LUNG CANCER STAGING UPDATE

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LUNG CANCER STAGING

• Review definitions in new TNM system and highlight changes
• Review imaging features of non-small cell lung cancers (NSCLC) that indicate tumor stage
• Discuss usefulness/accuracy of imaging findings in predicting stage
• CT, FDG-PET, MRI
LUNG CANCER STAGING

• TNM international staging system (6th ed., 2002)
  – T = primary tumor
  – N = regional lymph nodes
  – M = distant metastases

• Stage used to establish prognosis and direct therapy

• System based on old, very limited data
LUNG CANCER STAGING

• 7th ed. of TNM staging system 2010
• International Association for the Study of Lung Cancer (IASLC):
  – Initiated international Lung Cancer Staging project 1996
  – Data on > 100,000 cases
• Changes to better reflect survival, treatment options

  • Rami-Porta R. J Thorac Oncol 2007; 2:593
  • Rusch VW. J Thorac Oncol 2007; 2:603
  • Postmus PE. J Thorac Oncol 2007; 2:686
  • Groome PA. J Thorac Oncol 2007; 2:694
  • Goldstraw P. J Thorac Oncol 2007; 2:706
STAGING: 1\textsuperscript{O} TUMOR

**T1**

- \( \leq 3 \text{ cm} \)
- Surrounded by lung or visceral pleura
- Not in mainstem bronchus
STAGING: $1^\circ$ TUMOR

**T1**
- $\leq 3$ cm
- Surrounded by lung or visceral pleura
- Not in mainstem bronchus

**Change**
- T1a: $\leq 2$ cm
- T1b: $>2-3$ cm
STAGING: 1º TUMOR

T2

- > 3 cm
- Distal mainstem bronchus (>2 cm from carina)
- Invades visceral pleura
- Postobstructive atel/pneumonia < entire lung
STAGING: $1^0$ TUMOR

**T2**
- $> 3$ cm
- Distal mainstem bronchus ($>2$ cm from carina)
- Invades visceral pleura
- Postobstructive atel/pneumonia $< \text{entire lung}$

**Change**
- T2a: $>3-5$ cm
- T2b: $>5-7$ cm
- $> 7$ cm $\rightarrow$ T3
STAGING: 1° TUMOR

T3

- Invades chest wall, diaphragm, phrenic nerve, mediastinal pleura, parietal pericardium
- Proximal mainstem bronchus (< 2 cm from carina)
- Postobstructive atel/pneumonia entire lung
Chest wall invasion = T3

- Pleural thickening, loss of extrapleural fat plane
- Obtuse angle, >3 cm contact between mass and chest wall
- Soft tissue in chest wall
- CT sens 38-87%, spec 40-90%
- Only specific sign: bone destruction
- Chest wall pain reliable symptom
INDETERMINATE FOR CHEST WALL INVASION
• OVERALL MR ~ CT
• CHEST WALL INVASION = T3
STAGING: $1^0$ TUMOR

Brachial plexus

- MR > CT
Chest wall invasion

- Does not preclude surgery
- En bloc resection and chest wall reconstruction
  - ↑ morbidity and mortality
- Contraindicated if mediastinal lymph node metastases due to poor prognosis (7% 5-yr survival)
STAGING: $1^{\text{O}}$ TUMOR

**T3**
- Invades chest wall, diaphragm, mediastinal pleura, parietal pericardium
- Proximal mainstem bronchus (< 2 cm from carina)
- Postobstructive atel/pneumonia entire lung

**Changes**
- > 7 cm
  - previously T2
- Separate tumor nodule(s) in same lobe
  - previously T4
**STAGING: 1° TUMOR**

**T4**
- Invades mediastinum, heart, great vessels, trachea, esophagus, recurrent laryngeal nerve, vertebral body, carina
- Separate tumor nodule in different ipsilateral lobe (prev M1)
STAGING: 1° TUMOR

Mediastinal fat invasion = T4

- CT/MR criteria: extensive contact with mediastinum, abnormal soft tissue in mediastinal fat, pleural or pericardial thickening

- CT and MR: poor accuracy
GROSS INVASION

? INVASION
STAGING: 1º TUMOR

Invasion of vital structure = T4

- CT criteria: loss of fat plane, mass effect, extensive contact
- MR similar to CT:
  - Low accuracy
  - Contiguity $\neq$ invasion
CONTIGUITY

No invasion    Invasion
STAGING: REGIONAL LYMPH NODES

- N0  
- N1  
- N2  
- N3

Change

- None
STAGING: LYMPH NODES

**N0**

- No regional lymph node metastases
T1 N0

Figure 1
N1

- Metastasis in ipsilateral hilar and/or peribronchial nodes
- Intrapulmonary nodes involved by direct extension from primary tumor
- Affects prognosis, not resectability
- Does not predict status of mediastinal nodes
STAGING: LYMPH NODES

N1
STAGING: LYMPH NODES

N2

• Metastasis in ipsilateral mediastinal and/or subcarinal nodes

• Potentially resectable, usually after neoadjuvant chemo/RT
  – Not numerous or bulky
STAGING: LYMPH NODES

N3

• Metastasis in contralateral mediastinal or hilar nodes
• Metastasis in any scalene or supraclavicular nodes
• Unresectable
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<thead>
<tr>
<th>Modality</th>
<th>Sens</th>
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<tbody>
<tr>
<td>CT</td>
<td>60%</td>
<td>80%</td>
</tr>
<tr>
<td>PET</td>
<td>80%</td>
<td>90%</td>
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</table>

MEDIASTINAL LYMPH NODES

PET pitfalls

• False positives due to inflammatory nodes → poor specificity in enlarged nodes

• False negatives due to microscopic mets → poor sensitivity in small nodes
MEDIASTINAL LYMPH NODES

Enlarged at CT (no PET or abnormal PET)

Abnormal at PET (small or enlarged at CT)

use CT to direct best method of lymph node biopsy
MEDIASTINAL LYMPH NODES

Normal size at CT (no PET or normal PET)  
Normal at PET (small or enlarged at CT)

Proceed directly to surgery

- Microscopic metastases may be present
- Such patients may benefit from resection
MEDIASTINAL LYMPH NODES

Normal size at CT (no PET or normal PET)
Normal at PET (small or enlarged at CT)

Proceed directly to surgery

- Exception: adenocarcinoma or T3 tumors (including Pancoast)
- Presence of mediastinal metastases → poor prognosis, not surgical candidate
- Consider mediastinoscopy
STAGING: DISTANT METASTASES

- **M0:**
  - no distant metastasis

- **M1:**
  - distant metastasis present
  - Malignant pleural or pericardial effusion (prev T4, now M1)
• Tiny left pleural effusion
STAGING: DISTANT METASTASES

Changes

• M1a:
  – intrathoracic
  – separate tumor nodule(s) in a contralateral lobe
  – pleural nodules or malignant pleural or pericardial effusion

• M1b:
  – Distant mets outside lung/pleura
STAGING: DISTANT METS

• 18-36% of new NSCLC pts
  – Adenoca > squamous cell
• Brain > bone > liver > adrenals
• PET finds unsuspected distant mets in 9-19% pts
• Usually abdominal, occasionally lung, bone
? N3 disease
M1 disease
LUNG CANCER STAGING

Changes in stage groupings:

• Minor

Goldstraw P. J Thorac Oncol 2007; 2:706
<table>
<thead>
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Conclusions:

- CT staging is imperfect.
- PET improves staging accuracy.
- New staging system (2010) better aligned with prognosis and should improve treatment options and outcome.