Rehabilitation and Lung Cancer Resection

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Mayo Clinic
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Disclosure

• Funded by the National Cancer Institute NIH for “Preoperative Rehabilitation before Lung Cancer Resection” (NCI RO1)
Operative risk prevent sometime the most effective Rx for lung cancer: surgery

• Post operative pulmonary complications are the major cause of M/M after surgery
  Stephan et al Chest 2000

• Patients that develop PPCs have a more prolonged hospital stay
Predictors of PPCs

- **Airway obstruction** (Mitsudomi et al. Sekine et al.)
- **Decreased lung diffusion** (Vaporciyan et al, Melendez et al. Wang et al)
- **Hyperinflation and Hypoxemia** (Uramoto et al.)
- **Current smoker** (Vaporciyan et al, Warner et al, Bonde P.)
- **Decrease exercise capacity** (Bolliger et al, Sciurba, Smith et al, Brustche et al)
Strategies to decrease PPCs

• Smoking cessation (unclear time frame to be effective)

• Improve exercise capacity: Pulmonary Rehabilitation (not defined length and component of the intervention)
Exercise capacity as predictor of complications


**COMPlications OF LUNG RESECTION AND EXERCISE CAPACITY: A META-ANALYSIS**

Roberto Benzo, MD, MSc, FCCP<sup>1,4</sup>, George A. Kelley, DA, FACSM<sup>2</sup>, Laura Recchi, MSc<sup>3</sup>, Albert Hofman, M.D., PhD<sup>4,5</sup>, and Frank Sciurba, MD, FCCP<sup>1</sup>

Benzo et al.
Post operative cardio-pulmonary complications

- Prolonged mechanical ventilation (>48hs)
- Pneumonia
- Atelectasis
- Respiratory failure
- Acute hypercapnia or need of home O2
- Death
• 12 patients denied to surgery were invited to participate in an in-patient Rehab Program
• 4 week in-patient PR—five sessions a week 3 h each
• Mean improvement in 6MWT: 79m (range 10-260 m)
• 2/12 patients had complications (25%)
Post-operative respiratory rehabilitation after lung resection for non-small cell lung cancer

CesarioA et al Lung Cancer (2007) 57, 175—180

• N=25 in-patient Rehab
• Five 3-hour sessions each week (mean, 18.2 sessions) during a hospital stay of 26±3 days.
• 6MWT improved 100 m in the PR group
Effects of Presurgical Exercise Training on Cardiorespiratory Fitness Among Patients Undergoing Thoracic Surgery for Malignant Lung Lesions

Jones et al, Cancer 2007;110:590–8

• 3 weeks, 5 times a week training
• 20 patients, 72 % adherence
• VO2 improved 2.4 ml/kg/min (3.3 per protocol analysis)
• No complications reported
Preoperative pulmonary rehabilitation in patients undergoing lung resection for non-small cell lung cancer


- 12 patients with low exercise capacity were offered PR, 11 operated
- VO2 (mean) 13ml/kg/min
- FEV1 (mean) 47%
4 week pre op

- Morano MT, N=12

- PR group had a lower incidence of postoperative respiratory morbidity (P=.01)
- Shorter length of postoperative stay (12.2±3.6d vs 7.8±4.8d, respectively; P=.04)
- Chest tube for fewer days (7.4±2.6d vs 4.5±2.9d, respectively; P=.03) compared with the CPT arm.
What do we learn for the evidence?

• Non randomized studies with small number of patients
• Exercise capacity is likely improved when adding preop rehab and likely improve post operative outcome
Rehabilitation and lung cancer resection


Schmidt-Hansen M,
Post op Rehab after discharge

- Stigt JA,

Rehabilitation did not result in a better QOL. Exercise tolerance improved at the cost of more pain and more limitations because of physical problems. We suggest that rehabilitation is better postponed for 3 to 4 months after hospital discharge.
Training the Respiratory Muscles

Preoperative Intensive Inspiratory Muscle Training to Prevent Postoperative Pulmonary Complications in High-Risk Patients Undergoing CABG Surgery: A Randomized Clinical Trial

Erik H. J. Hulzebos; Paul J. M. Holders; Nine J. Faviè; et al.


Conclusion  Preoperative IMT reduced the incidence of PPCs and duration of postoperative hospitalization in patients at high risk of developing a pulmonary complication undergoing CABG surgery.
<table>
<thead>
<tr>
<th>Outcome</th>
<th>IMT Group (n = 139)</th>
<th>Usual Care Group (n = 137)</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of postoperative hospitalization, median (range), d</td>
<td>7 (5-41)</td>
<td>8 (6-70)</td>
<td></td>
<td>.02</td>
</tr>
<tr>
<td>Level of PPC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>114 (82.0)</td>
<td>89 (65.0)</td>
<td>1.90 (1.09-3.38)</td>
<td>.02</td>
</tr>
<tr>
<td>Grade 2</td>
<td>14 (10.1)</td>
<td>18 (13.1)</td>
<td>0.63 (0.41-0.95)</td>
<td>.02</td>
</tr>
<tr>
<td>Grade 3</td>
<td>10 (7.2)</td>
<td>24 (17.5)</td>
<td>0.44 (0.23-0.84)</td>
<td>.01</td>
</tr>
<tr>
<td>Grade 4</td>
<td>1 (0.7)</td>
<td>6 (4.4)</td>
<td>0.20 (0.02-1.64)</td>
<td>.09</td>
</tr>
<tr>
<td>PPC grade ≥2</td>
<td>25 (18.0)</td>
<td>48 (35.0)</td>
<td>0.52 (0.30-0.92)</td>
<td>.02</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>9 (6.5)</td>
<td>22 (16.1)</td>
<td>0.40 (0.19-0.84)</td>
<td>.01</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; IMT, inspiratory muscle training; PPC, postoperative pulmonary complication.

*Data are presented as number (percentage) unless otherwise specified.
Box 2. Operational Definitions of Postoperative Pulmonary Complications*

Grade 1
Cough, dry
Microatelectasis: abnormal lung findings and temperature >37.5°C without other documented cause; results of chest radiograph either normal or unavailable
Dyspnea, not due to other documented cause

Grade 2
Cough, productive, not due to other documented cause
Bronchospasm: new wheezing or preexistent wheezing resulting in change therapy
Hypoxemia: alveolar-arterial gradient >29 and symptoms of dyspnea or wheezing
Atelectasis: radiological confirmation plus either temperature >37.5°C or abnormal lung findings
Hypercarbia, transient, requiring treatment, such as naloxone or increased manual or mechanical ventilation
Adverse reaction to pulmonary medication

Grade 3
Pleural effusion, resulting in thoracentesis
Pneumonia, suspected: radiological evidence without bacteriological confirmation
Pneumonia, proved: radiological evidence and documentation of pathological organism by Gram stain or culture
Pneumothorax
Reintubation postoperative or intubation, period of ventilator dependence does not exceed 48 hours

Grade 4
Ventilatory failure: postoperative ventilator dependence exceeding 48 hours, or reintubation with subsequent period of ventilator dependence exceeding 48 hours

*Source: Kroenke et al.23
Preoperative PR in for Lung Cancer patients with COPD

- 2 weeks inpatient rehab
- Walking 5000 steps per day
- Abdominal and Breathing exercises (pursed lips, huffing and coughing) 5 times a day
- Incentive Spirometry
- Reduction of LOS by 30% (29 to 21 days)
Watch for emotional health

- Pompili C

- Patients with a worse mental health (p=0.0007) deteriorates physically and emotionally after surgery
We have some ideas
Exploratory studies to find a “Dose” of Pre op Rehab (NCI K23 Roberto Benzo)

• 4 weeks of preoperative (5 hospitals, large volume) : UN recruitable (patients do not want to wait)

• 10 sessions or Rehab before surgery including non standard components showed to be a feasible intervention (results below)
Preoperative pulmonary rehabilitation before lung cancer resection: Results from two randomized studies

Roberto Benzo\textsuperscript{a,*}, Dennis Wigle\textsuperscript{b}, Paul Novotny\textsuperscript{c}, Marnie Wetzstein\textsuperscript{a}.
Preoperative pulmonary rehabilitation before lung cancer resection: Results from two randomized studies

Roberto Benzo\textsuperscript{a,}\textsuperscript{,}*, Dennis Wigle\textsuperscript{b}, Paul Novotny\textsuperscript{c}, Marnie Wetzstein\textsuperscript{a}.

• 10 pre operative rehabilitation sessions (twice a day for 5 days (Mayo) or once a day for 10 days):

• SE based exercise training

• Inspiratory muscle training

• A breathing Practice targeting pursed lips for 15 minutes every session,
P flex

• Adjust inspiratory Resistance to Borg of 5
Brief 2 second forceful inspiration and the
## Preliminary data: Mayo Clinic

<table>
<thead>
<tr>
<th></th>
<th>Control (N=9)</th>
<th>Pulmonary Rehabilitation (N=10)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>72.0 (6.69)</td>
<td>70.2 (8.61)</td>
<td>0.71</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>5 (56%)</td>
<td>5 (50%)</td>
<td>0.81</td>
</tr>
<tr>
<td>Current Smoker, n (%)</td>
<td>2 (22%)</td>
<td>1 (10%)</td>
<td>0.47</td>
</tr>
<tr>
<td>Cigarettes Per Day, mean (SD)</td>
<td>26 (7.2)</td>
<td>24 (14.3)</td>
<td>0.37</td>
</tr>
<tr>
<td>Years Smoked Cigarettes, mean (SD)</td>
<td>46 (6.4)</td>
<td>43 (10.4)</td>
<td>0.62</td>
</tr>
<tr>
<td>Coronary Artery Disease (%)</td>
<td>1 (11%)</td>
<td>3 (30%)</td>
<td>0.31</td>
</tr>
<tr>
<td>Heart Failure, n (%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>--</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>3 (33%)</td>
<td>3 (30%)</td>
<td>0.88</td>
</tr>
<tr>
<td>MRC Dyspnea Score</td>
<td>2.0 (0.82)</td>
<td>2.3 (1.49)</td>
<td>0.43</td>
</tr>
<tr>
<td>FEV1 % Predicted</td>
<td>52.1 (13.32)</td>
<td>43.4 (10.18)</td>
<td>0.11</td>
</tr>
<tr>
<td>DLCO % predicted</td>
<td>60.3 (18.32)</td>
<td>48.9 (10.79)</td>
<td>0.24</td>
</tr>
<tr>
<td>Residual Volume % predicted</td>
<td>160.4 (31.1)</td>
<td>186.4 (57.97)</td>
<td>0.60</td>
</tr>
<tr>
<td>Outcome Measure</td>
<td>Control (N=9)</td>
<td>Pulmonary Rehabilitation (N=10)</td>
<td>Total (N=19)</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------------</td>
<td>---------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Days in Hospital, mean (SD)</td>
<td>11.0 (6.3)</td>
<td>6.3 (3.0)</td>
<td>8.5 (5.3)</td>
</tr>
<tr>
<td>ICU Hours, mean (SD)</td>
<td>40.5 (75.2)</td>
<td>14.9 (44.7)</td>
<td>26.9 (60.4)</td>
</tr>
<tr>
<td>PPC, n (%)</td>
<td>5 (63%)</td>
<td>3 (33%)</td>
<td>8 (47%)</td>
</tr>
<tr>
<td>PPC Total, mean (SD)</td>
<td>1.8 (2.1)</td>
<td>0.7 (1.3)</td>
<td>1.2 (1.8)</td>
</tr>
<tr>
<td>Ventilation Hours, mean (SD)</td>
<td>33.3 (61.9)</td>
<td>6.0 (18.0)</td>
<td>18.8 (45.1)</td>
</tr>
<tr>
<td>Prolonged Chest Tube, n (%)</td>
<td>5 (63%)</td>
<td>1 (11%)</td>
<td>6 (35%)</td>
</tr>
<tr>
<td>Chest Tube Days, mean (SD)</td>
<td>8.8 (5.3)</td>
<td>4.3 (2.1)</td>
<td>6.4 (4.4)</td>
</tr>
<tr>
<td>Respiratory Failure, n (%)</td>
<td>2 (25%)</td>
<td>1 (11%)</td>
<td>3 (18%)</td>
</tr>
<tr>
<td>Pneumonia, n (%)</td>
<td>2 (25%)</td>
<td>1 (11%)</td>
<td>3 (18%)</td>
</tr>
<tr>
<td>Myocardial Infarction, n (%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Atelectasis, n (%)</td>
<td>2 (25%)</td>
<td>1 (11%)</td>
<td>3 (18%)</td>
</tr>
</tbody>
</table>
Conclusions of the Pilot RCT

• *We identified a preoperative PR that decreased the amount of prolonged chest tubes, and possibly make a meaningful difference in length of stay*
• People did not improved by better exercise capacity
• *We improved something else!!!* (Self efficacy, Spark Motivation, Mindfulness?)
• NCI RO1 funding as a multicenter trial (4 centers Mayo, OofPitt, WashU, and UofVA) is undergoing including the behavioral targets.
Pulmonary Rehabilitation Before Lung Cancer Resection Intervention

- Intervention
- Baseline Questionnaires
- 10 Mindful Pulmonary Rehabilitation Sessions with Goal Setting
- Surgery (Coordinator to collect RESPeRATE and CD player)

- 2-5 Month Coaching Call
- 1 Month Coaching Call
- 1 Week Coaching Call

- 3 Month Questionnaires and Activity Monitor
- 6 Month Questionnaires and Activity Monitor
- 12 Month Questionnaires
Pulmonary Rehabilitation Before Lung Cancer Resection
Control/Usual Care

- Control
- Baseline Questionnaires
- Surgery
- 6 Month Questionnaires and Activity Monitor
- 3 Month Questionnaires and Activity Monitor
- 12 Month Questionnaires
The targets

• High Risk individuals pre op
• Engage the patient
• Physical Activity
• Breathing Awareness
• Inspiratory Muscle training
• Self efficacy, Mindfulness?
Who to Rehab

- Patient with Significant Dyspnea or Poor lung function
GOLD 3-4 = FEV1 < 50%
Exacerbation = acute change in symptoms that needed change in RX
# Measuring Dyspnea: MRC score

<table>
<thead>
<tr>
<th>MMRC Dyspnea Scale</th>
<th>Description of Breathlessness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>I only get breathless with strenuous exercise.</td>
</tr>
<tr>
<td>1</td>
<td>I get short of breath when hurrying on level ground or walking up a slight hill. On level ground, I walk slower than people of the same age because of breathlessness, or have to stop for breath when walking at my own pace.</td>
</tr>
<tr>
<td>2</td>
<td>I stop for breath after walking about 100 yards or after a few minutes on level ground.</td>
</tr>
<tr>
<td>3</td>
<td>I am too breathless to leave the house or I am breathless when dressing.</td>
</tr>
</tbody>
</table>
Engage the patient
Physical Activity
Breathing Awareness: Slow Breathing

- Slow breathing decrease hyperinflation and sympathetic output
- Pursed lip breathing practice
- Biofeedback
- 15 minutes
Self efficacy based training

• Mastery
• Rehab is meaningful and will work
• Modeling from others
• Emotional states affect confidence and performance
Mindfulness?

• A purposeful way of paying attention moment to moment
• Not labeling the experience as good or bad
• Different way of coping: Encourages engagement, rather than turning away
• A door to the present moment
Presence
Heart
Practicing Mindfulness

• **Step 1:** Seek silence.
  Just breathe.

• **Step 2:** Befriend with your body.

• **Step 3:** Find the Positive in everything you encounter.

• **Step 4:** Take notice.

> You are where you need to be. Just breathe.
The outcomes

- Length of Hospital Stay
- Post Operative complications
- QOL - Emotions
- Physical Activity
Provider-the patient-the system model
Perioperative Rehab

- Preoperative seems to be time to incorporate rehab
- More Compromised people are the target
- Incorporating new tools: IMT, Motivational interviewing, Self Efficacy, Mindfulness
- Rehab is much much much more than a set of exercises
this is it