Management of CAD: Drugs, PCI or CABG?

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Disclosures

- **Speaker honoraria:**
  - Astra Zeneca, St. Jude Medical, Menarini
Case: Mr. J. K. 68 years

Admission 11/2012

- COPD Gold IV
  - Former smoker (50 PY)
  - Diffuse lung emphysema
  - Scheduled for bilateral LVRS
- Psoriasis
- St. n. upper GI-bleeding 6/2009

Patient referred by his pneumologist for preoperative cardiological assessment
Case: Mr. J. K. 68 years

Present history:
Severely symptomatic in light daily activities, dyspnea attacks at rest
No regular exacerbations
Irregular $O_2$-concentrator use

Medication:
Symbicort TH 400 (Budensoide/Formoterol), Spiriva (Tiotropium bromide) 1x/d, Aspirin 100mg 1x/d, Pantoprazol 40mg irregularly

«By the way, I’m diabetic (diet treatment)…»
Case: Mr. J. K. 68 years

Clinical examination:
171cm, 61kg, RR 15/min (prolonged expiration), BP 120/80mmHg, HR 90%, SpO₂ 95%, clinical signs of emphysema, cardiac examination without pathological findings
Case: Mr. J. K. 68 years

Laboratory testing:

<table>
<thead>
<tr>
<th>Electrolyte and Water Balance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Natrium (mmol/l)</td>
<td>136 - 145</td>
</tr>
<tr>
<td>Kalium (mmol/l)</td>
<td>3.3 - 4.5</td>
</tr>
<tr>
<td>Härne</td>
<td></td>
</tr>
<tr>
<td>Harnstoff (mmol/l)</td>
<td>2.06 - 8.21</td>
</tr>
<tr>
<td>Kreatinin (μmol/l)</td>
<td>62 - 106</td>
</tr>
<tr>
<td>GFR nach CKD-EPI-Formel (ml/min)</td>
<td>&gt;90 (1)</td>
</tr>
<tr>
<td>Enzyme</td>
<td></td>
</tr>
<tr>
<td>LDH (Laktat-Dehydrogenase) (U/l)</td>
<td>240 - 480</td>
</tr>
<tr>
<td>AST (GOT) Aspartat-Aminotransferase (U/l)</td>
<td>&lt; 50</td>
</tr>
<tr>
<td>ALT (GPT) Alanin-Aminotransferase (U/l)</td>
<td>10 - 50</td>
</tr>
<tr>
<td>GGT (g-Glutamyltranspeptidase) (U/l)</td>
<td>8 - 61</td>
</tr>
<tr>
<td>ALP (alkaline Phosphatase) (U/l)</td>
<td>40 - 129</td>
</tr>
</tbody>
</table>

| Inflammation |  |
| CRP (C-reactive Protein) (mg/l) | < 5 | 1.0 |

| Diabetes and Energy Status |  |
| Glucose spontan (mmol/l) | < 11.1 | 8.9 (2) |
| HbA1c n.NGSP | % 4.8 - 5.9 | * 6.0 (3) |
| HbA1c nach IFCC (mmol/mol) | 29 - 42 | 42 |

| Blood Status |  |
| Hemoglobin (g/l) | 134 - 170 | 134 |
| Hämoglobinerit | 1/1 0.400 - 0.500 | 0.402 |
| Erythrozyten (μl/l) | 4.2 - 5.7 | 4.41 |
| MCV | fl 80 - 100 | 91.2 |
| MCH | pg 26 - 34 | 30.4 |
| MCHC | g/l 310 - 360 | 333 |
| Thrombozyten (automatisch) (G/l) | 143 - 400 | 243 |
| Leukozyten (G/l) | 3.0 - 9.6 | 8.43 |

| Haostase Untersuchungen |  |
| Globaltests |  |
| Quick (automat) % | >70 | 109 |
| INR (%) | <1.2 | 1.0 |
Case: Mr. J. K. 68 years

ECG:
Case: Mr. J. K. 68 years

Thorax Rx:
Case: Mr. J. K. 68 years

Lung function testing:

Lungenfunktion: Gesamtprotokoll

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Einheit</th>
<th>Soll</th>
<th>% Soll</th>
<th>Pre</th>
<th>% Pre</th>
<th>Post</th>
<th>% Post</th>
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<tbody>
<tr>
<td>IVC</td>
<td>l</td>
<td>3.90</td>
<td>2.09</td>
<td>53</td>
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<tr>
<td>ERV</td>
<td>l</td>
<td>1.08</td>
<td>1.24</td>
<td>121</td>
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<tr>
<td>JC</td>
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<tr>
<td>FVCex</td>
<td>l</td>
<td>3.77</td>
<td>1.92</td>
<td>51</td>
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<tr>
<td>FEV1</td>
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<td>0.57</td>
<td>19</td>
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<tr>
<td>FEV1/IVC</td>
<td>%</td>
<td>75</td>
<td>27</td>
<td>36</td>
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<td></td>
<td></td>
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<tr>
<td>FEV1/FVCex</td>
<td>%</td>
<td>75</td>
<td>29</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PEF</td>
<td>l/s</td>
<td>7.77</td>
<td>2.39</td>
<td>31</td>
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<tr>
<td>MEF75</td>
<td>l/s</td>
<td>6.92</td>
<td>0.38</td>
<td>5</td>
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<tr>
<td>MEF50</td>
<td>l/s</td>
<td>4.05</td>
<td>0.29</td>
<td>7</td>
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<tr>
<td>MEF25</td>
<td>l/s</td>
<td>1.38</td>
<td>0.20</td>
<td>14</td>
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<tr>
<td>MEF25-75</td>
<td>l/s</td>
<td>3.14</td>
<td>0.23</td>
<td>7</td>
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</tbody>
</table>

Bodyplethysmographische Resistance

RAWtot | kPa*l/s 0.30 1.95 651

sRAWtot | kPa*l/s 1.05 12.84 1218

Bodyplethysmographische Volumina

TG | l 3.51 6.57 187

TLC | l 6.58 7.42 113

RV | l 2.48 5.33 215

TG/TLC | % 58 89 153

RV/TLC | % 40 72 179
Case: Mr. J. K. 68 years

6min walking test:
375m (Borg 5)

SpO2 pretest  95%  SpO2 posttest  90%
HR pretest  88/min  HR posttest  78/min
Case: Mr. J. K. 68 years

CT:

Homogeneous bilateral emphysema

Slightly dilated RV, dilated main pulmonary artery
Case: Mr. J. K. 68 years

Echo:
- Normal LVEF without regional wall motion abnormalities
- Normal RV-Function
- No valvular abnormalities
- $dP_{RV/RA} = 42\text{mmHg}$
Case: Mr. J. K. 68 years

- Surgery not possible
- Proceed to surgery without further testing
- Exercise testing
- Non-invasive imaging
- Right Heart Catheterization
- Coronary Angiogram
- Gastroscopy
Case: Mr. J. K. 68 years

LVRS exclusion criteria:

- History and physical examination consistent with emphysema
- CT scan evidence of bilateral emphysema
- Prehabilitation postbronchodilator TLC > 100% predicted
- Prehabilitation postbronchodilator RV > 150% predicted
- Prehabilitation FEV₁ (maximum of pre- and postbronchodilator values) < 45% of predicted and, if age > 70 yr prehabilitation, FEV₁ (maximum of pre- and postbronchodilator values) < 15% of predicted
- Prehabilitation room air, resting PaO₂ < 60 mm Hg (<55 mm Hg in Denver)
- Prehabilitation room air, resting PaCO₂ > 45 mm Hg (>30 mm Hg in Denver)
- Prehabilitation plasma cotinine > 13.7 ng/ml (if not using nicotine products) or prehabilitation arterial carboxyhemoglobin > 2.5% (if using nicotine products)
- Body mass index < 31.1 (males) or < 32.3 (females) as of randomization
- Non-smoker (tobacco products) for 4 mo before initial interview
- Approval for surgery by cardiologist if any of the following: unstable angina, left ventricular ejection fraction cannot be estimated from the echocardiogram, left ventricular ejection fraction < 45%, dobutamine-radiosonde cardiac scan indicates coronary artery disease or ventricular dysfunction, >5 premature ventricular beats/min (rest), cardiac rhythm other than sinus or premature atrial contractions noted during resting EKG, S₁ gallop on physical examination
- Completion of all prehabilitation assessments
- Judgment by study physician that patient is likely to be approved for surgery on completion of the rehabilitation program
- Completion of NETT rehabilitation program
- Completion of all postrehabilitation and all randomization assessments

Exclusion Criteria
- CT scan evidence of diffuse emphysema judged unsuitable for LVRS
- Previous LVRS (laser or excision)
- Pleural or intrathoracic disease that precludes surgery
- Giant bulla (>one-third of the volume of the lung)
- Clinically significant bronchiectasis
- Pulmonary nodule requiring surgery
- Previous pneumonectomy or lobectomy
- Myocardial infarction within 6 mo of interview and ejection fraction < 45%
- CHF within 6 mo of interview and ejection fraction < 45%
- Uncontrolled hypertension (systolic > 200 mm Hg or diastolic > 110 mm Hg)
- Pulmonary hypertension: mean Ppa on right heart catheterization > 35 mm Hg (>38 mm Hg in Denver) or peak systolic Ppa on right heart catheterization > 45 mm Hg (>50 mm Hg in Denver); right heart catheterization is required to rule out pulmonary hypertension if peak systolic Ppa on echocardiogram > 45 mm Hg
- Unplanned, unexplained weight loss > 10% usual weight in 90 d before interview or unplanned, explained weight loss > 10% usual weight in 90 d before interview
- History of recurrent infestations with daily sputum production judged clinically significant
- Daily use of >20 mg of prednisone or its equivalent
- History of exercise-related syncope
- Resting bradycardia (<50 beats/min), frequent multifocal PVCs, or complex ventricular arrhythmia or sustained VT
- Cardiac dysrhythmia that poses a risk to the patient during exercise testing or training
- Oxygen requirement during resting or oxygen titration exceeding 6 l/min to keep saturation >90%
- Evidence of systemic disease or neoplasm that is expected to compromise survival
- Any disease or condition that may interfere with completion of tests, therapy, or follow-up
- 6MWD < 140 m postrehabilitation
- Inability to complete successfully any of the screening or baseline data collection procedures
Case: Mr. J. K. 68 years

CAD in LVRS?

Coronary Artery Disease in Patients Undergoing Lung Volume Reduction Surgery for Emphysema*

(CHEST 1997; 112:122-28)

Robert Thurnheer, MD; Jörg Muntwyler, MD; Uz Stammberger, MD; Konrad E. Bloch, MD, FCCP; Andreas Zollinger, MD; Walter Weder, MD; and Erich W. Russi, MD, FCCP

Coronary Angiography Findings and Left Heart Function in Asymptomatic Patients

In 35 patients, no significant CAD was found, but 6 of 41 patients (15%) without a history of CAD were documented to have significant CAD by coronary angiography. All had an ejection fraction above 50% and a mean pulmonary capillary wedge pressure within the normal range (<15 mm Hg) as assessed by right and left heart catheterization (Table 1).
Case: Mr. J. K. 68 years

Cardiac Catheterization (Hemodynamics):
HMV: 5.1 l/min (Fick). CI: 3 l/min/m²
Case: Mr. J. K. 68 years

Cardiac Catherization (Coronary Angiogram):
Case: Mr. J. K. 68 years

Cardiac Catherization (Coronary Angiogram):
Case: Mr. J. K. 68 years

Another additional diagnosis....

Eingriff

PTEE und LTL (200 000E Urokinase) des akuten Verschlusses Tr.tibiofibularis, A.tib.ant und A.tib.post rechts

☐ PTA  ☒ LTL  ☒ PTEE  ☐ Stent  ☐ Stentgraft  ☐ Atherektomie  ☐ Drug-coated PTA  ☐ DES  ☐ REENTRY-DEVICE

Detaillierte Angaben zur Intervention

PTA = perkutane transluminale Angioplastie

PTEE = perkutane Thrombenbolektomie / LTL = lokale Thrombolyse / DES = drug eluting stent
Case: Mr. J. K. 68 years

SPECT:
Case: Mr. J. K. 68 years

LVRS Risks:

Major pulmonary and cardiovascular morbidity (assessed in the 30 d after LVRS) occurred in 29.8 and 20% of patients, respectively. Pulmonary morbidity was greater in older patients ($P = 0.02$), and those with lower FEV$_1$ ($P = 0.05$) or D$_{LCO}$ (0.97; $P = 0.01$). Cardiovascular morbidity was higher with age (1.07; $P = 0.004$), use of oral steroids ($P = 0.04$), or in the presence of non-upper lobe–predominant emphysema ($P < 0.001$).
Case: Mr. J. K. 68 years

LVRS Benefits:

Exercise capacity improvement

Survival

The National Emphysema Treatment Trial (NETT)
Part II: Lessons Learned about Lung Volume Reduction Surgery
Am J Respir Crit Care Med Vol 184, pp 881–893, 2011
Case: Mr. J. K. 68 years

CAD Revascularization Benefits:

Hachamovitch et al., Circulation 1998; 97:535-43
Case: Mr. J. K. 68 years

- COPD Gold IV
  - Diffuse lung emphysema, scheduled for bilateral LVRS
  - mPAP=27mmHg
- Coronary Artery Disease
  - Mid-LAD-CTO, 50% stenosis of first marginal branch
  - >20% Ischemia (SPECT)
  - Normal LVEF, CI=3.0 l/min/m²
- Peripheral Artery Disease
  - Acute ischemic limb syndrome post angiography 11/12
- Diabetes mellitus Typ2
  - On diet
  - HbA1c 6.7%
- Psoriasis
- St. n. upper GI-bleeding 6/2009
Case: Mr. J. K. 68 years

- Surgery not possible, OMT
- Proceed to surgery on OMT
- Full CABG pre LVRS
- Full PCI pre LVRS
- MIDCAB and OM-PCI (Hybridrevascularization) pre LVRS
- Combined LVRS/CABG procedure
- Revascularization post LVRS
- Sildenafil
Thank You

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