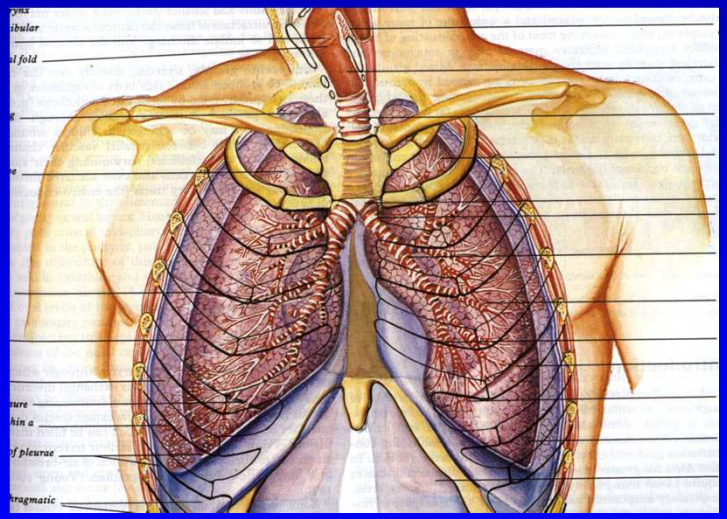
# Current Status of Surgical Management of NSC Lung Cancer



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# Greetings

All India Institute of Medical Sciences

New Delhi, India

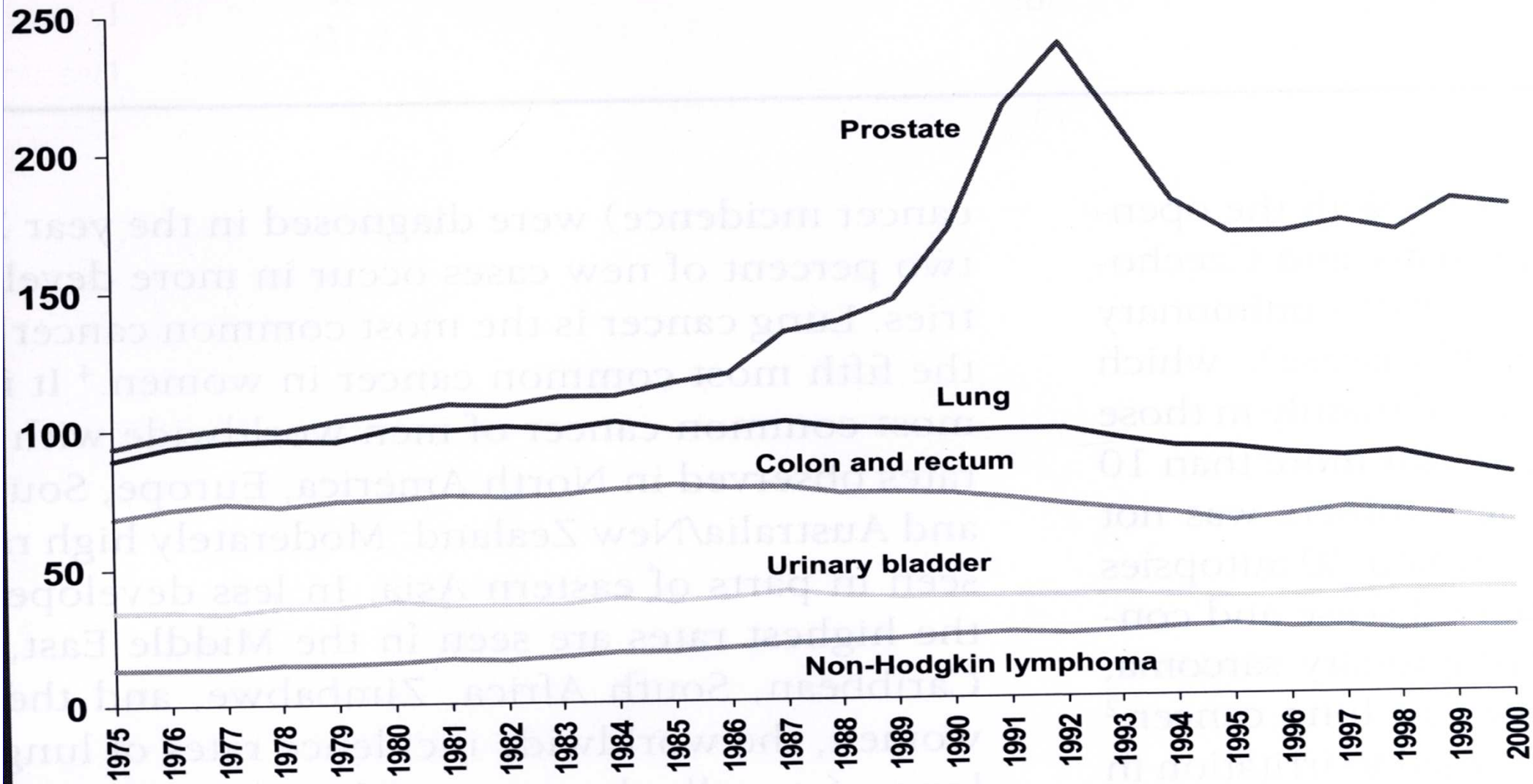
# Lung Cancer : Surgery

- Incidence
- Workup
- Staging
- Pre-op assessment
- Pre-op Preparation
- Surgery
- Post-op management
- Survival

# Lung Cancer
# The magnitude of problem

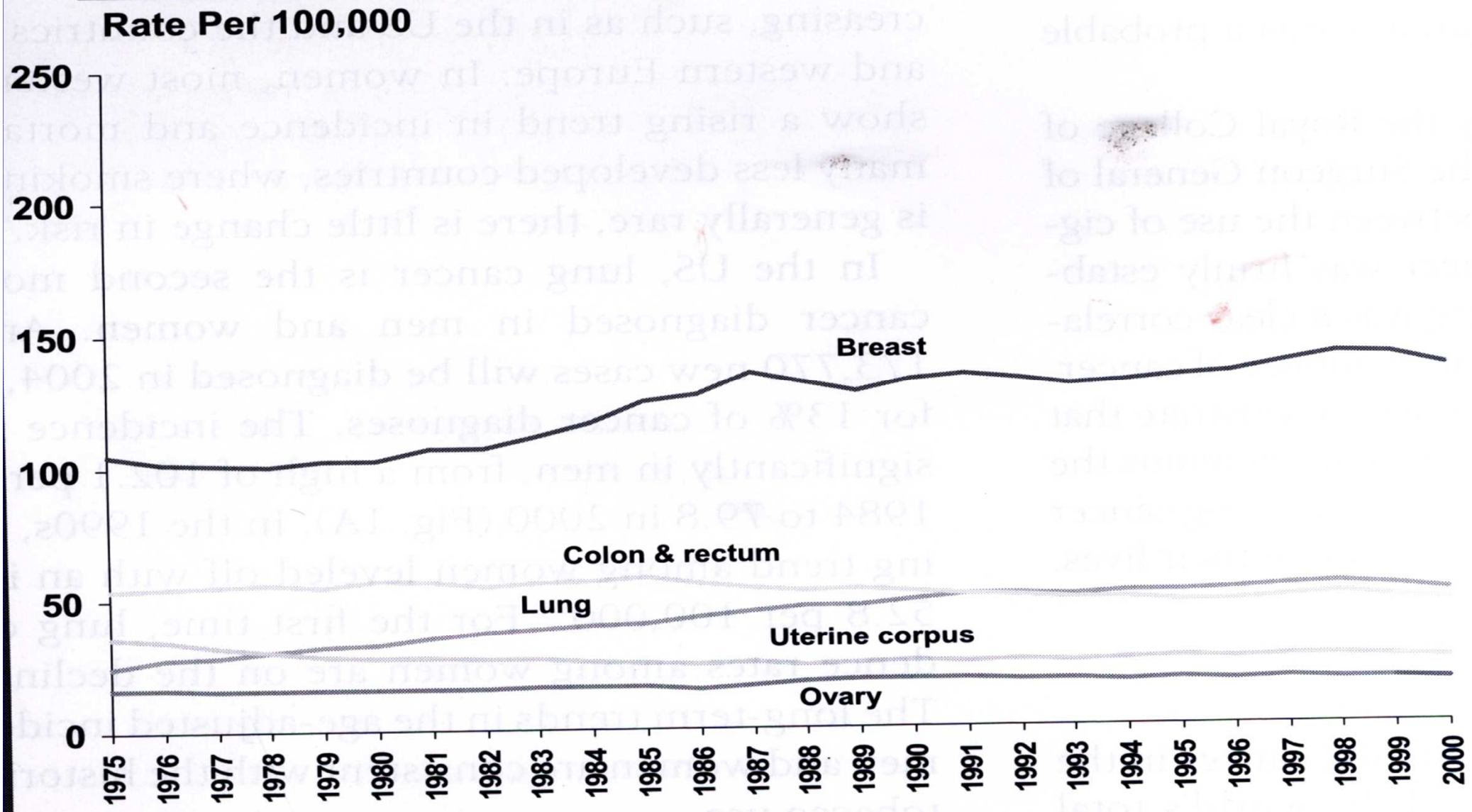
- Leading cause of cancer related mortality worldwide
- Incidence among US males / US females
- Incidence among Asians : Males / Females
- Indian Data

# Cancer Incidence Rates* for Men, US, 1975-2000




*Age-adjusted to the 2000 US standard population.
Source: Surveillance, Epidemiology, and End Results Program, 1975-2000, Division of Cancer Control and Population Sciences, National Cancer Institute, 2003.

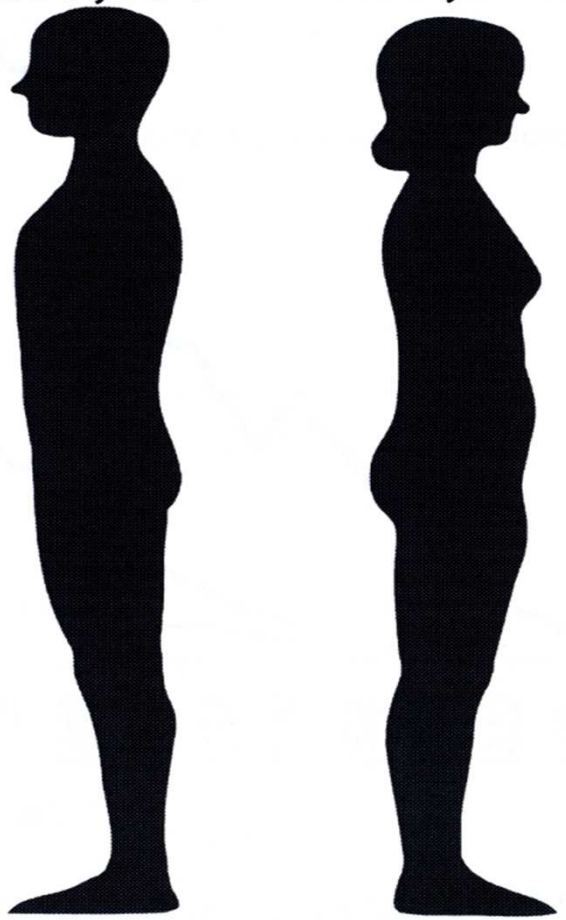
# Cancer Incidence Rates* for Women, US, 1975-2000




*Age-adjusted to the 2000 US standard population.
Source: Surveillance, Epidemiology, and End Results Program, 1975-2000, Division of Cancer Control and Population Sciences, National Cancer Institute, 2003.

# 2004 Estimated US Cancer Deaths*

| Men 290,890 | | Women 272,810 | |
|---|---|---|---|
| Lung & bronchus | 32% | 25% | Lung & bronchus |
| Prostate | 10% | 15% | Breast |
| Colon & rectum | 10% | 10% | Colon & rectum |
| Pancreas | 5% | 6% | Ovary |
| Leukemia | 5% | 6% | Pancreas |
| Non-Hodgkin lymphoma | 4% | 4% | Leukemia |
| Esophagus | 4% | 3% | Non-Hodgkin lymphoma |
| Liver & intrahepatic bile duct | 3% | 3% | Uterine corpus |
| Urinary bladder | 3% | 2% | Multiple myeloma |
| Kidney | 3% | 2% | Brain/ONS |
| All other sites | 21% | 24% | All other sites |



**ONS=Other nervous system.**
**Source: American Cancer Society, 2004.**

# Lung Cancer
# The magnitude of problem

## Future Scenario

- Tobacco industry : Asian Females
- No discussion of the Tobacco Industry today is complete without addressing what may be the most important feature on the landscape – the Female Asian market.

# Workup in Lung Cancer

- Step 1- Presumptive Dx
  Presumptive Cell type
  (SCLC vs NSCLC)
  Presumptive stage
  (clinical evaluation, risk factors, CT findings)

- Step 2- Confirmation of Dx / Cell type
  Confirmation of Stage
  ( Radiology & **invasive tests** )

- Step 3- Treatment

# Lung Cancer

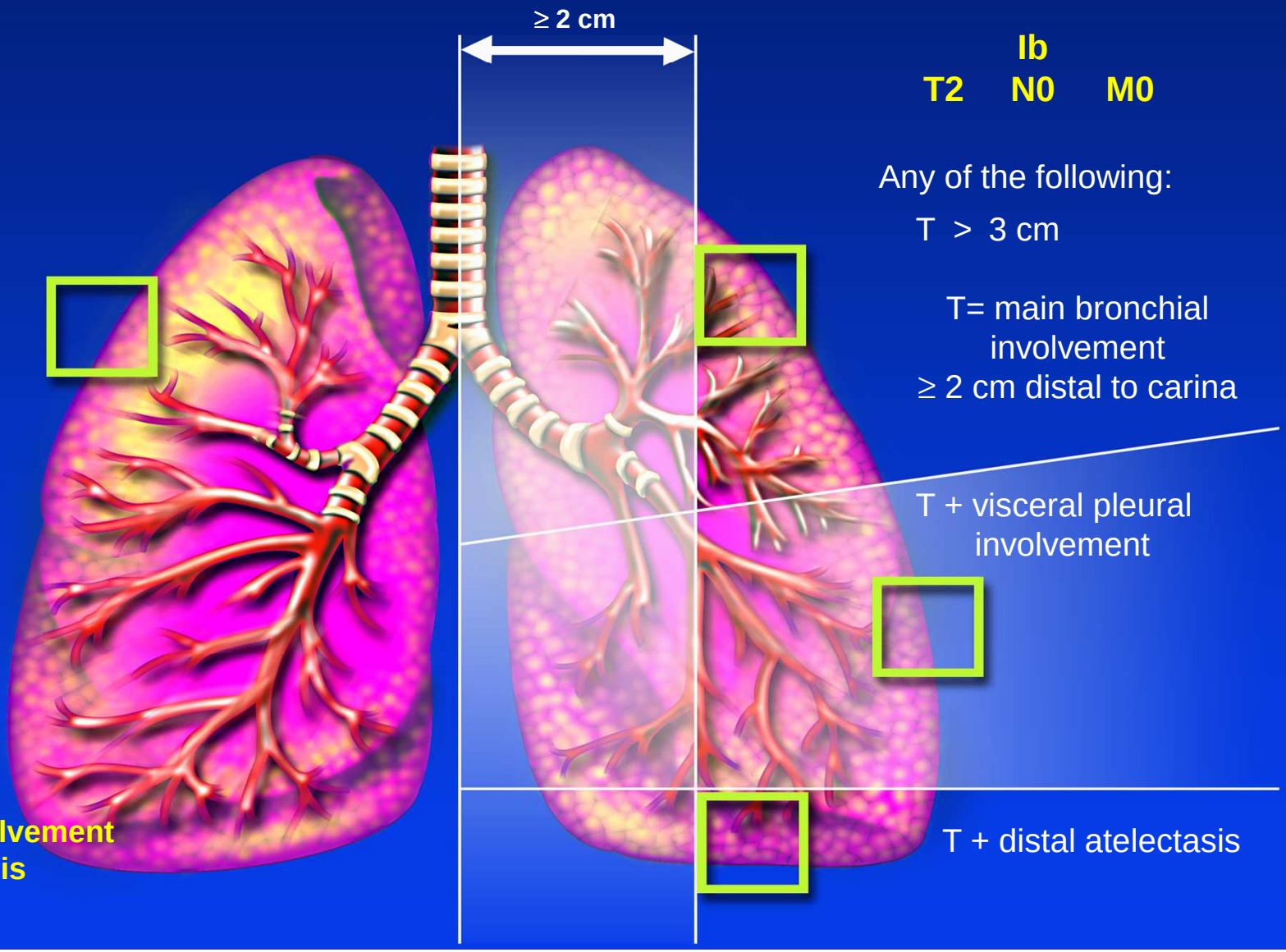
**Staging**

# NSCLC: Stage I

**Ia**
**T1 N0 M0**

T ≤ 3 cm

No lobar bronchus involvement




**Ib**
**T2 N0 M0**

Any of the following:

T > 3 cm

T= main bronchial involvement
≥ 2 cm distal to carina

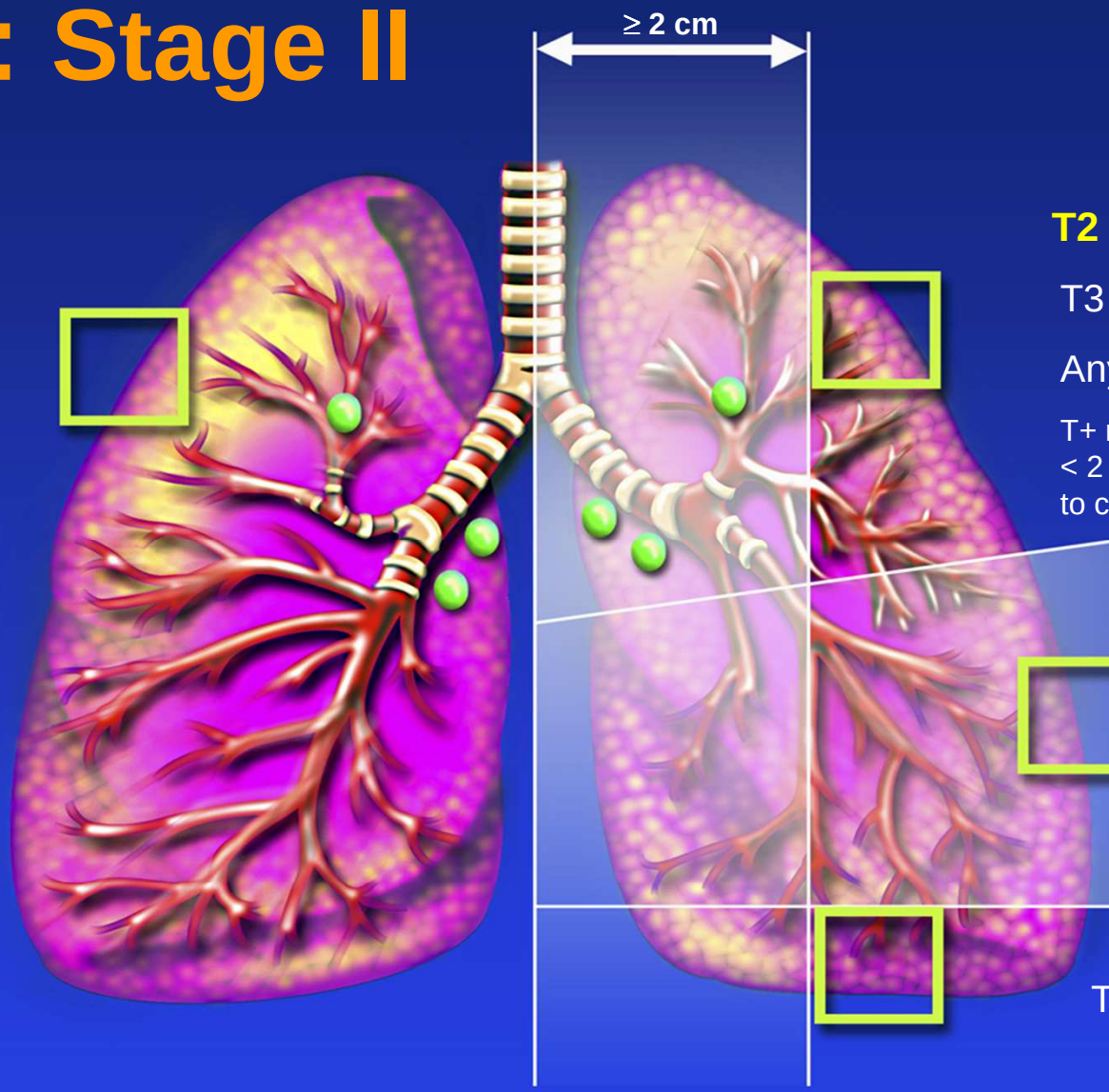
T + visceral pleural involvement

T + distal atelectasis

**N0: no lymph node involvement**
**M0: no distant metastasis**

# NSCLC: Stage II

**IIa**
**T1 N1 M0**




**IIb**
**T2 N1 M0**

T3 N0 M0

Any of the following:

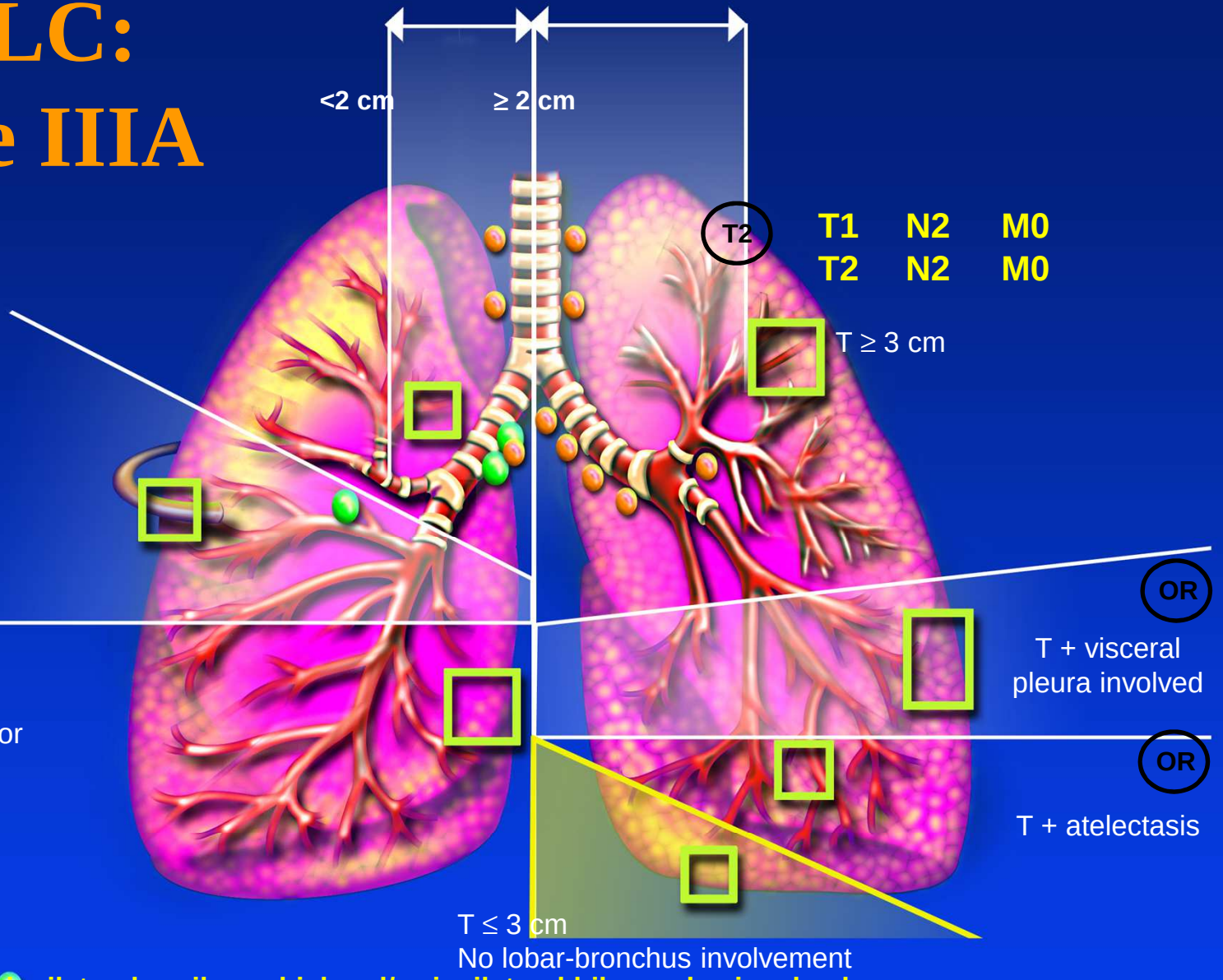
T+ main bronchial involvement
< 2 cm distal
to carina

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




**T3 N1 M0**
**T3 N2 M0**

OR

T → chest wall (or diaphragm)

OR

T → mediastinal pleura (or pericardium)

**T1 N2 M0**
**T2 N2 M0**

OR

T + visceral pleura involved

OR

T + atelectasis

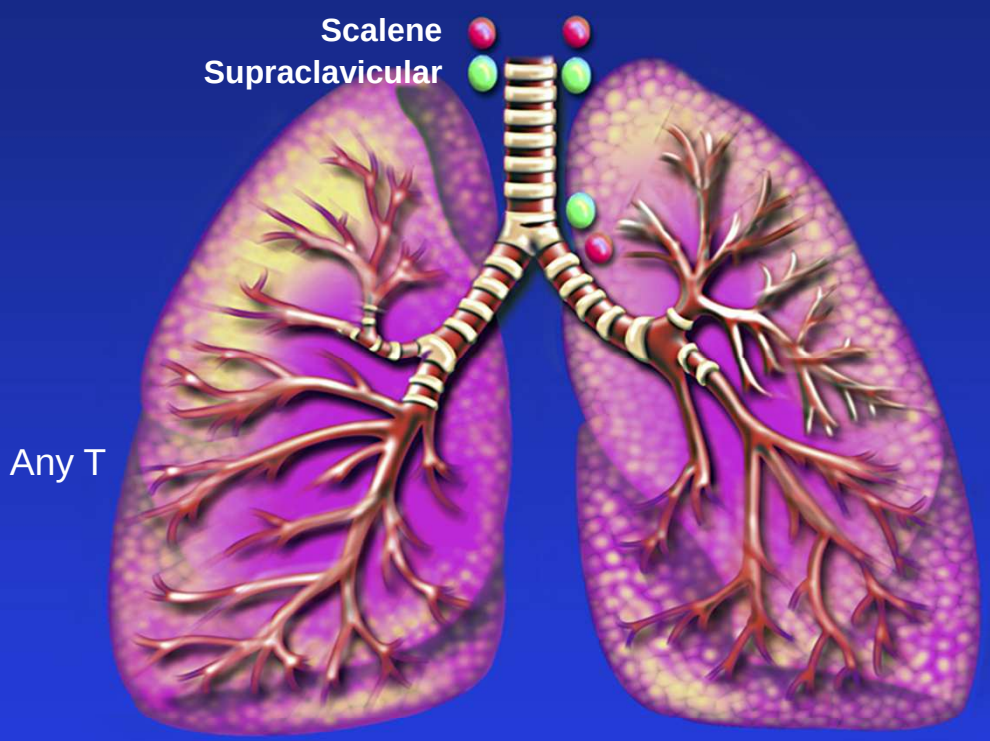
**N1: Ipsilateral peribronchial and/or ipsilateral hilar nodes involved**

**N2: Ipsilateral mediastinal and/or subcarinal nodes involved**

**M0: no distant metastasis**

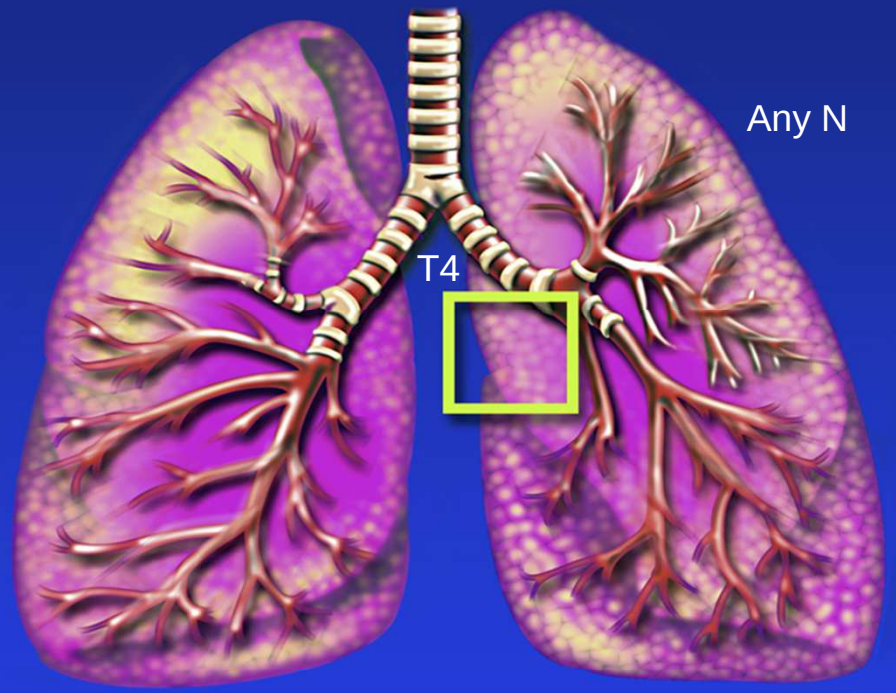
# NSCLC :Stage IIIB

**Any T, N3, M0**




**N3: contralateral mediastinal, contralateral hilar, ipsilateral, or contralateral scaline or supraclavicular nodes involved**

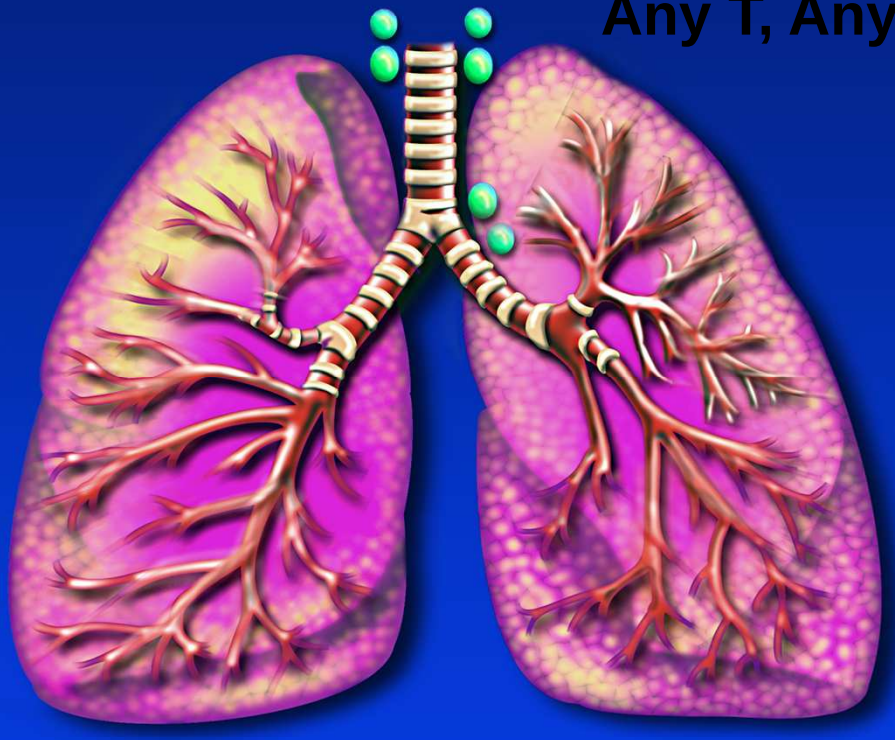
**T4, Any N, M0**

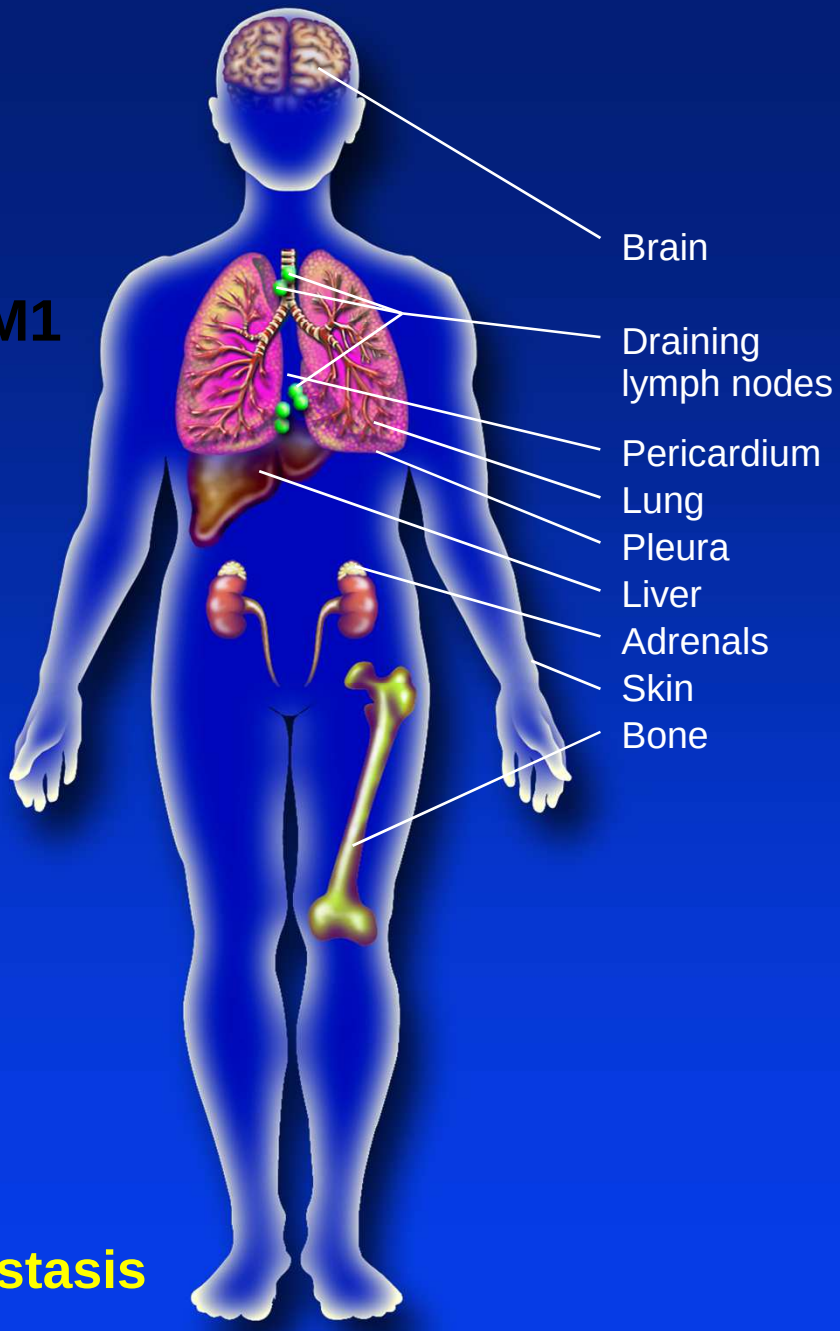



**T (any size) invading mediastinum, heart, great vessels, trachea, esophagus, vertebral body, or carina**
**or T+ malignant pleural effusion**

# NSCLC: Stage IV

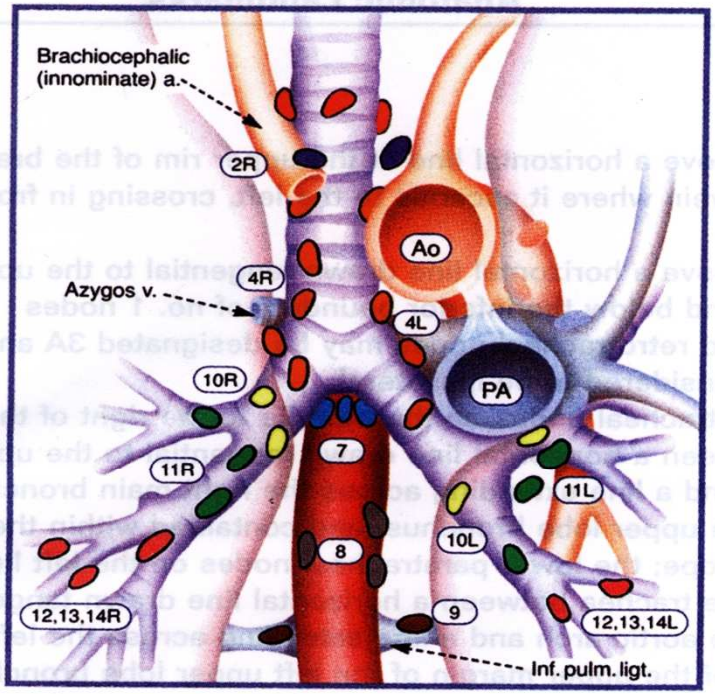
**Any T, Any N, M1**

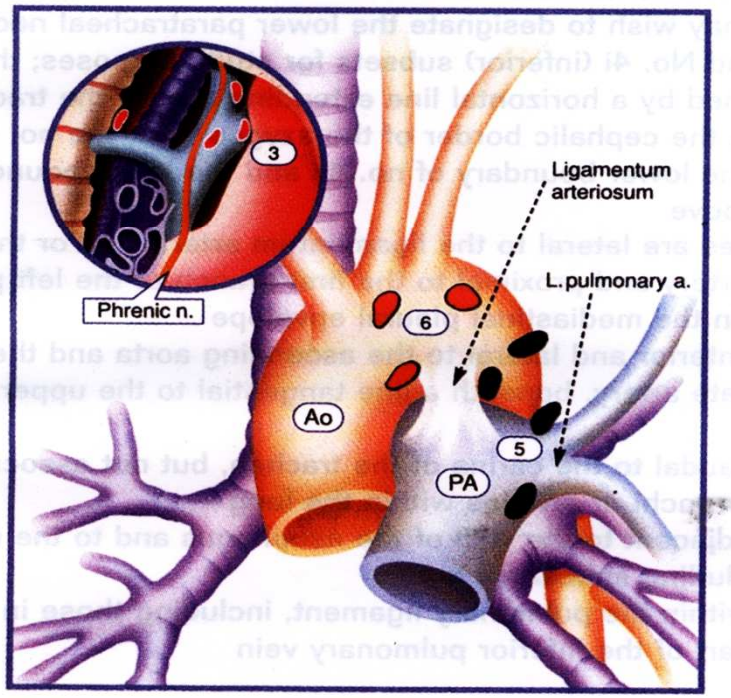





**M1: distant metastasis**

Mountain CF. *Chest.* 1997;111:1710-1717.




## Superior Mediastinal Nodes

- **1** Highest Mediastinal
- **2** Upper Paratracheal
- **3** Pre-vascular and Retrotracheal
- **4** Lower Paratracheal (including Azygos Nodes)

$N_2$ = single digit, ipsilateral
$N_3$ = single digit, contralateral or supraclavicular

## Aortic Nodes

- **5** Subaortic (A-P window)
- **6** Para-aortic (ascending aorta or phrenic)

## Inferior Mediastinal Nodes

- **7** Subcarinal
- **8** Paraesophageal (below carina)
- **9** Pulmonary Ligament

## $N_1$ Nodes

- **10** Hilar
- **11** Interlobar
- **12** Lobar
- **13** Segmental
- **14** Subsegmental

# What is Accurate Staging

Clinical Stage

Vs

Pathological Stage

# Clinical Stage vs Pathological Stage

Lymph Node Status

- Clinical N0 - 62% N0
  38% up-stage
- Clinical N1 - 40% N1
  30% False +ve (CT scan)
  30% False –ve (CT scan)
- Clinical N2 – 30% N2
  > 50% False +ve (CT scan)

**(Hans Hoffmann. Lung Cancer 2001;34:S3-S5)**

# Lung Cancer
# Staging

## Why is it necessary ?

- Determines Rx
- Determines Prognosis
- Prerequisite for the development and modification of Rx Strategies
- Comparing of results

Accurate Staging is vital to avoid unnecessary Surgery

# Lung Cancer Staging

## Non Invasive

- CT Scan
- MRI
- PET Scan
- TBNA
- TTNA
- EUS-NA

## Invasive

- Mediastinoscopy
- Thoracoscopy
- Sentinel LN Mapping

# Lung Cancer Staging : Non invasive

## CT Scan

- Chest wall, Mediastinal structures, Pulm. Vessels : Infiltration vs contact
- Pleural nodules
- L.N. : Size Criteria, >1 cm : abnormal

  Enlargement vs involvement
- Para esoph., Pulm. Lig.
- Includes upper abd. : Liver / adrenal : 3-5 %

**Always done, guide to biopsy confirmation of LN**

# Lung Cancer Staging : Non invasive
# **MRI**

- No additional advantage over CT except :
  - Pancoast tumors
  - ? Chest wall
- Not recommended as routine

# Lung Cancer Staging : Non invasive
# TBNA

## Bronchoscopy with TBNA

- Positive aspirate from TBNA obviates the need for further staging
- Pooled data :
  - Sensitivity - 76%
  - Specificity - 96%
  - NPV - 71%

Toloza et al, Chest 2003; 123 ; 157-166

# Lung Cancer Staging : Non invasive
# EUS-NA

- Excellent modality for evaluation of  Med. LN as well as primary tumor
- Accesses sites not accessible to C.M.
- Evaluation for T4 also possible
- Biopsy from L.N.
- Local anaesthesia

# Lung Cancer Staging : Non invasive
# EUS-NA

- 107 pts. : Resectable NSCLC :
- EUS – CM – thoracotomy if CM negative
- EUS + CM : 36% LN positive
- EUS : 28%
- CM : 20%

Thus, 16% of thoracotomies could have been avoided by using EUS with CM

**Annema et al, JAMA 2005: 294 ; 931-36**

# Lung Cancer Staging : Non invasive
# EUS-NA

EUS NA when added to CM, improves the preop.Staging of lung cancer due to complementary reach of EUS in determining LN metastasis and the ability to assess mediastinal tumor invasion (T4)

Annema et al, JAMA 2005: 294 ; 931-36

Larsen et al, Lung Cancer 2005 May 27

# Lung Cancer Staging : Non invasive
# PET Scan

- PET – CT fusion scan
- T : superior in diagnostic accuracy for T staging and differentiation between tumor and peritumoral atelectasis
- N : very effective for Mediastinal nodal staging. Assists mediastinoscopy to reveal additional disease in 6% of patients.
- M : detects unexpected extrathoracic metastases in 10-20% of patients and changes therapeutic management in about 20% of patients. , **NOT good for Brain mets.**

# Lung Cancer Staging : Non invasive
# PET Scan

- High accuracy in distinguishing recurrent disease from benign treatment effects.

- Although not all tumors take up FDG, other radiotracers are being studied to expand the utility of PET-CT : DOTATOC Scan

**The standard imaging modality for staging patients with lung cancer.**

-

# Lung Cancer Staging : Non invasive
# PET Scan

- Inflammatory disease
- Infectious disease

**Tuberculosis**

**Gilman et al, seminars in Roentgenology , 2005**

**Steinert HC. Chang Gung Med J. 2005 May;28(5):296-305.**

# Lung Cancer Staging : Invasive
# C. M.

- Excellent modality for Mediastinal exploration
- Routine vs **selective**
- < 1 cm on CT : No CM
- > 1 cm : CM in all
- Sensitivity : 81%
- NPV : 91%

# Lung Cancer Staging : Invasive
# VATS

- Direct Visualisation : Tumor / LN / Pleura
- Tools :
  - Ultrasound
  - FNAC /  Biopsy
  - Wedge resection

# Role of VATS in Lung Cancer

- Tumor - Contact / Compression / Invasion of Hilar or Mediastinal structures
- Staging- Bx of all LN stations (except 1,12-14)
- Discover- Unsuspected pleural implants
- Identify- Synchronous satellite nodules

# VATS Criteria of Unresectability

- **Extranodal N2 disease**
- **Bilateral lymph node involvement**
- **Extensive Pericardial invasion**
- **Superior Vena Cava involvement**

# VATS Criteria of Unresectability

- **Esophageal invasion**
- **Extensive chest wall involvement( > 3 ribs )**
- **Pleural Dissemination**
- **Centrally located primary tumor with intrapericardial extension ( Clinical T4 )**

# Lung Cancer Staging : Limitations

- CT scan- No tissue diagnosis
  Under/ over staging
- PET- No tissue diagnosis
  No anatomic size of tumor
  False +ve (TB, fungal)
  False -ve (< 1cm tumor,hyperglycemia)
- TTNA- Only large ant. mediastinal masses
  False negative rate 20 – 50%

# Limitations

- TBNA- Subcarinal LNs (station 7)
  False negative rate 30%
- EUS-NA- Few reports
  LNs at station 9, 7, 5
  False –ve 23%
- Mediastinscopy- LNs at station 1,2,3,4 & 7
  No assessment of Tumor

# Lung Cancer

Surgery

# Lung Cancer : Surgery

- Surgery : Best chance of cure, long survival
- Possible < 10 % , Majority advanced
- Tumour Dx conf. , No C.I. For Sx
- Pt fit for Sx. ; Operable vs Resectable
- **Stage O - III A : Resectable**
- Radiotherapy : Primary / Adj.: Preop./ post
- Chemotherapy: Neo-adj./ Adj. / Chemorad.

**MULTI-MODALITY**

# Lung Cancer : C.I. to Sx

Tumour ***Unresectable*** : Inv.of Str.

- Nerve Inv. : RLN, Phrenic.
- Vessels : SVC, Ao, MPA
- Str. : Heart , Esoph , Trachea , ? Vertebra
- Cavities : Malignant Pleural / Peric. Effusion
- L.N. : Supraclavic. , Contralateral Med.
- Metastatic Dis : Brain,Bone,Adrenal ,Liver,Other

***Chest wall (rib) : Not C.I. to Sx***

# Lung Cancer : C.I. to Sx

**Pt. Unfit for Sx**

- Performance status ( GC )
- Cardiac
- Pulmonary
- hepatic
- renal
- others

# Lung Cancer : Surgery

## Factors which ↑ risk of Sx

- ASA class > 2 ., Advanced age
- Cardiac Inv. : Valvular / CAD
- COAD
- Em. Proc. , Extensive lung resection
- Immuno-compromised ; Post CT/ RT
- Morbid obesity, Smoking, Prolonged Sx
- Drugs : Steroids

# Lung Cancer : Sx : Pre-Op. assesment

- Hx , Examination ,Co-morbid conditions
- PFT : Spirometric / gas Exch.

| **Spirometric** | **??** | **Operable** |
|---|---|---|
| FVC | < 60% | > 60% |
| FEV1 | < 60% | > 60% |
| | | |
| **Gas Exch.** | | |
| DLCO | < 60% | > 60% |
| PaCO2 | > 45mmhg | <45 |

# Lung Cancer : Sx : Pre-Op. assesment

Split Fn test : Post-op. Predicted values

- FEV1/DLCO > 60% : Fit : Any Proc
- Rest : Quantitative V/ Q lung scan : Pred. Post-op
- > 40% : Sx ,
- < 40% : Exercise study / others

High risk for Sx :

Ventilator , Mortality

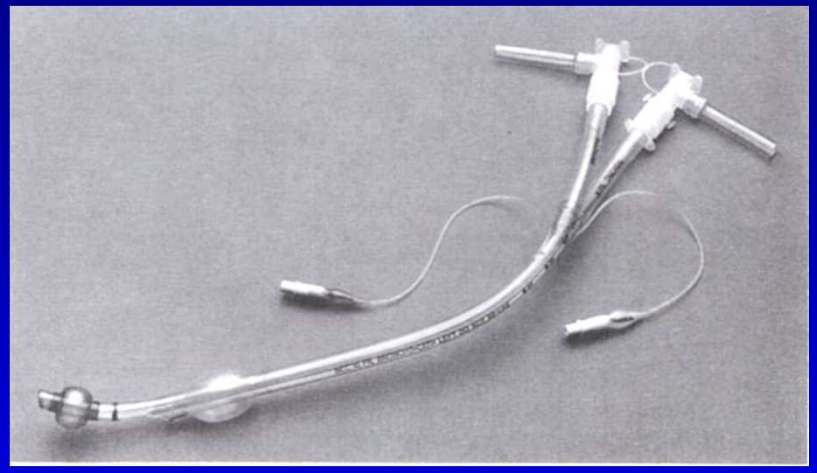
**Breath Holding Time : Stair Climbing Test**

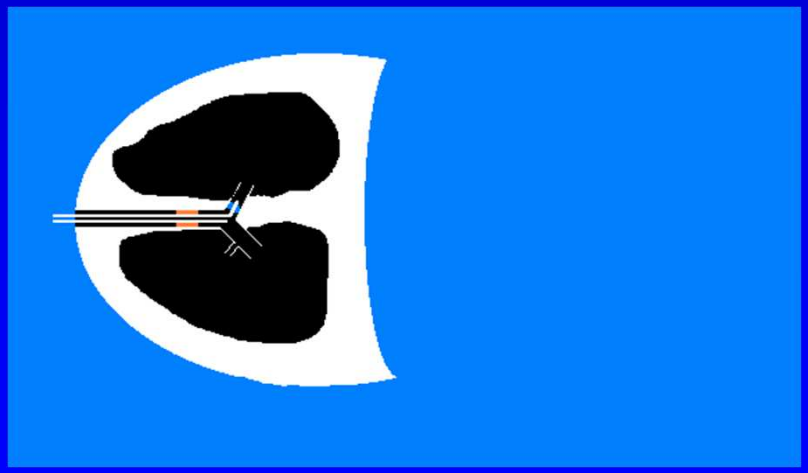
# Lung Cancer : Sx : Pre-Op. Preparation

- Stop Smoking , Steam , Sputum liquefy , Sputum c/s : Antibiotics , Bronchodilators
- Dry patient : Not wet
- Chest Phys.thx , Exercises : Conditioning
- Incentive Spirometry
- Explain , solicit co-operation
- **Few days of pre-op. hard work : post-op**
- Steroids , ? Digitalis

Check Chemothx dates

# Lung Cancer : Surgery Team Work





- Surgical Team
- Anaesthetist
- ICU Set up
- Pain Management Protocol
- Physio therapist

# Lung Cancer : Surgery

- Primary Tumor
  - Complete removal
- Lymph Nodes
  - LN Sampling
  - Systematic LN Dissection

# Lung Cancer : Surgery

- Wedge , Segment , Lobe , Lung
- Anatomical / Non-anatomical
- Chest wall **: In continuity ribs res. : MESH ,**
- Mediastinum : Tumour Res. : Clear margin
- Save parenchyma : as much as possible
- Sleeve resections : Br., Trachea , Carina

# Lung Cancer : Surgery

- LN : None - Extensive radical LN'ectomy
  Staging vs Curative value

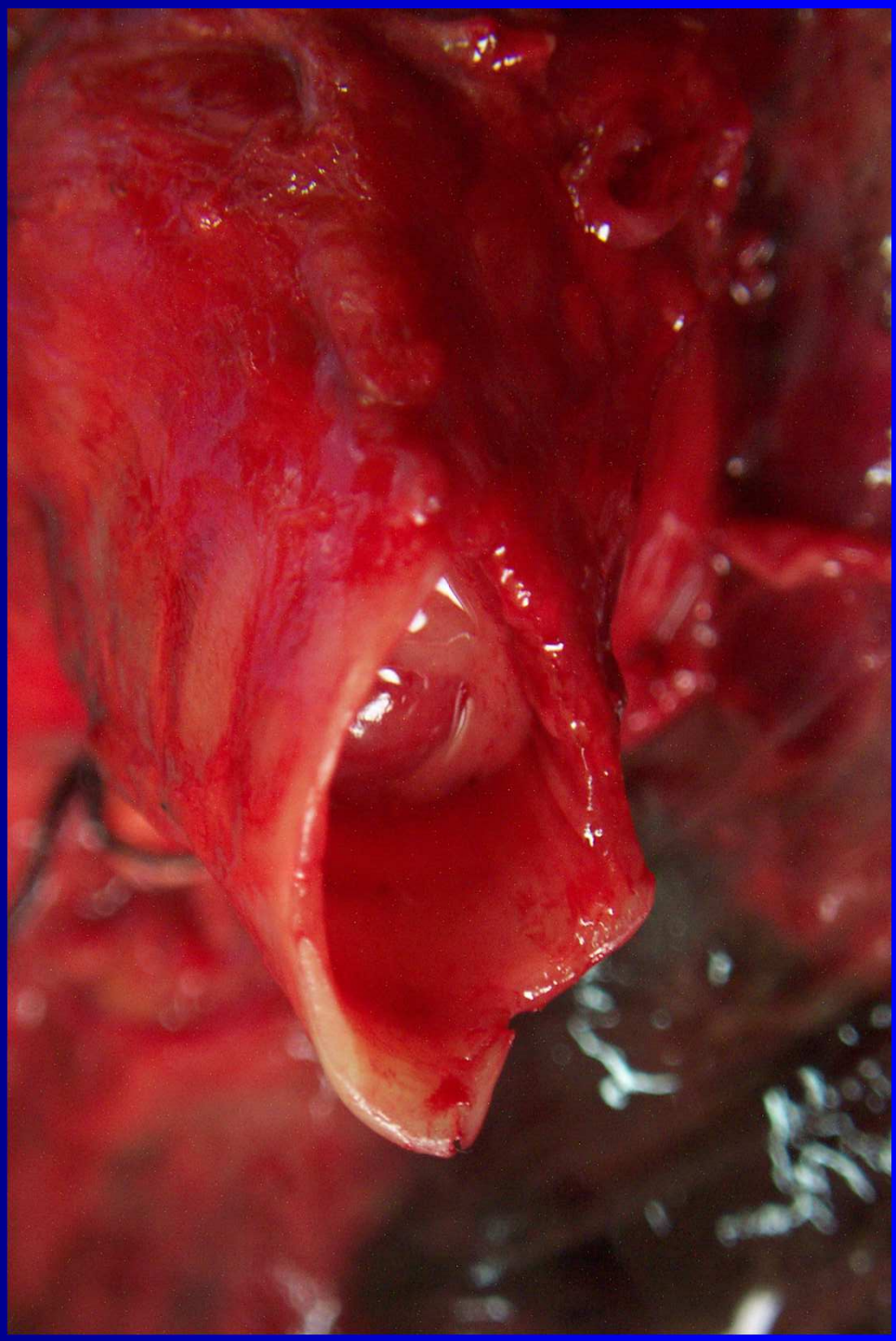
# Lung Cancer : Others

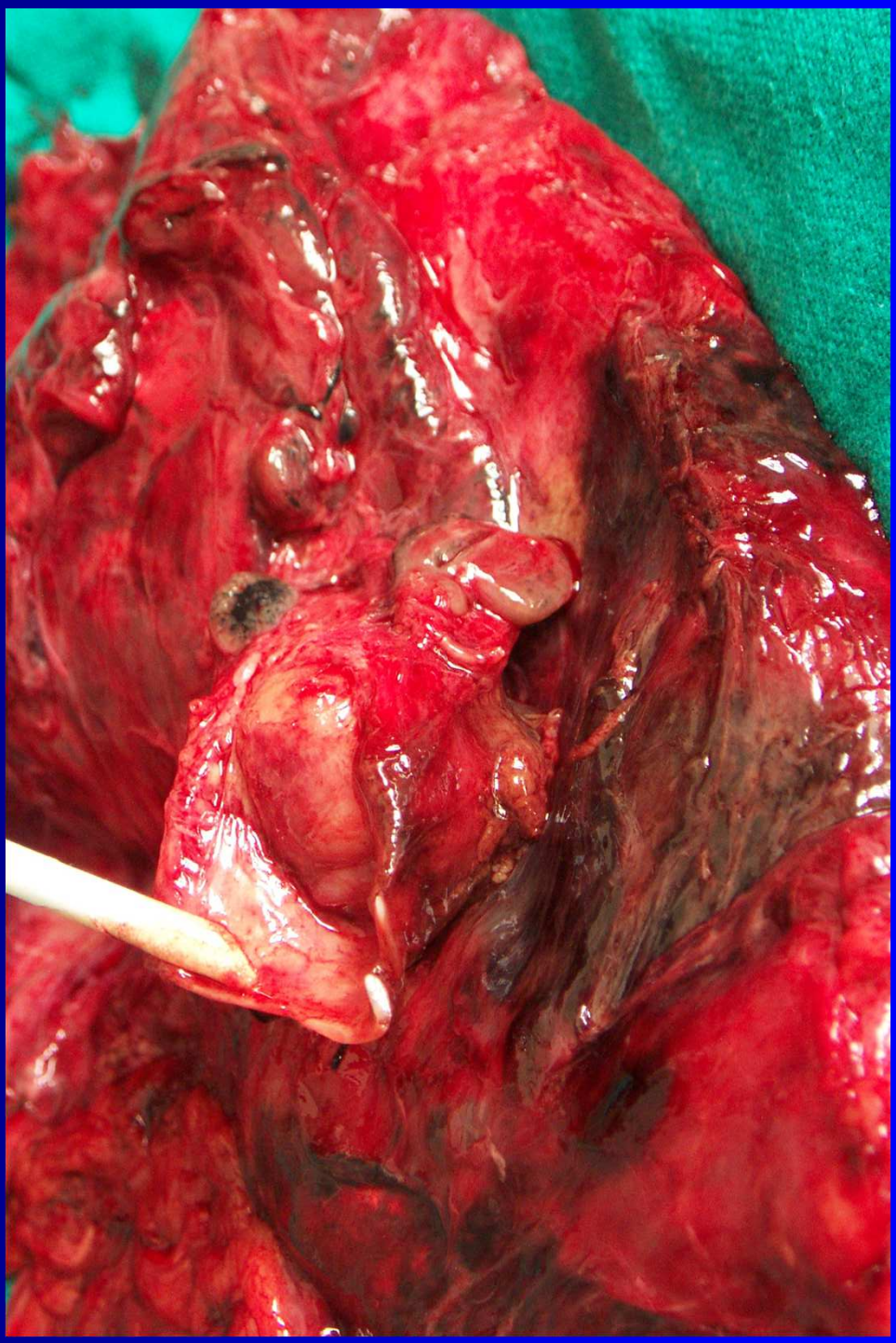
Carcinoids

# Lung Cancer : Surgery

Malignant Pleural Effusion

Pleurodesis : Talc / Bleomycin





# % Survival in NSCLC

| | 1 Year | 5 Year |
|---|---|---|
| • Stage I | 80.7 | 46.9 |
| • Stage II | 68.3 | 26.1 |
| • Stage III | 41.5 | 8.4 |
| • Stage IV | 16.9 | 1.6 |

(American Joint Committee on Cancer: 2002)

# Lung Cancer

Early diagnosis

TRIALS

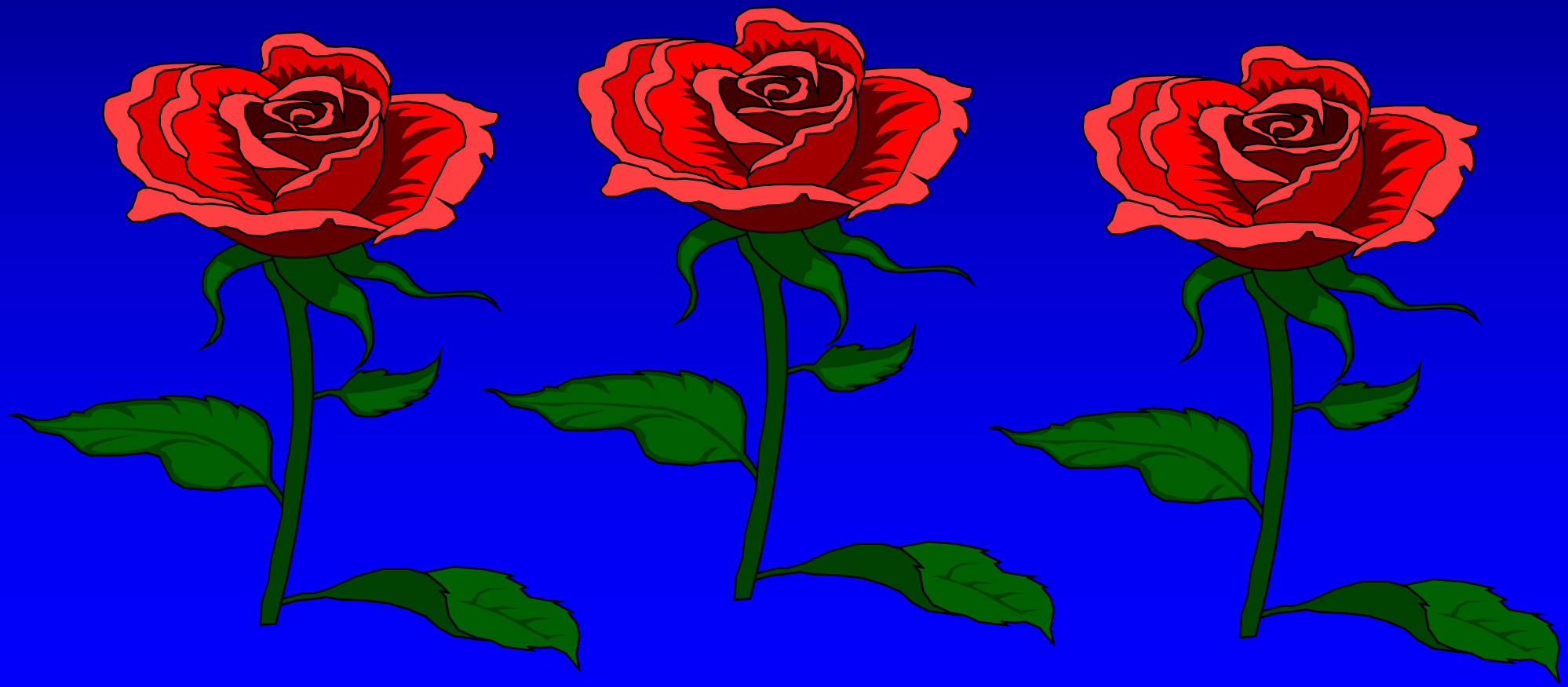
# Lung Cancer : Prevention

- Health or Tobacco : SMOKING
  - Active / Passive
  - Laws : Public places
  - Public Awareness
  - Concerted Movement
- Others

A conference is a gathering of important people
who singly can do nothing, but
together can decide that
nothing can be done.

Fred Allen

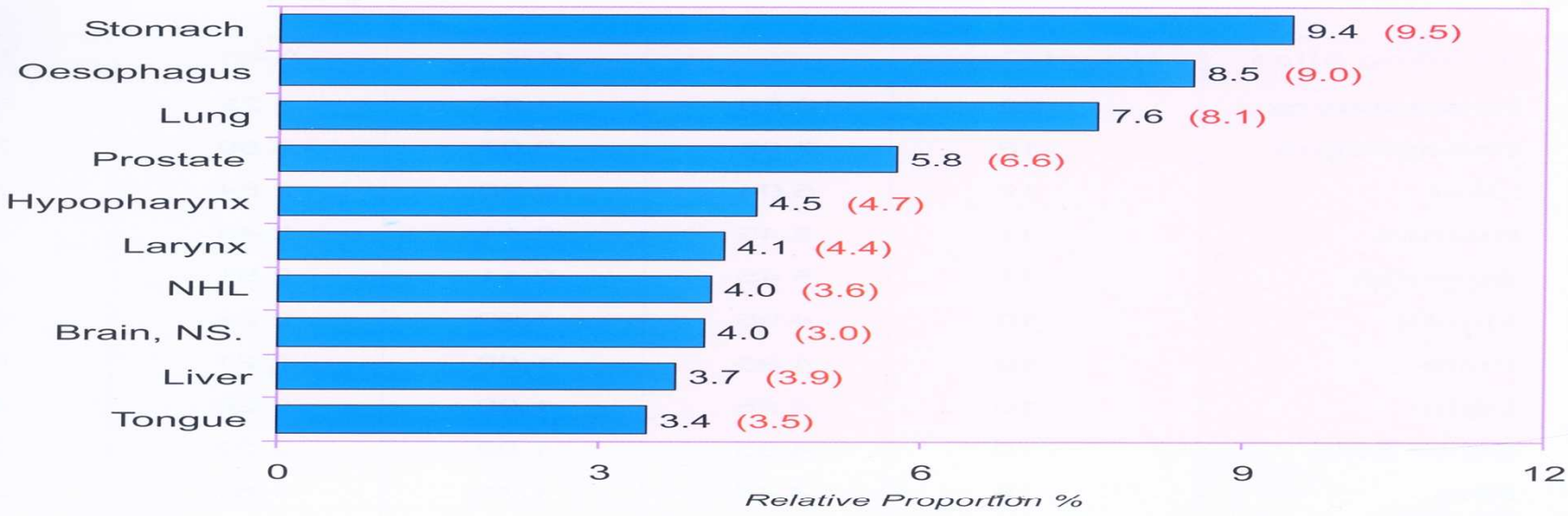
# Thank you



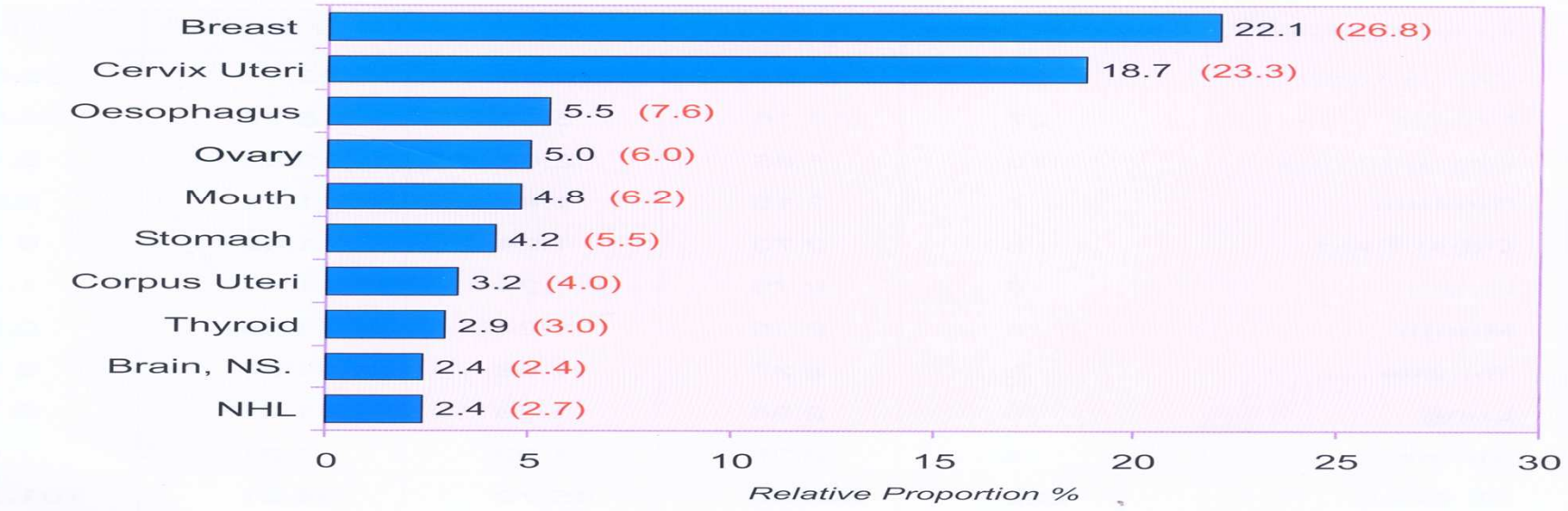
## Fig. 2.1: Ten Leading Sites of Cancer - Bangalore (1999-2000)

*Age Adjusted Rates given in parentheses*

**Males**



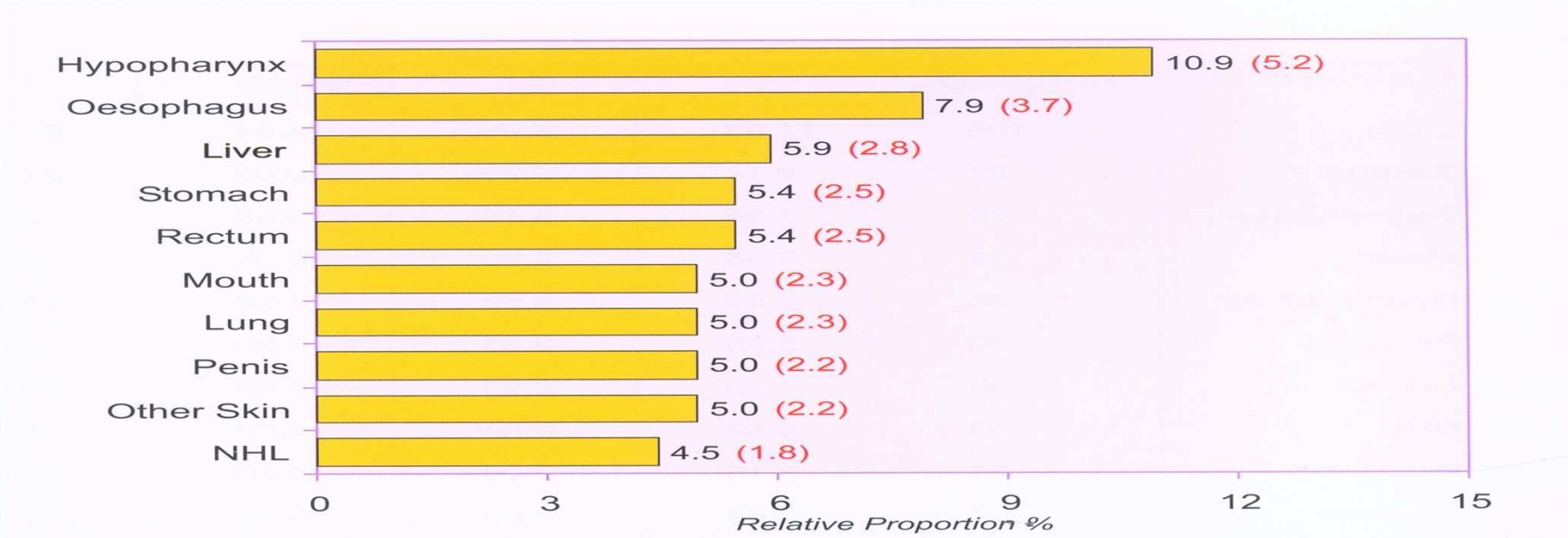

**Females**



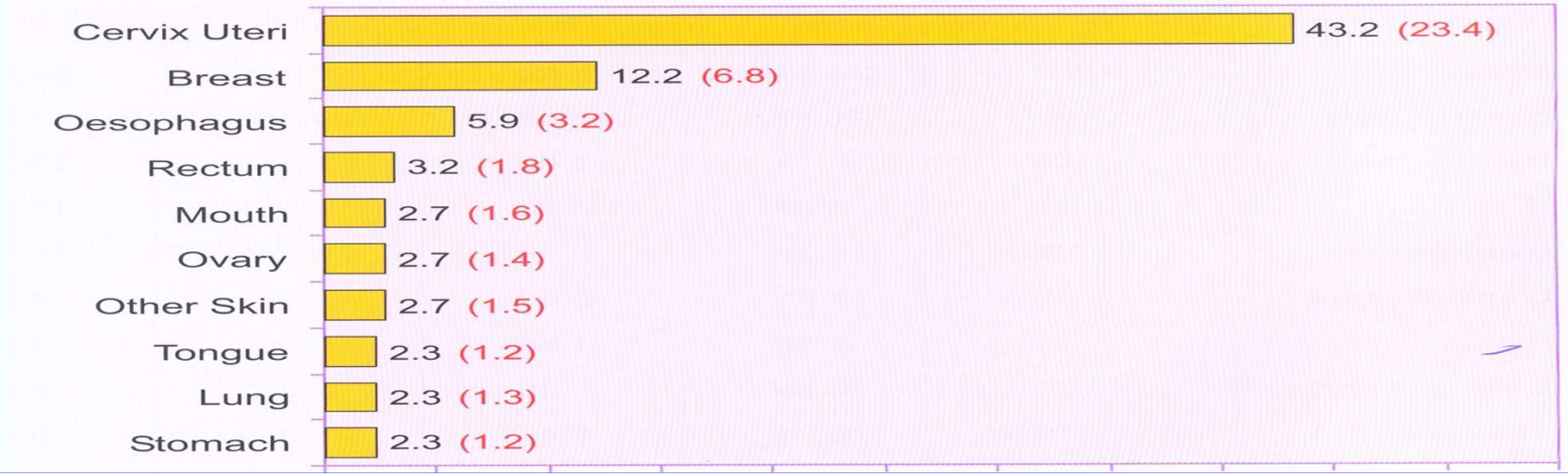
## Fig. 2.2: Ten Leading Sites of Cancer - Barshi (1999-2000)

*Age Adjusted Rates given in parentheses*

**Males**



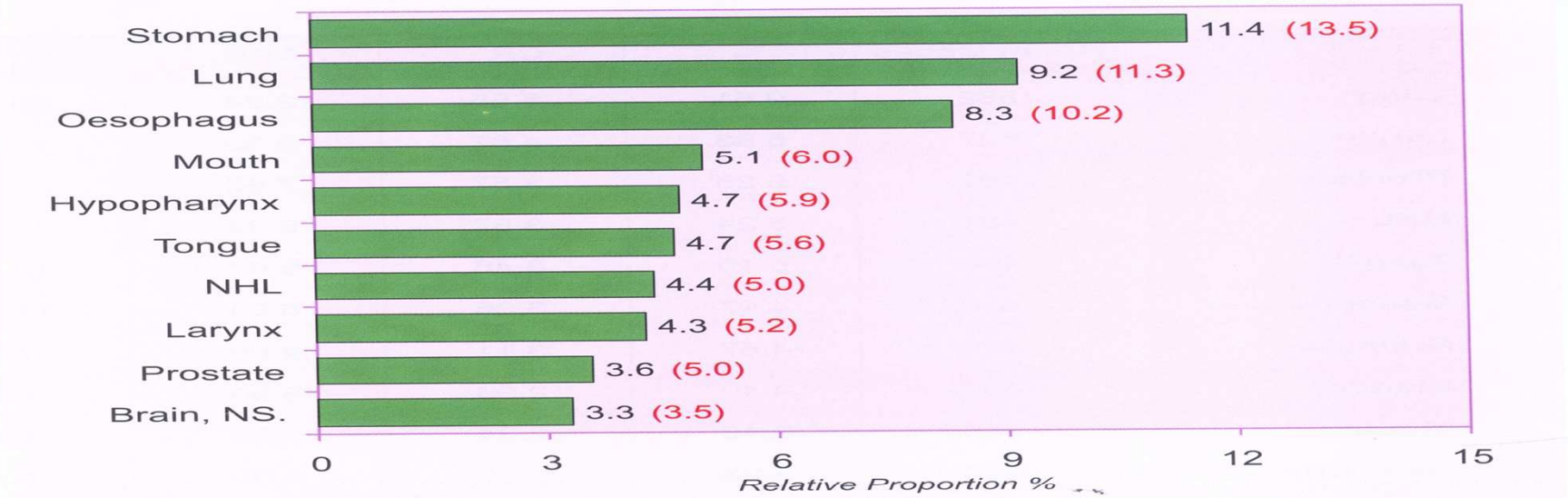

**Females**



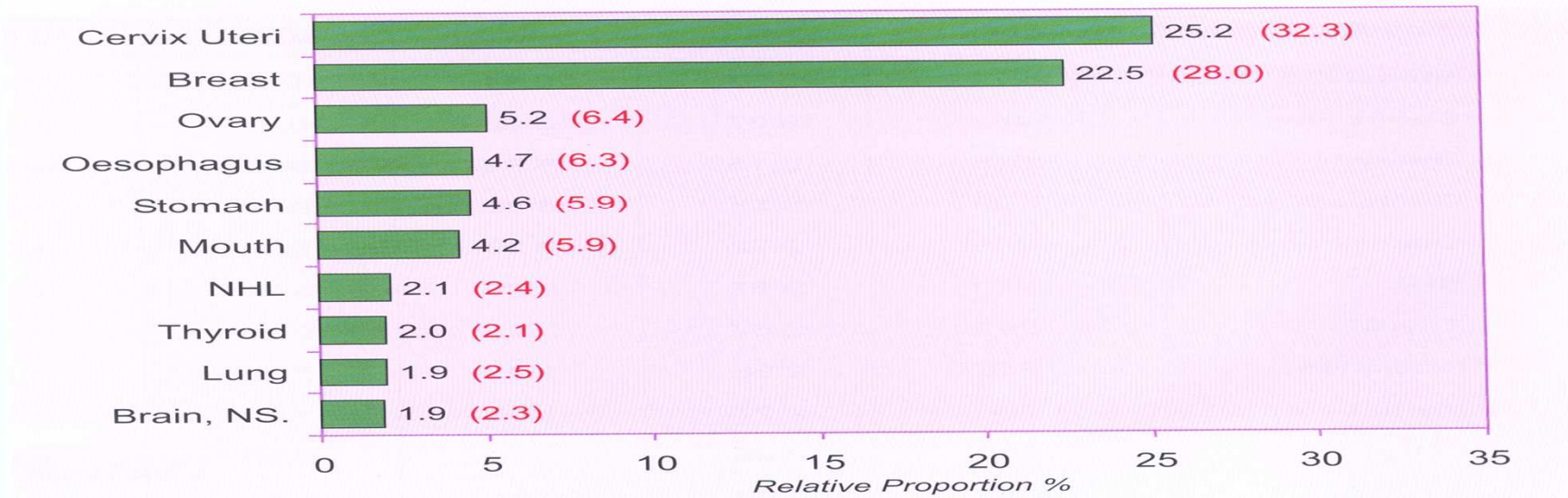
## Fig. 2.4: Ten Leading Sites of Cancer - Chennai (1999-2000)

*Age Adjusted Rates given in parentheses*

**Males**



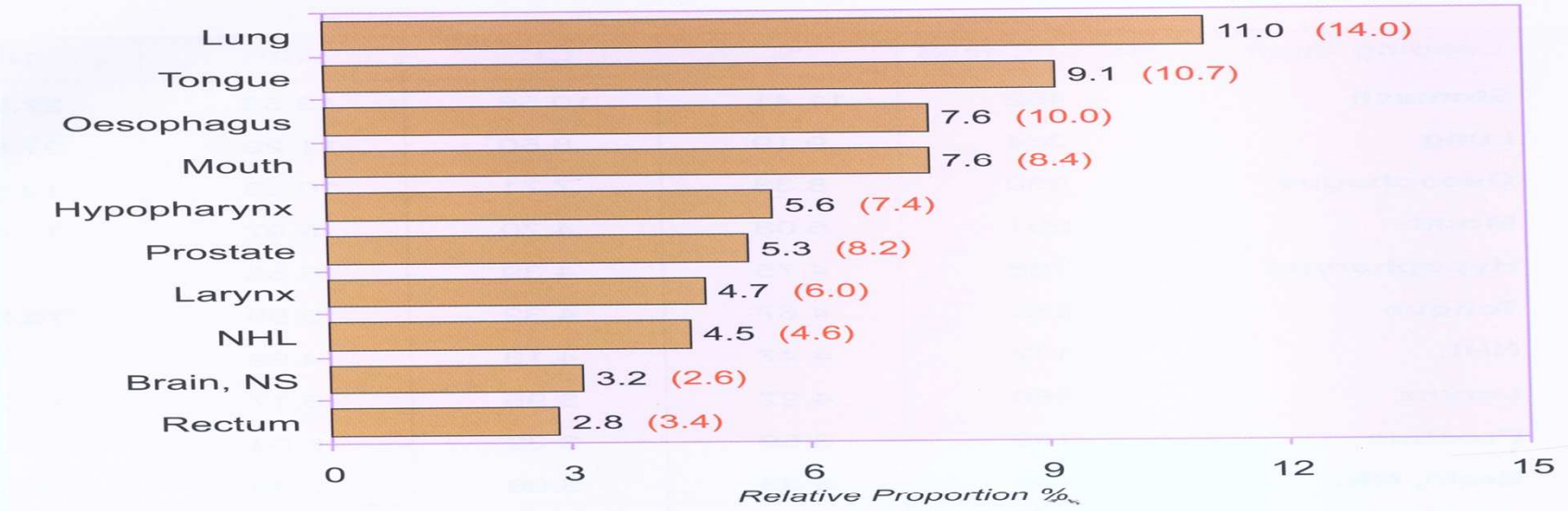

**Females**



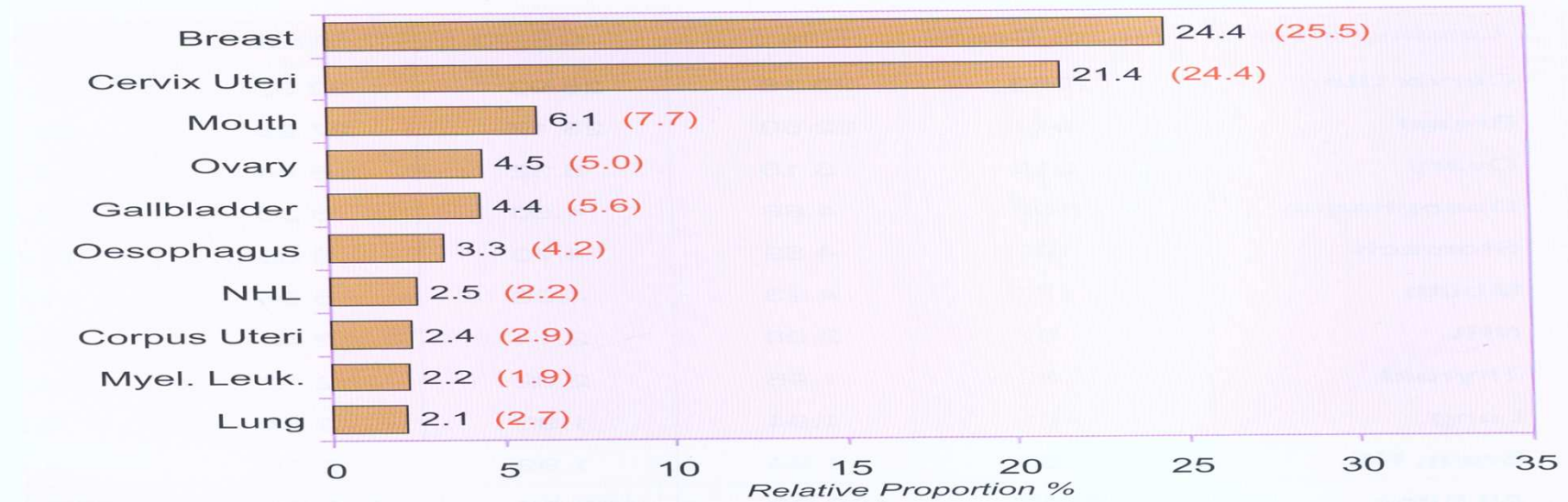
## Fig. 2.3: Ten Leading Sites of Cancer - Bhopal (1999-2000)

*Age Adjusted Rates given in parentheses*

**Males**



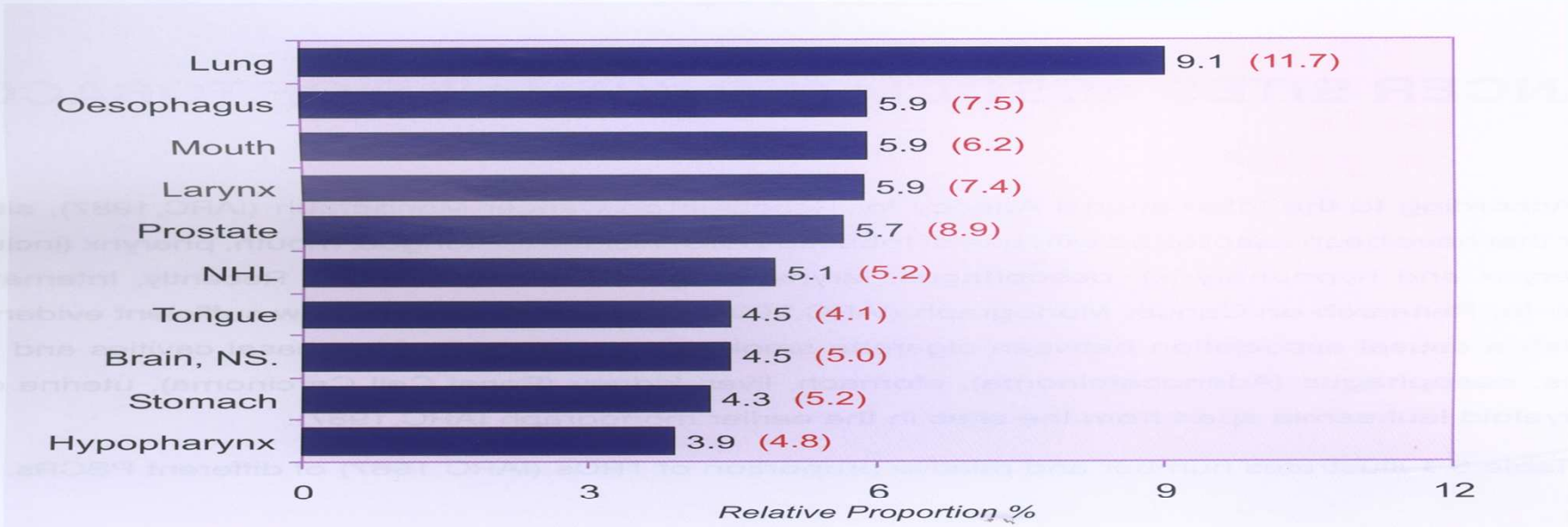

**Females**



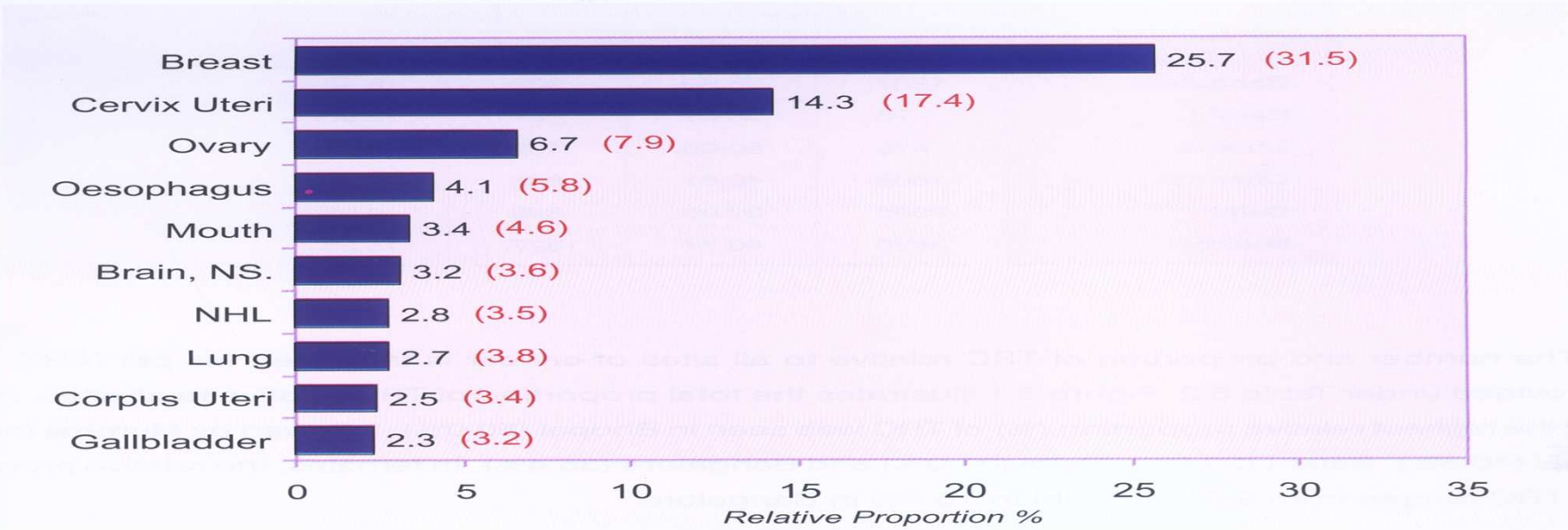
## Fig. 2.6: Ten Leading Sites of Cancer - Mumbai (1999-2000)

*Age Adjusted Rates given in parentheses*

**Males**



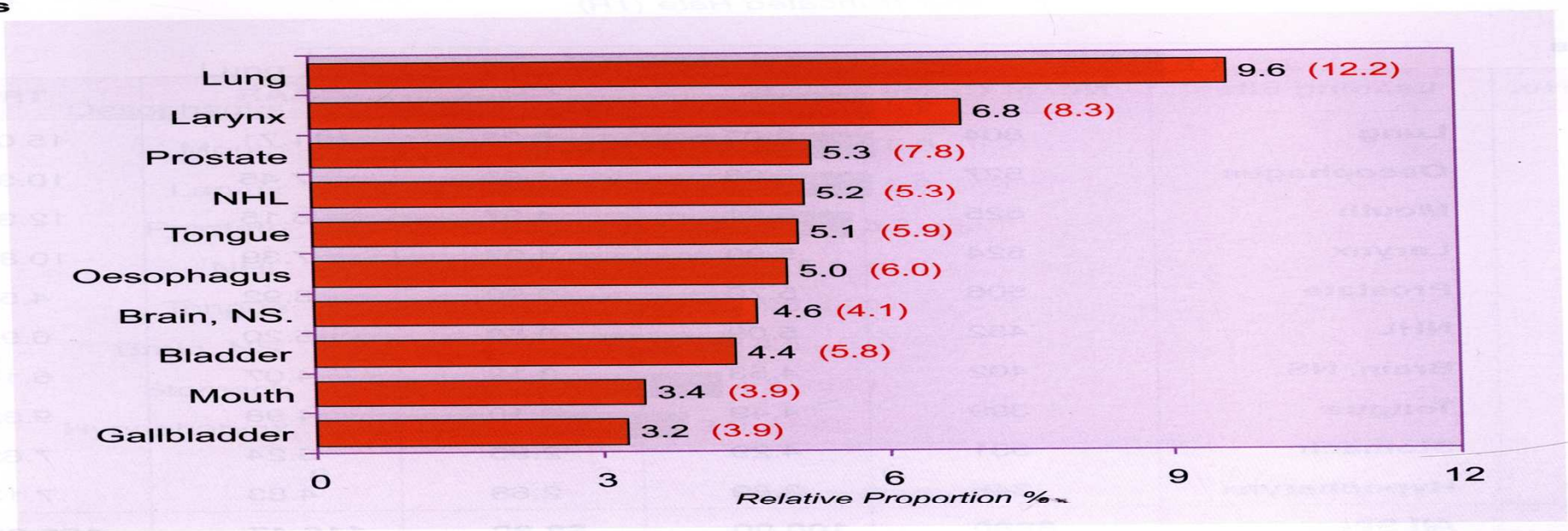

**Females**



## Fig. 2.5: Ten Leading Sites of Cancer - Delhi (1999-2000)

*Age Adjusted Rates given in parentheses*

**Males**




**Females**