Surgical management of lung cancer

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Thoracic Oncology

- Non Small Cell Lung Cancer (NSCLC)
- Small Cell Lung Cancer
- Mesothelioma
- Pulmonary Carcinoid
- Metastatic Disease
  - Lung
  - Pleura
NSCLC

- Screening – who and how
- Surveillance of pulmonary nodules
- Optimal management of small cancers
- Ground glass lesions, pulmonary smudges
- Induction therapy
- Pancoast
- And the list goes on………..
NSCLC

- Surgeons view of staging system
  - PET, EBUS, mediastinoscopy

- Areas for further development –
  - subsets of IIIA disease,
  - Extended resection

- Palliative procedures
Staging

- TNM
- Revision in 2009 - 7th ed – international database
- 8th ed as of 2017
- No consideration of histology/molecular or genetic markers
  - Small cell v non small cell
Definitions

**Primary Tumor (T)**

- **TX** Primary tumor cannot be assessed, or tumor proven by the presence of malignant cells in sputum or bronchial washings but not visualized by imaging or bronchoscopy
- **T0** No evidence of primary tumor
- **Tis** Carcinoma in situ
- **T1** Tumor 3 cm or less in greatest dimension, surrounded by lung or visceral pleura, without bronchoscopic evidence of invasion more proximal than the lobar bronchus (for example, not in the main bronchus)
- **T1a** Tumor 2 cm or less in greatest dimension
- **T1b** Tumor more than 2 cm but 3 cm or less in greatest dimension
- **T2** Tumor more than 3 cm but 7 cm or less or tumor with any of the following features (T2 tumors with these features are classified T2a if 5 cm or less): involves main bronchus, 2 cm or more distal to the carina; invades visceral pleura (PL1 or PL2); associated with atelectasis or obstructive pneumonitis that extends to the hilar region but does not involve the entire lung
- **T2a** Tumor more than 3 cm but 5 cm or less in greatest dimension
- **T2b** Tumor more than 5 cm but 7 cm or less in greatest dimension
- **T3** Tumor more than 7 cm or one that directly invades any of the following: parietal pleural (PL3), chest wall (including superior sulcus tumors), diaphragm, phrenic nerve, mediastinal pleura, parietal pericardium; or tumor in the main bronchus less than 2 cm distal to the carina but without involvement of the carina; or associated atelectasis or obstructive pneumonitis of the entire lung or separate tumor nodule(s) in the same lobe
- **T4** Tumor of any size that invades any of the following: mediastinum, heart, great vessels, trachea, recurrent laryngeal nerve, esophagus, vertebral body, carina, separate tumor nodule(s) in a different ipsilateral lobe

**Distant Metastasis (M)**

- **M0** No distant metastasis
- **M1** Distant metastasis
- **M1a** Separate tumor nodule(s) in a contralateral lobe, tumor with pleural nodules or malignant pleural (or pericardial) effusion
- **M1b** Distant metastasis (in extrathoracic organs)

**Anatomic Stage/Prognostic Groups**

<table>
<thead>
<tr>
<th>Stage</th>
<th>T</th>
<th>N</th>
<th>M</th>
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<tr>
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<tr>
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Stage grouping.

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<td>Any N</td>
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<td><strong>Stage IVB</strong></td>
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<td>Any N</td>
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Advances

- Higher resolution CT Scans
- PET Scanning
- Endobronchial Ultrasound - EBUS
- Minimally invasive surgery – VATS Lobectomy
- Adjuvant and neoadjuvant therapy
Strategy

- NSCLC
  - confined to lung -> surgery (or radiotherapy)
  - Lung and ipsilateral structures – options
  - Beyond 1 hemithorax
<table>
<thead>
<tr>
<th>Descriptors</th>
<th>Definitions</th>
<th>Subgroups*</th>
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<tbody>
<tr>
<td><strong>T</strong></td>
<td><strong>Primary tumor</strong></td>
<td></td>
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<tr>
<td>T0</td>
<td>No primary tumor</td>
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<tr>
<td>T1</td>
<td>Tumor $\leq$ 3 cm,† surrounded by lung or visceral pleura, not more proximal than the lobar bronchus</td>
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<td>T1a</td>
<td>Tumor $\leq$ 2 cm†</td>
<td>T1a</td>
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<tr>
<td>T1b</td>
<td>Tumor $&gt; 2$ but $\leq$ 3 cm†</td>
<td>T1b</td>
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<tr>
<td>T2</td>
<td>Tumor $&gt; 3$ but $\leq 7$ cm† or tumor with any of the following†: Invades visceral pleura, involves main bronchus ≥ 2 cm distal to the carina, atelectasis/obstructive pneumonia extending to hilum but not involving the entire lung</td>
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<td>T2a</td>
<td>Tumor $&gt; 3$ but $\leq 5$ cm†</td>
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<tr>
<td>T2b</td>
<td>Tumor $&gt; 5$ but $\leq 7$ cm†</td>
<td>T2b</td>
</tr>
</tbody>
</table>
| T3          | Tumor $> 7$ cm; or directly invading chest wall, diaphragm, phrenic nerve, mediastinal pleura, or parietal pericardium; or tumor in the main bronchus $< 2$ cm distal to the carina‡; or atelectasis/obstructive pneumonitis of entire lung; or separate tumor nodules in the same lobe | T3$>_7$  
T3$\text{Inv}$  
T3$\text{Car$\text{nr}$}$  
T3$\text{S$\text{nr}$}$  
T4$\text{Inv}$  
T4$\text{Ips$\text{I}$} Nod$ |
| T4          | Tumor of any size with invasion of heart, great vessels, trachea, recurrent laryngeal nerve, esophagus, vertebral body, or carina; or separate tumor nodules in a different ipsilateral lobe | T4$\text{Ips$\text{I}$} Nod$ |
Algorithm

- **T stage - is the tumour resectable?**
  - Size (2,3,5,7)
  - Involvement of visceral pleura
  - Proximity to main airways
  - Chest wall invasion
  - Involvement of mediastinum, great vessels
  - Satellite nodule – same lobe, ipsilateral lung
FIGURE 2. Prognosis according to additional nodules, T4 invasion, and pleural dissemination. A: overall survival for patients with
T1b N0 M0
N

- **N0** = No regional nodal metastasis
- **N1** = Ipsilateral peribronchial/hilar or intrapulmonary nodes
- **N2** = Involvement of ipsilateral mediastinal or subcarinal lymph nodes
- **N3** = Involvement of contralateral mediastinal, hilar or supraclavicular nodes
Supraclavicular zone

1. Low cervical, supraclavicular, and sternal notch nodes

Superior Mediastinal Nodes

Upper zone

- 2R Upper Paratracheal (right)
- 2L Upper Paratracheal (left)
- 3a Pre-vascular
- 3p Retrotracheal
- 4R Lower Paratracheal (right)
- 4L Lower Paratracheal (left)

Aortic Nodes

AP zone

- 5 Subaortic
- 6 Para-aortic (ascending aorta or phrenic)

Inferior Mediastinal Nodes

Subcarinal zone

- 7 Subcarinal

Lower zone

- 8 Paraesophageal (below carina)
- 9 Pulmonary ligament

N1 Nodes

Hilar/Interlobar zone

- 10 Hilar
- 11 Interiobar

Peripheral zone

- 12 Lobar
- 13 Segmental
- 14 Subsegmental

Regional Lymph Nodes (N)

- NX Regional lymph nodes cannot be assessed
- N0 No regional lymph node metastases
- N1 Metastasis in ipsilateral peribronchial and/or ipsilateral hilar lymph nodes and intrapulmonary nodes, including involvement by direct extension
- N2 Metastasis in ipsilateral mediastinal and/or subcarinal lymph node(s)
- N3 Metastasis in contralateral mediastinal, contralateral hilar, ipsilateral or contralateral scalene, or supraclavicular lymph node(s)

ILLUSTRATION
The IASLC lymph node map shown with the proposed amalgamation of lymph into zones.

(© Memorial Sloan-Kettering Cancer Center, 2009.)
N Stage

- N0 or N1 -> Surgery
- N2 – complicated category
  - Volume
  - Location
    - Surgery + adjuvant therapy
    - Induction chemotherapy +/− surgery
    - Radical Chemo/XRT
N Staging

- PET
- EBUS/EUS
- Mediastinoscopy
- VATS
Performance of EBUS-TBNA
EBUS-TBNA – performance

- Sensitivity (lung cancer) 92-3%
  - Higher sensitivity than PET
  - Normal mediastinum on PET: sens 89%
  - Equiv/higher sensitivity than mediastinoscopy

- Diagnostic assessment PPL + med/hilar LNopathy

- Restaging mediastinum
  - sens 79%, PPV 100%, NPV 20%

- Obtain sufficient specimen to allow genetic analysis
  - EGFR (Navani. AJRCCM 2012)
N2 Disease

- Disease subsets
  - Clinical v pathological
  - Bulky multi level
  - Single Station
  - Proximity to primary
N2 Disease

- Who should be considered for surgery?
  - Single station
  - Adjacent to tumour
  - No extra thoracic disease (including on MRI brain)
  - Patient will tolerate surgery with planned adjuvant therapy
  - Benefit of neoadjuvant treatment
PET

- ?N2 disease – difficult to clarify position of nodes

- EBUS - negative
- T2N2 Stage IIIA
- Adjuvant chemo + mediastinal irradiation
M Category

M1a Separate tumour nodule(s) in a contralateral lobe; tumour with pleural or pericardial nodules or malignant pleural or pericardial effusion
M1b Single extrathoracic metastasis in a single organ
M1c Multiple extrathoracic metastasis in a single or multiple organs
Thoracic Surgery

- **Resection**
  - Wedge, segment, lobe, pneumonectomy
  - Sleeve
  - Extended – chest wall, other structures

- **Interventional Bronchoscopy**
  - Laser, stents

- **Pleurodesis**
Thoracic Surgery

- Physiological assessment
  - FEV1, FVC, DLCO
  - CPEX – anaerobic threshold, VO2 max
- Cardiac
  - LVEF, Pulmonary Pressures, Valvular Heart Disease
  - Coronary Artery Disease
Primary Objective

- Achieving R0 resection and complete intra thoracic pathological staging in Stage I / II / (IIIA) NSCLC
Primary Objective

- Meticulous assessment of patient fitness, especially in borderline cases
- Appropriate surgical approach to achieve objective
- No patient to be denied a chance of cure
Secondary Considerations

- Secondary sarcomas and other lesions posing threat to life
- Palliative resections when faced with infection / post obstructive pneumonitis
- Resections for Complications & Salvage after other treatment modalities
Secondary Considerations

- Solitary or oligo-metastatic lesions in otherwise disease controlled patients, where the pulmonary lesion/s demands complex resection.
  - (CRC / Renal / Melanoma)

- Benign Conditions – threat to life
Wedge Resection
Segmentectomy

- Survival compared to lobectomy
- Inadequate nodal staging?
  - Missed adjuvant therapy
- Comorbidities/lung function
- Small T1 NSCLC
Lobectomy
Lobectomy
Lobectomy

- Open
- VATS
- Robotic

- After 3 months, the major morbidity is losing ½ a lung!
VATS Lobectomy


CONCLUSION: Patients undergoing video-assisted lobectomy had fewer respiratory complications and shorter length of stay. These data suggest video-assisted thoracoscopic lobectomy is safe in patients with resectable lung cancer. Longer follow-up is needed to determine the oncologic equivalency of video-assisted versus open lobectomy.
VATS Microlobectomy
VATS Microlobectomy
Extended resection

Can you cut it out Doctor?

V

Should you cut it out Doctor?
Context for Extended Pulmonary Resections

- True Surgical Masters pushing the limits with complex minimally invasive techniques
- Others pressured into above and de-skilling themselves and letting the minimally invasive mindset influence surgical decision making.
What Constitutes an Extended Pulmonary Resection?

• Is it surgeon specific? Anything beyond a lobectomy or pneumonectomy?
• Is it bronchoplastic procedures or intra-pulmonary vascular reconstructive procedures?
• Is it resection/reconstruction of extra-pulmonary vital structures or trachea?
• Is it requirement for cardiopulmonary bypass?
Extended Pulmonary Resections

- Chest Wall / Diaphragm
- Airway Involvement
  - Bronchial Sleeve Resections
  - Carinal Resections
  - Tracheal Repairs
- SVC
- Pulmonary Artery
- Left Atrium
- Oesophagus
- Aorta

- Neoadjuvant Chemo RT
- Salvage after Radical RT
- Iatrogenic Complications

- Airway Management
- Circulatory Support
Philosophy

- If there is a valid alternative treatment with lesser risk is available then one should not embark on heroic surgery in palliative scenarios.

- If surgery is undertaken even in immediate threat to life scenarios, achieving quality of life benefits should be the overarching objective.
If a curative resection is a possibility then all the expertise should be brought to the table before

Extended Pulmonary Resection is discounted in favour of alternative treatments.
Palliative procedures

- Pleurodesis
  - Will the lung reinflate?

- Pericardial drainage and window
  - Haemodynamic assessment
  - Risk of progression
  - Not all malignant (XRT)
Pleurodesis

- Assessment
  - State of patient
  - Assessment of effusion
  - Sxs with drainage
  - Reinflation with drainage
  - Exclude pericardial collection
Pleurodesis

- Surgery
  - VATS
  - Pleurectomy
  - Talc/abrasive pleurodesis
  - Decortication
  - Early reintervention in selected cases for failure
Pericardial effusion

- Potential emergency
- Refer early
- Consider pericardiocentesis for tamponade
  - Sxs, BP, heart rate, clinical paradoxus
  - Beware echo assessment if coexisting lung disease, pleural effusion or pulmonary hypertension
Pericardial effusion

- Subxiphoid
- VATS
- Mini left anterior thoracotomy
Conclusion

- Increasing complexity of staging and management
- Evolution of staging with need to incorporate histology, genetics etc
- Surgery – continued role for early stage disease and for palliation
- Role in selected more advanced cases
- Palliation challenging