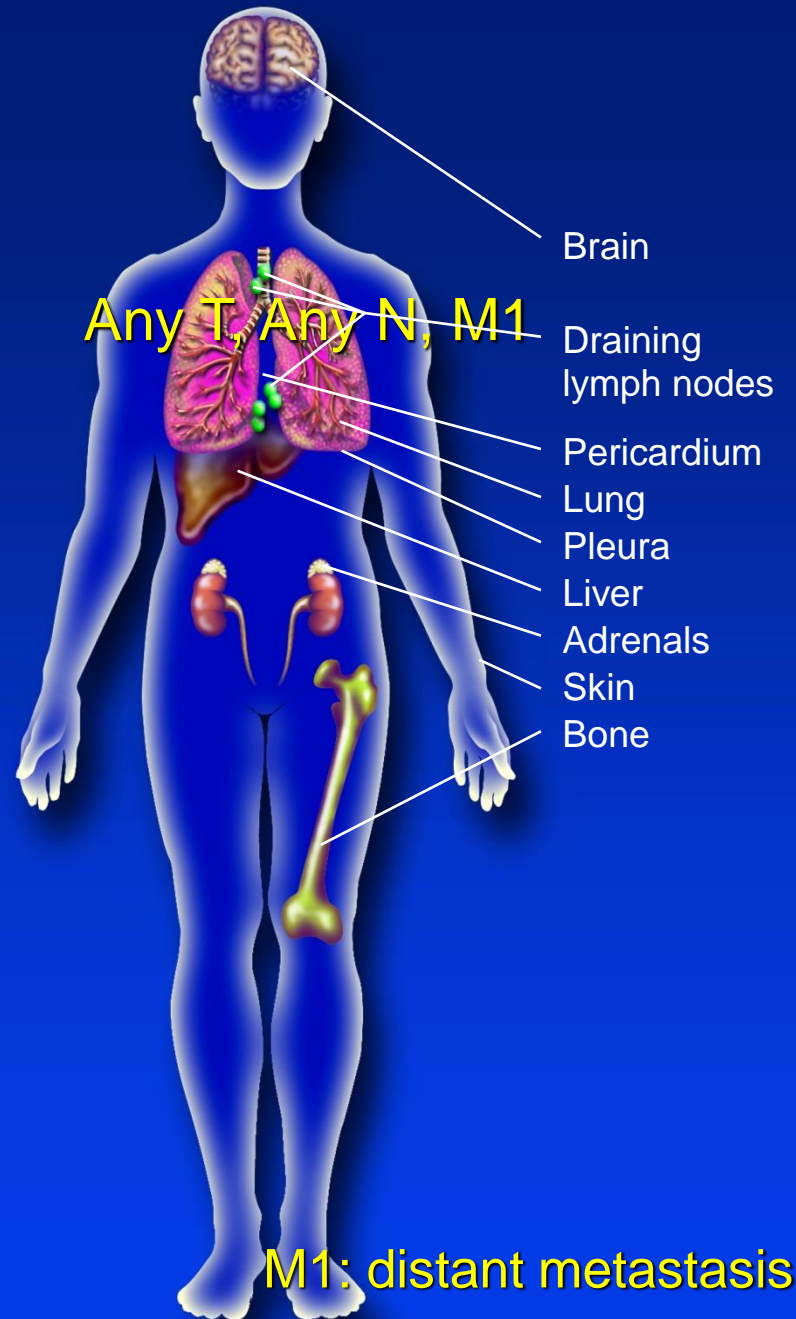
N3: contralateral mediastinal, contralateral hilar, ipsilateral, or contralateral scalene or supraclavicular nodes involved

Any T, N3, M0



T (any size) invading mediastinum, heart, great vessels, trachea, esophagus, vertebral body, or carina  
or T+ malignant pleural effusion

# NSCLC Stage IV





# TNM : classification by stage and prognosis

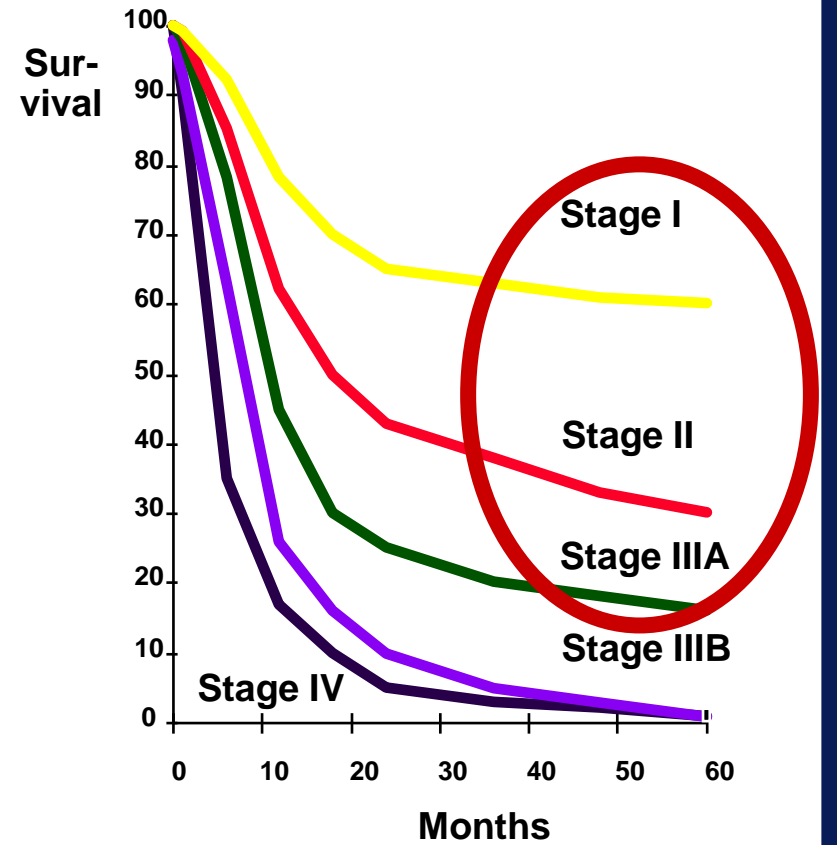
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# *How is Lung Cancer Treated?*

- Treatment depends on the stage and type of lung cancer
- Surgery
- Radiation therapy
- Chemotherapy (options include a combination of drugs)
- Targeted therapy
- Lung cancer is usually treated with a combination of therapies
- Multidisciplinary team plan for treatment

# First Choice of Therapy: Surgery





# Treatment Guidelines

- I
  - IA            T1N0
  - IB            T2N0
- Surgical resection:                            OS-5: 65-70%
  - Lobectomy + mediastinal nodal mapping
    - Adj chemo or RT not beneficial
- RT alone    OS-5: 30%
- Pt refuses surgery or medically inoperable



# Treatment Guidelines

- II
  - IIA      T1N1
  - IIB      T2N1,T3N0
- Surgical Resection      OS-5: 35-50%
  - Adjuvant CT prolongs OS
  - Adjuvant RT
    - Close or positive margins or ?pos. hilar nodes
- Definitive RT alone: same as stage I



# Stage III A: T3 N1 M0 T1, T2 N2 M0



T3N1M0: N1

- *Surgery alone in operable patients without bulky lymphadenopathy.*
- *Adjuvant chemotherapy.*
- *Chemo radiotherapy for patients who are not suitable for surgery.*

T1, T2 N2M0: N2

- *Preoperative chemotherapy is standard for resectable stage IIIA. In randomized trials the survival of stage IIIA patients was significantly better with induction chemotherapy plus surgical resection than with resection alone.*
- *Radiation therapy alone, for patients who are not suitable for neoadjuvant chemotherapy plus surgery.*
- *Platinum-based chemotherapy and thoracic radiotherapy is the standard treatment for medically inoperable stage IIIA NSCLC.*

# Survival After Resection for Stage I NSCLC



- Martini, et al 1995
  - 598 patients with stage 1 NSCLC
    - 291 T1 & 307 T2
    - 5 yr minimum follow up

	<i>stage T1 N0</i>	<i>stage T2 N0</i>	<i>p-value</i>
5-yr OS rate	82%	68%	0.004
10-yr OS rate	74%	60%	0.004



# LN Evaluation at Surgery

- Practice pattern for LN evaluation varies from visual inspection to radical lymphadenectomy
- 2 randomized trials (Izbicki; Sugi, 1998) found no difference in OS for lymphadenectomy vs sampling for early stage NSCLC
- Cochrane review of 11 randomized trials w/total of 1,910 pts w/ early stage NSCLC
  - @ 4 yrs, ↑ OS after resection + complete mediastinal LN dissection vs sampling



# Recommendations

*In patients undergoing resection for stage I and II NSCLC, it is recommended that intraoperative systematic mediastinal lymph node sampling or dissection be performed for accurate pathologic staging.*

*(not enough evidence to recommend one over the other)*



# Factors affecting survival

- **Tumor size**
- **Visceral pleura involvement** may be a significant prognostic factor in stage I.
- **The histological type of tumor** is a determinant of survival and time to recurrence in completely resected stage I patients, with worse results in nonsquamous histology tumors.
- Typically, in a Lung Cancer Study Group series, the 5-year survival for T1N0 patients
  - **83% for squamous carcinomas**
  - **69% for adenocarcinomas**



# Surgical goals

- To achieve complete resection of the primary tumor with no macroscopic tumor remaining and microscopically free margins.
- Only patients in whom a complete resection is anticipated are selected for surgery.
- These include patients with T1 to T4 and N0 to N1 tumors, and selected N2 patients



# Surgical Principles

- Whenever possible, the tumor and all intrapulmonary lymphatic drainage should be removed completely, most frequently by lobectomy or pneumonectomy.
- The tumor should not be disrupted during dissection to avoid spillage.
- In case of direct invasion of extrapulmonary structures, en bloc resection is the treatment of choice rather than discontinuous resection.



# Surgical Principles

- Resection margins should be checked with frozen
- Section analysis, including bronchial, vascular, and any other margins with close proximity to the tumor. If positive margins are encountered, wider excision should be performed when possible.
- All accessible mediastinal lymph node stations should be removed for pathological evaluation. These should be clearly identified by the surgeon and properly labeled.





# Intraoperative Strategy

- No structures are sacrificed until the final decision to resect is reached,
- Fundamental questions before proceeding to a resection
  - (1) Is the tumor resectable with a pneumonectomy?
  - (2) If a pneu- monectomy is feasible is it also justified by the extent of the disease?
  - (3) Can we then achieve complete resection with a lesser procedure?



# Thoracic curative resection

- Indication for type of surgical resection

## Pneumonectomy

- Central cancers with hilar or fissure involvement
- Peripheral cancers with extension across fissure and/or hilar or fissure lymph node metastases

## Lobectomy

- Simple, enlarged, bilobectomy
- Peripheral cancer N0 or N1

- Lymph node dissection : systematic

Hilar and mediastinal (*sampling* or systematic lymphadenectomy)

Intra and bronchopulmonary

Role of sentinel lymph node during evaluation



Possible extension of the resection (heart, diaphragm)

**Chest wall tumor resection** can be done if the cancer has invaded the surrounding tissue or the muscles and bones in front of the lungs. If needed, the surgeon can do a chest wall reconstruction using regional muscle and/or mesh to assist in repair of the area.



- **Sleeve Resection- Removal of part of the airway with or without the lobe of the lung and sewing the airway back together. This procedure is most commonly done to avoid removing the entire lung.**
- Thoracotomy (incision between the ribs),
- Thoracoscopy (using three small incisions and a video camera, also known as VATS), or using Robotic-assisted surgery.





	<b>Traditional</b>	<b>Minimally Invasive Surgery</b>
<b>Pain</b>	<b>Incisions and your patients' chest area may be painful for several weeks to months after surgery and sometimes longer</b>	<b>While pain in the hospital will still occur, it is usually less than that experienced with a thoracotomy**</b>
<b>Incision Size</b>	<b>One large incision 10-15 cm</b>	<b>One main incision 4-6 cm (usually 4.5 cm); multiple additional incisions, typically 2-4 cm</b>
<b>Anesthesia</b>	<b>General</b>	<b>General</b>
<b>Eligibility</b>	<b>Stages I-III A</b>	<b>Stages I-III A</b>
<b>Length of Hospital Stay</b>	<b>Up to 7 days</b>	<b>3-4 days</b>



# Procedures that help symptoms from Lung Cancer

- **Pleural catheter- Placement of a soft tube in the chest that allows drainage of Pleural effusion.**
- **Pleurodesis.**
- **Airway stenting.**
- **Laser or removal of airway tumor- A tumor within the airway can be partially removed using different techniques, including lasers, to improve breathing.**

# The Problems?



- 40- 60% of patients with radically resected NSCLC will develop distant metastases
- Cancer cells present in bone marrow of  $>30\%$  of resectable NSCLC patients
  - correlated with shorter survival

Can we eliminate micrometastases with additional chemotherapy?



# ***Targeted Agents For Treatment of NSCLC With Demonstrated Activity***



- Angiogenesis (VEGF) inhibitors
  - Bevacizumab (Avastin™)
- EGFR inhibitors
  - Gefitinib (Iressa®)
  - Erlotinib (Tarceva™)
  - Cetuximab (Erbitux™)
- EGFR + VEGF inhibitor
  - ZD6474
- Proteasome inhibitor
  - Bortezomib (Velcade™)



# PANCOAST TUMOR

- Definition: Lung tumor localized in the pulmonary apex with invasion of pleural and adjacent structures. It has clear symptoms and signs.





# PANCOAST TUMOR Challenge

- Technical point of view: anatomical structures.
- Oncological point of view: High rate of local recurrences and distant progression



# ***SURGERY***

## ***Approach***

- Thoracic approach:
  
- Cervical approach:

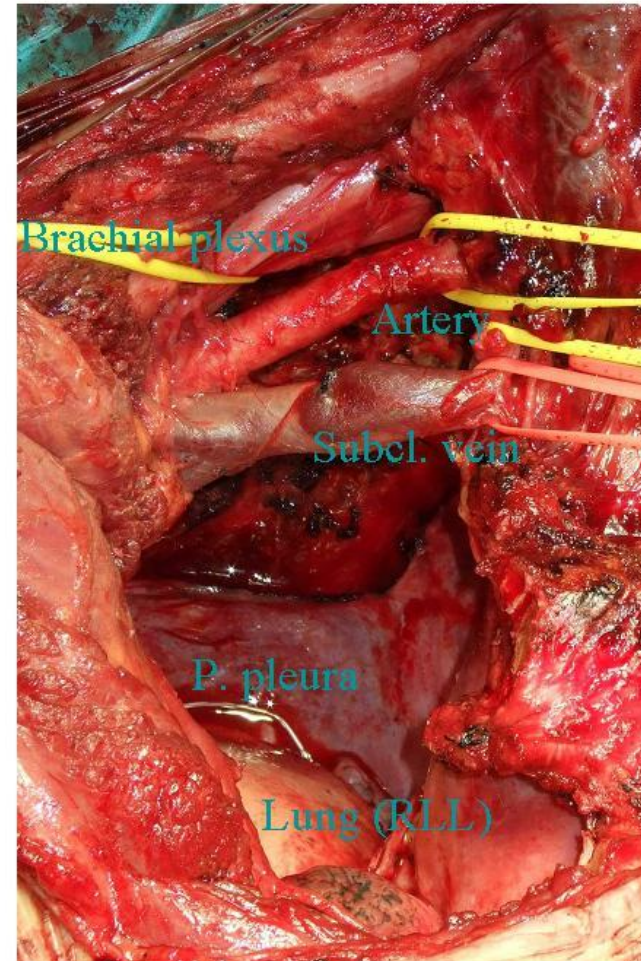
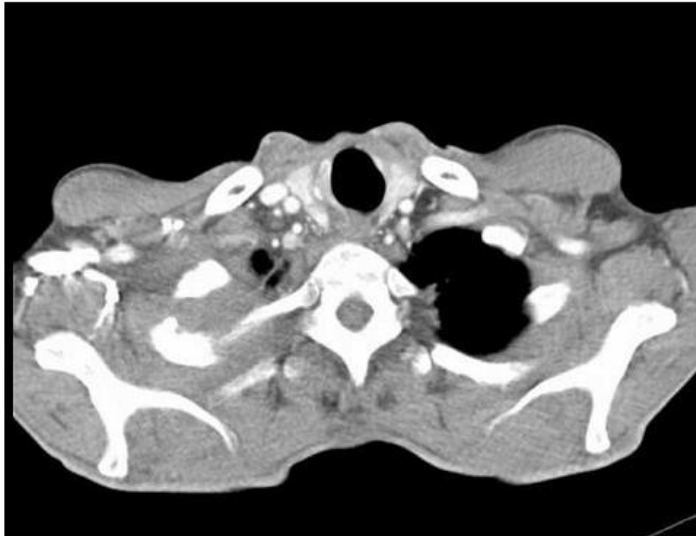
# PANCOAST TUMOR SURGERY



- Anterior trans-cervical approach (Dartevelle)



# PANCOAST TUMOR SURGERY





# PANCOAST TUMOR SURGERY

- Management: **Concurrent CRT**
  - Contraindications for surgery
    - Extensive invasion of the brachial plexus, subclavian artery, and vertebral bodies
      - Pancoast's tumors may produce Horner's syndrome as a result of the involvement of the satellite ganglia or vertebral bodies with or without extension of the tumor into the foramen
      - Horner's syndrome is a contraindication
    - Mediastinal involvement
    - Venous obstruction
    - Distant metastasis



# PANCOAST TUMOR



- Historically, pts given pre-op RT followed by exploratory thoracotomy and resection
- If mediastinoscopy shows LN-, thoracotomy with complete surgical resection if possible
- If unresectable, consider aggressive management with CRT



**THANK YOU**