Surgical therapy of lung cancer

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Considerations about lung cancer

• Lung cancer’s incidence and mortality in male the highest in Hungary
• Treatment is complex and diverse
• Smoking increasing the small cell lung cancer and the plano cc. incidence the most
• 10 % of the patient is non smoker (adenocc.)

• In the past two decades the incidence is increasing: In 2012 410,000 new patient in Europe and 5757 in Hungary
• In 2012 353,000 deaths causes lung cancer, 5750 in Hungary
• Az operability rate: 22%
Etiology
(Primary prevention)

Smoking

- In Europe at about 27% of people is smoking!
- The 85% of the patients is smoker, the heavy smokers risk is 15x higher!

Genetic susceptibility

Air pollution

Asbestos, heavy metals, radon exposure

Lifestyle (consumption habits, alcohol, stress)
Early detection (secondary prevention)

**Screening or not?**

**YES**
- 30-40% is diagnosed
- More patients found in early stages
- In these patients after the operation the survival is better

**NO**
- One year is a long time
- Too much false positive/negative
- Expensive
- Do not decrease the all mortality
- The screening methods are insufficient (low dose CT for screening?)
Aim of the preoperative tests

- Detection of the tumour, localisation
- Extension of the tumour, situation of the nearby anatomical parts and organs,
- Lymph node staging,
- Detection of the metastases,
- Design of the surgical treatment,
- Detection of the recidives
Primary lung cancer TNM system

„T” stage

<table>
<thead>
<tr>
<th>Diam</th>
<th>Scopy</th>
<th>Atelectasis</th>
<th>Invasion</th>
<th>Nodules</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>T1a &lt; 2cm</td>
<td>No invasion lobar bronchus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T1b: 2-3cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>T2a: 3-5cm</td>
<td>&gt; 2cm to carina</td>
<td>Lobar atelectasis or obstructive pneumonia to hilus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T2b: 5-7cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>&gt; 7cm</td>
<td>&lt; 2cm to carina</td>
<td>Whole lung</td>
<td>Chest wall diaphragm mediast pleura pericard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nodules in same lobe</td>
</tr>
<tr>
<td>T4</td>
<td>Tumor in carina</td>
<td></td>
<td>Heart great vessels trachea esophagus spine</td>
<td>Nodules in other ipsilateral lobes</td>
</tr>
</tbody>
</table>
"N" stage

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

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

N₁ Nodes
- 10 Hilar
- 11 Interlobar
- 12 Lobar
- 13 Segmental
- 14 Subsegmental
"M" stage

M1a

Other side of the lung metastasis
Pleural metastasis

M1b:

→ distant metastasis
brain
bone
adrenal glands
liver
Diagnostic opportunities

anamnestic history

physical examination

functional diagnostic:

- spirometry

- arterial Astrup

- laboratory test

- bicycle ergometry test
Noninvasive radiologica tests

Chest X-rays, CT scan

PET CT

Perfusion scintigrafi
Noninvasive radiological tests
Noninvasive radiological tests
Noninvasive radiological tests
Noninvasive radiological test
Noninvasive radiological tests
Noninvasive radiological test
PET CT - diagnostic indications

- Make the difference between malignant and benign masses, if other tests were insufficient
- Detection of the recidives
- Staging (TNM)
- Plan the optional place for biopsy
- In case of unknown tumours
PET CT test

**False positive**
- infections,
- positive benign lesions,
- sarcoidosis

**False negative**
- small size,
- adenocarcinomas, BAC with mucinous features
- high blood glucose
Invasive non surgical biopsies

**Bronchoscopy**

Biopsies:
- brush citology / excision,
- lavage,
- TBNA

**Transthoracic needle biopsy**
- X-rays
- Ultrasound
- CT
Invasive surgical biopsies

puncture / drainage (in case of pleural effusion)
Mediastinoscopy (single or extended)
- VAMLA (video assisted mediastinal lymphadenectomy),
- TEMPLA (transcervical extended mediastinal lymphadenectomy)

Lymph nodes:
# 1
# 2R, #2L
# 4R, #4L
# 7
NSCLC treatment algorithm

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<thead>
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<th>Stádium</th>
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<tbody>
<tr>
<td>IA</td>
</tr>
<tr>
<td>IB</td>
</tr>
<tr>
<td>IIA</td>
</tr>
<tr>
<td>IIB</td>
</tr>
<tr>
<td>IIIA</td>
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<tr>
<td>IIIB-IV.</td>
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</table>

- **IA**: Definitive radio-chemotherapy, operations only in solitary metastases of the brain, adrenal glands and liver.
- **IB**: Adjuvant chemotherapy
- **IIA**: Neoadjuvant chemotherapy
- **IIB**: Operation
- **IIIA**: Adjuvant chemotherapy
- **IIIB-IV.**: Adjuvant radio-chemotherapy

**Key Points**:
- NSCLC: Non-Small Cell Lung Cancer
- Treatment algorithm is based on tumor stage and treatment options.
- Stages IA, IB, IIA, IIB, IIIA, and IIIB-IV are defined.
- Treatment options include definitive radio-chemotherapy, operations, neoadjuvant chemotherapy, and adjuvant chemotherapy.
- Metastases in specific organs (brain, adrenal glands, liver) are considered in stage-specific treatment algorithms.
Surgical treatment of lung cancer

• Basis method: anatomical resection with the nearby lymph node (segment resection lobectomy, bilobectomy, pneumonectomy)

• Smaller (atypical) resection is an oncological compromise solution, only use in patients with high risk comorbidity
Type of the resections

1. Atypical resection:

wedge resection
Type of the resections

2. Anatomical resections:

- segmentectomy
- lobectomy
- pneumonectomy
Thoracotomy

Posterior lateral thoracotomy

Anterolateral thoracotomy
VIDEO LOBECTOMY
VATS
/Video assisted thoracoscopic surgery/
VATS lobectomy's advantages compared to open surgeries:

- Less postoperative complications \((Paul \ et \ al., \ 2010)\)
- Earlier hospital emission \((Scott \ et \ al., \ 2010)\)
- Better pulmonary function \((Kaseda \ et \ al., \ 2000)\)
- Less postoperative pain \((McKenna \ et \ al., \ 2006)\)
- Less costs \((Burfeind \ et \ al. \ 2010, \ Casali \ & \ Walker, \ 2009)\)
- Better access for adjuvant chemotherapy \((Lee \ et \ al., \ 2011)\)
VATS lobectomy indications

- I-II/A stadium is the optional...
VATS lobectomy indications

- Less than 6-cm tumor size
VATS lobectomy technic (I)

Utility 3-4 cm incision and two ports
VATS lobectomy technic (II)
One 3-4 cm incision (uniportal)
VATS lung resection
VATS lung resection

• Faster recovery and less hospital staying

1. day chest tube removing

Less pain killer is needed
Survival

In connection of overall survival there are no differences between the open and VATS technic.

(McKenna et al., 2006, Walker et al., 2003, Yamamoto et al., 2010, Rueth & Andrade, 2010)
General considerations in connection of lung resection
Histology distribution among the patients who get surgical treatment
Extended resection

*Involvement of the chest wall (T3):*

- If its take place inside the parietal pleura: extrapleural separation is enough
- If its beyond the chest wall: an block chest wall resection
- Adjuvant radiotherapy needed only in case of incomplet resection

*In case of T4:*

- carina- bifurcatio resection!
- pericardium resection!
- atrial resectio
- resection of the diaphragma (!)
- v. cava superior, or esophagus resection
Trachea and bronchus anastomosis
Inoperability of lung cancer

Inoperability – unresectability?

Absolutely inop.: - haematogenic dissemination in the other lung
  - pleuritis carcinomatosa
  - N3
  - distant metastases (except the following)

Relatív inop.: - n. recurrens paresis (left side N2, right side
  Pancoast tumour
  - n. phrenicus infiltration (middle lobe or lingula
tumours)
  - soliter metastases (brain, ipsilateral lung, adrenal
glands, liver)
  - v. cava sup. involvement
Inoperability because of AP intrapericardial infiltration
Infililtration of the left atrium
Infiltration of trachea and oesophagus
VATS pleura biopsy
VATS pleurodesis
Treatment of the „N2 disease”

- in cN2 suspect patients should confirm or exclude the diagnosis with histology
- under the operation revealed single stage N2 involvement, should make complete resection of the station!
- in case of Bulky, multilevel and beyond the capsule lymph node there is no point of operation (poor survival)
- in case of confirmed cN2 neoadjuvant chemotherapy needed and the restaging: in case of regression operation
- in case of residual N2 radiotherapy
- 15-30% the 5 years survival
N2 stage
Pancoast tumour
(sulcus superior tumor)

- take place in the apex of the lung and growing extrapulmonary the most involving the nearby structures (rib, vertebra, plexus br., a.v. subclavia)

- shoulder pain (+Horner-triad, paresis)

- MRI !!!

- in case of N2 there is no point of operation!

- Preoperative radiotherapy, and after 3-4 weeks, operation (an block resectio)

- Postoperative radiotherapy

- 5 years overall survival is 30%
Pancoast tumour
(sulcus superior tumour)
Treatment of the local recidives

- local recidives can be in the *resection surface* (parenchyma, bronchus), or in the *regional lymph ways*

- *recidives in the lymph nodes/ways are not oncologically potential* for surgical resection!

- re-resection is possible, but before the operation exclude the metastases

- wedge resections contains higher risks for local recidives
Adjuvant chemotherapy

- IA(T1N0): no need, IB(T2N0): ?, II(T1-2-3N1): need
  higher 5 years survival with 4-15%!
- 3-4 cycle platina based chemotherapy in 4-8 weeks after the operation.

N2-mediastinal lymph node
Involvement of chest wall (Pancoast!)
T4 tumours(?)
Haematogenous dissemination
Inkomplekt resection

III-IV. stádiumban
Neoadjuvant chemo-/radiotherapy

- Pancoast tumours
- N-2 diseases:
  1. chemotherapy
  2. restaging (50-70% remission)
  3. operation
  4. (adjuvant treatment)
Surgical treatment of SCLC
General considerations

- 15-20% of the lung cancers
- in female is more common
- its place central in the lung
- high malignancy
- early metastases (brain, bone, lymph nodes, adrenal glands, liver)
- Part of the neuroendocrine tumours family
- Should difference between the carcinoid an anaplastic carcinoma
Clinical presentation

Two groups:

→ *Limited disease* (40%): tumour is localised to the hemithorax (including ipsi- or contralateral lymph node metastases or pleural effusion)

→ *Extensive disease* (60%): diseases exceed the hemithorax or makes distant metastases
Surgical treatment of SCLC

• In case of „very limited disease” = T1N0 and T2N0
• N1=?,
• N2 = there is no reason for the operation!

• Before the lung resection diagnostic mediastinoscopy should be performed for exclude N2 metastases
SCLC treatment algorithm

- Confirm SCLC with biopsy
- Staging
- Patients with negative N2 disease in the chest CT should undergo mediastinoscopy
- OPERATION
  - Adjuvant chemotherapy, in case of N2 involvement
  - Radiotherapy
- Prophylactic brain radiation
Pneumotorax and hydrothorax

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• **Basics:** air penetration into pleural cavity that results:
  - partial or total lung collapse
  - reduced ventilation surface
  - reduced respiratory muscle effectivity
  - shunt-circulation
  - mediastinal shift and reduced cardiac preload

• **Incidence:** 20-30/100,000 hab.; peaks of incidence between the ages of 20-30 and 60-70 years; 4-5 times more frequently in males;
PTX classification 1.

- **Etiology:**
  - **Spontaneous:**
    - **Primary:** rupture of subpleural bullae
    - **Secondary:**
      - COPD
      - Cystic fibrosis
      - Oesophageal rupture
      - Marfan syndrome
      - Eosinophil granuloma
      - Lung carcinoma
      - Pneumocystis carinii - AIDS
      - Metastasis - sarcoma
      - Pulmonary abscess
      - **Catamenial (endometriosis)**
      - Asthma
  - **Traumatic:** barotrauma, chest wall injury, surgery
  - **Iatrogenic:** central venous canulation, transthoracic biopsy or nerve block, transbronchial biopsy, pleural puncture, abdominal surgery
PTX classification 2.

Pathophysiology and clinical presentation:

- **Closed (simple)** – usually small amount of air is present without persistent air leak; spontaneous absorption in a couple of days;
- **Open** – persistent parenchymal or chest wall air leak after partial or total lung collapse
- **Tension ptx.**
- **Haemoptx.** – *(rupture of bullae)*
- **Simultaneous bilateral ptx.**

**EMERGENT THERAPY**
PTX classification 3.

Localization and size:

- apical, bazal, mediastinal, dorsal, ventral
- Partial or total ptx. – collapsed lung
  - Small (<2cm) or large ptx (if >2 cm)
Diagnosis

• **Complains**: chest pain, dyspnoe, cough; *12% without any complain*

• **Symptoms**: attenuated respiratory murmur and tympanic resonance, diminuated phremitus;
  
  *tension ptx* results neck vein dilatation, cyanosis, CV instability, sc. emphysema - pneumomediastinum

• **Exams**:
  
  **Chest X-Ray**:
  
  – if mediastinal shift or/and diaphragmatic depression present – **consider tension PTX**
  
  – if air-fluid level present – **consider haemoptx or seroptx**.

  **CT**: parenchymal quality, presence of bullae
  
  differential dg. of giant bulla or ptx. – therapeutic choice!

• **Differential dg.**: AMI, PE, COPD exacerbation, pneumonia, hydrothorax, haemothorax

• **Complications**: prolonged air leak, subcutaneous emphysema, tension ptx – haemo ptx. with CV instability, hypoxia – respiratory failure; sero-ptx, infection due to prolonged air leak and/or atelectasia, empyema;
Terapy

**Terapeutic choices :**
- Conservative – bed rest and observation
- **Needle aspiration** – high recurrence rate
- **chest drainage** – „gold standard”
- **Operative treatment :** VATS or open surgery

**Indication of surgical therapy** - usually in young patient without advanced stage underlying parenchymal disease !!!

- **First PTX and**
  - Prolonged air leak
  - Persistent lung collapse after correct chest drainage
  - bilateral ptx
  - haemo-px. (HTX)
  - Specific profession (pilot, diver, trumpeter etc.)

- **Recidivant PTX**
  - Same side recurrence
  - Isolated environment with limited access to medical treatment
  - tension ptx
  - Presence of resectable bullae on chest CT
Pleural effusion
Etiology

➢ **Transudative effusion**

A) Heart failure  
B) Hepatic cirrhosis  
C) Nephrosis sy.  
D) Glomerulonephritis  
E) Myxodema  
F) Pulmonar artery embolism  
G) Sarcoidosis

➢ **Exudative effusion**

A) **malignancy**  
   1) pleural carcinosis  
   2) mesothelioma pleurae  

B) **Inflammatory**  
   1) bacterial infection  
   2) tuberculosis  
   3) mycosis  
   4) parasitic  
   5) viral infection  

C) **Pulmonar artery embolism**

D) **Gastrointestinal diseases**  
   1) Pancreatitis  
   2) Subdiaphragmatic abscess  
   3) Intrahepatic abscess  
   4) Oesophageal perforation  
   5) diaphragmatic hernia

E) **Autoimmune deseases**  
   1) Rheumatoid pleuritis  
   2) SLE  
   3) Wegener granulomatosis  

F) **Drug adverse effects**

G) **Miscellaneos**  
   1) Asbestosis  
   2) Irradiation  

H) **Haemothorax**

I) **Chylothorax**
Malignant pleural effusion - MPE

- **Definition**: condition in which cancer causes directly or indirectly (post stenotic pneumonia, malignant hepatic effusion, tumor-related malnutrition) an abnormal amount of fluid to collect between pleural layers.

- **Epidemiology and prognosis**: in 15% of patient died due to malignant disease; 42% of exudative effusions are malignant
  - Median survival 6 month (worst prognosis related to lung cancer, better in ovarian cc.)

- **Etiology**: 
  - **Man**: lung, haematological, gastrointestinal, urological malignancies
  - **Woman**: breast, lung, ovarian, haematological malignancies

- **Diagnosis**: 
  - symptoms - dyspnoe, chest pain, cough;
  - **X-Ray**
  - **Thoracocentesis** – fluid analysis; sensitivity of citology is low (60-90%) - consider only positive results
  - **CT** – primary tumor diagnosis, staging
  - **Pleuroscopy** - VATS sensitivity 96%; (blind pleural biopsy 40-75%)
  - **BRFSC**
MPE - therapy

- **Repeted thoracentesis** – in poor general condition

- **Pleurodesis** – „gold standard”- large particle size *Talcum in 5g dose* –
  - **Talc slurry - instillation**
  - **Talc poudrage – insuflation** – advantages: direct vision of pleura and lung expansion, biopsy, uniform dispersion of talc
  - complications: ARDS, heart failure due to microembolisation;
  - Contraindication: „trapped lung „.

- **Chronic indwelling pleural catheter** *(PleurX)*
  - pleurodesis failure, contraindication;
  - advantages: more easier, less complication
  - 50% spontan pleurodesis rate, even in case of trapped lung!

- **Pleurectomy** –sometimes in cases when very good condition and more than 6 month expected survival is present
  - **Emerging therapies:** – very few evidence
    - Hipertermic intrapleural chemotherapy,
    - hipotonic ip. chemotherapy
Empyema thoracis

- **Definition**: purulent fluid in the pleural cavity!
- **Epidemiology**: in case of community-acquired pneumonia:
  - 20-50% will develop parapneumonic fluid
  - 2-5% will develop late stage empyema
- **Etiology**:
  - parapneumonic 60% *(mostly in community-acquired pneumonia)*
  - Iatrogenic, surgical infection 16%
  - open chest injury 10%
  - TBC 6%
  - Pulmonar embolism 4%
  - Malignant pleural effusion 2%
  - aspergillosis 2%
  - actinomycosis 0.3%
- **Bacterial background**: 50-60% positive culture!
  - In community acquired pn.: Stafilooccus, Streptococcus;
  - In nosocomial pn.: mostly Klebsiella, Pseudomonas and other Gram negatives
Empyema thoracis
Empyema thoracis

- **Symptoms**: cough, fever, dyspnoe, thoracic pain, septicaemia! ...in late stages – retraction of affected hemithorax
- **Diagnosis**: - thoracocentesis indicated when fluid is more than 10 mm or septum presence on US
- Fluid sample is purulent and/or bacteriology is positive
- Fluid analysis:
  - pH < 7.00
  - glucose < 60 mg/dL
  - LDH > 1000U/l
- **Stages**:
  - **Exudative** – lung expansion not affected
  - **Fibrinopurulent** – lung expansion can be affected, worst stage for decortication
  - **Organised** – trapped lung, usually good for decortication
- **Complications**:
  - Recurrent pneumonia
  - Broncho-pleural fistula
  - Empyema necessitatis
  - Mediastinitis
  - Osteomyelitis
  - Haematogen spreading – abscesses

<table>
<thead>
<tr>
<th></th>
<th>Stage I (exudative)</th>
<th>Stage II (fibrinopurulent)</th>
<th>Stage III (organised)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleura</td>
<td>Thin</td>
<td>Fibrin deposition/loculi</td>
<td>Thick</td>
</tr>
<tr>
<td>Fluid appearance</td>
<td>Clear</td>
<td>Opalescent</td>
<td>Pus</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Sterile</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>pH</td>
<td>&gt;7.2</td>
<td>&lt;7.2</td>
<td>&lt;7.2</td>
</tr>
<tr>
<td>Lactate dehydrogenase (LDH)</td>
<td>&lt;500 IU</td>
<td>&gt;1000 IU</td>
<td>&gt;1000 IU</td>
</tr>
<tr>
<td>Glucose</td>
<td>&gt;60 mg/dL</td>
<td>&lt;60 mg/dL</td>
<td>&lt;60 mg/dL</td>
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</tbody>
</table>
Empyema therapy

- Antibiotics
- Thoracentesis, chest tube
- Fibrinolysis
- VATS debridement
- Decortication
- Omentoplasty
- Myoplasty (intrathoracic muscle transfer)
- Thoracomyoplasty
- Open-window thoracostomy (pleurostomy)
Myoplasty
(m. pectoralis, m. latissimus, m. serratus)

**Advantages:**
1. Easy and accessible dissection
2. Rich vascularization
3. Long muscular flap with big volumen
4. Non-worsening respiratory volumes

**Disadvantages:**
1. Require experience
2. Longer operation time
Chylothorax

- **Etiology:** damage of ductus thoracicus or other major branch
  - Congenital (perinatal injury, atresia)
  - Trauma (open or blunt trauma, operation)
  - Tumor (lymphoma, lung cancer)
  - Inflammation (tbc, filariasis other)
  - Other reason (VCS syndrome, pancreatitis)

- **Treatment:**
  - Conservativ therapy: carentia, total parenteral nutrition
  - Surgical therapy: thoracic drainage, VATS, open thoracic surgery (ligation, pleurectomy)
  - Irradiation
  - Chemotherapy
Thank you for your attention!