

Clinical Question: For COPD patients undergoing lung transplant, would pre- and post-transplant pulmonary rehabilitation versus post-transplant pulmonary rehabilitation alone, improve functional outcomes 1-year post-surgery?								
Author, Year, Journal	Title	Purpose of Study, Study Design	N= Number of Subjects, Type of Subject	Intervention	Outcome Measures	Results	Analysis/ Conclusions	Clinical Relevance
Langer et al. 2012 <i>Respiratory Medicine</i>	Determinants of physical activity in daily life in candidates for lung transplant	To objectively assess physical activity and determinants affecting participation in lung-transplant candidates; Cross-Sectional	N= 96, 42 males, 54 females, mean age 55± 7, 69 with COPD, 27 with ILD; all awaiting single or double lung transplant	4 day period: Baseline measurements taken of pulmonary function, functional exercise capacity, muscle force, health status and quality of life - Daily physical activity measured continuously during 12 waking hours using DynaPort Activity Monitor & SenseWear Pro Monitor	Baseline: SF-36, Hospital Anxiety and Depression Scale (HADS, 6 MWD, FEV1, FVC, TLC, TLCO, Borg dyspnea scale and Borg leg fatigue score, BMI, MIP/MEP, handgrip force, quad force	- Patients were markedly inactive Low 6MWD High expiratory muscle force - High fatigue score on SF-36	- FEC, muscle force, use of long-term O2 therapy, self-reported physical activity functioning and seasonal variation all affected daily participation Functional exercise capacity (6 MWD) was strongest determinant of activity behavior	Reducing sedentary behavior before transplant should be important treatment goal towards Reducing burden of co-morbidity both before and after lung transplant. Identifying modifiable risk factors for sedentary behavior. Exercise training interventions should combine exercise capacity and respiratory muscle force to increase daily activity participation
Amaral et al. 2006 <i>Respiratory Medicine</i>	Two different training programmes for patients with COPD: A randomized study with 1-year follow up	To compare the effects of exercise capacity and HRQoL between 2 exercise programs and to find out if severity of COPD affected long-term training response; RCT	N= 71, 35 male, 36 female, 2 groups included: (1)severely ill, n=42; (2) moderately ill, n=21; all had COPD and were smokers or ex-smokers	2 Groups who were each trained 8 weeks 2x/week each 75 min sessions with groups of 3-5 subjects: Group A: exercise program including endurance training, resistance training, and callisthenics. Group B: exercise program including endurance and callisthenics.	Baseline, at 6 months, at 12 months: Spirometry, arterial blood gas, ECG, functional exercise capacity, St. George's Respiratory Questionnaire (SGRQ), Hospital Anxiety and Depression Scale (HADS), O2 saturation, 12 MWD	Group A: Exercise capacity increased. - 12 MWD increased by 50m and 1-year post-training 12MWD returned to baseline. Group B: -No change in variables. 1 year post-training 12MWD was below pre-training.	-Exercise capacity in COPD patients improved with endurance training 2x/week for 8 weeks. -Severity of illness did not affect response to training. Exercise capacity was back to baseline 6 months post-training. -Effects of short endurance training intervention slowed down decline in baseline FEC for 1 year.	Exercise programs for COPD patients awaiting lung transplantation should consist of endurance training, resistance training, and callisthenics to ensure improvement in FEC and HRQoL. Programs implemented < 6 months prior to transplant will ensure maintenance of exercise capacity in COPD patients.

<p>Bossenbroek et al. 2009 <i>Journal of Heart and Lung Transplant</i></p>	<p>Cross-sectional assessment of daily physical activity in chronic obstructive pulmonary disease lung transplant patients</p>	<p>To assess daily physical activity, pulmonary function, fear of physical activity and motivation to exercise in COPD patients who were lung transplant candidates and recipients; Cross-sectional</p>	<p>N= 47 lung transplant recipients (18 male, 29 female, mean age 55 ± 5.5 years) and 15 lung transplant candidates (5 male, 10 female, mean age 53 ± 6.3 years)</p>	<p>-Before transplant: rehab focused on muscle reinforcement and preservation of endurance. During the first 2 years after transplant rehab focused on muscle strength in relation to functional capabilities of patient. -Each patient measured in pulmonary function, performance-based daily physical activity, self-reported daily PA, physical fitness, fear of PA and motivation to exercise.</p>	<p>1x: BMI, FFMi, FEV, Spirometry, Pedometer (daily steps), Short Questionnaire to Assess Health-enhancing physical activity (SQUASH), sit-to-stand test, arm curl test, Tampa Scale for Kinesiophobia-Dutch version (TSK-DV), Exercise self-regulation questionnaire (SRQ-E)</p>	<p>Lung transplant recipients had more daily steps, and lower body strength. No significant difference between daily activity, physical fitness or fear & motivation between bilateral or unilateral recipients</p>	<p>Lung transplant improves daily activity level, lower body strength, and FEV in patients with COPD more so than transplant candidates. Lower body strength, pulmonary function, and number of months after transplant contributed to higher daily activity level in recipients. No significant difference between daily physical activity, fear of physical activity, and motivation to exercise.</p>	<p>Patients who are lung transplant candidates can benefit from an exercise program focusing on lower body strength and increased daily activity to improve their post-transplant activity levels. Transplant recipients improve their daily activity however, they are still walking less than the average healthy adult. Therefore, a pre-and post-rehab program would improve outcomes over 1 year post-transplant.</p>
<p>Reinsma et al. 2006 <i>Journal of Heart and Lung Transplant</i></p>	<p>Limiting factors of exercise performance 1 year after lung transplantation</p>	<p>To evaluate maximal exercise capacity and peripheral muscle force before and 1-year post-lung transplant (LTx); and if lactate threshold (LT) limits exercise capacity 1-year post LTx; Cohort</p>	<p>N= 25; Patients with ESRD who underwent single lung transplant (n=4, 3 female, 1 male) or double lung transplant (n=21, 14 female, 7 male); who survived >1 year post-transplant.</p>	<p>Baseline pulmonary function, peripheral muscle force of quads, biceps & triceps, and maximal exercise capacity taken. All Patients were instructed to exercise regularly with No structured program.</p>	<p>Baseline & 1-year post-LTx: BMI, FEV1, TLC, Maximal voluntary isometric muscle force, peak load, max exercise capacity, minute ventilation, O2 uptake/output</p>	<p>After LTx: exercise capacity improved significantly. Quad muscle force increased; Significant correlation between LT and exercise capacity and between LT and muscle force.</p>	<p>Maximal exercise capacity improved significantly 1-year post LTx (nearly to normal values). Presence of early and pathologic lactate threshold and peripheral muscle weakness contributes to the limitation of exercise capacity and reflects a peripheral deficit post-LTx.</p>	<p>With more muscle fibers, the better oxygen uptake and exercise capacity. For COPD patients awaiting transplant, a pre-LTx high intensity exercise program would improve their outcomes 1-year post-LTx. With a higher lactate threshold and improved peripheral muscle strength prior to transplant, the supplemental improved pulmonary function post-transplant will hopefully improve exercise capacity to normal levels.</p>

<p>Serres et al. 1997 <i>Journal of Cardiopulmonary Rehabilitation</i></p>	<p>Improved skeletal muscle performance after individualized exercise training in patients with chronic obstructive pulmonary disease</p>	<p>To determine if a training program at a set intensity can achieve a peripheral training effect in patients with COPD; Cohort</p>	<p>N= 14;Subjects were assigned to one of two groups: training group n=8 (mean age 60 ± 2), control group n=6 (mean age 70 ± 3); COPD patients</p>	<p>Training group: performed 1 training session/day including 1hr of physiotherapy, 50min cycling on ergometer, & 1hr walking outside (under PT supervision, 6days/week for 3 weeks); Control group: instructed to perform only 1hr of physiotherapy/day for 3 week period.</p>	<p>Before & After 3 wk training period: MVC of quads, spirometry, minute ventilation, O2 uptake, CO2 output, expiratory airflow, expired gases, gas exchange threshold (GET), 3 endurance tests</p>	<p>Training group increased exercise tolerance for symptom limited peak O2 consumption, maximum voluntary contraction, and critical power.</p>	<p>Greater muscle strength and endurance after training in COPD patients suggest better recruitment and improved oxidative capacity in the exercising muscles. Peripheral muscle performance can be increased rapidly in response to an individualized training program at the GET in COPD patients.</p>	<p>COPD patients can increase skeletal muscle performance after individualized exercise training at their GET. With improved peripheral muscle strength, exercise capacity can increase with endurance. A pre-LTx individualized rehab program can increase endurance and strength that will make up for any additional loss below baseline post-LTx, therefore improving functional outcomes.</p>
<p>Troosters et al. 2000 <i>American Journal of Medicine</i></p>	<p>Short- and long-term effects of outpatient rehabilitation in patients with chronic obstructive pulmonary disease: a randomized trial</p>	<p>To examine short- and long-term effects of a 6-month outpatient training program compared to usual care in patients with COPD; RCT</p>	<p>N= 70; control group n=33 (30 male, 3 female), training group n=37 (31 male, 6 female)</p>	<p>Training group: 3x/wk first 3 mo at 60% max work load, 2x/wk second 3 mo at 80%; each session 1.5 hrs (cycling, treadmill walking, stair climbing, peripheral muscle training)</p>	<p>Baseline, 6 mo, 18 mo post-training: BMI, FEV, FVC, CO2, max inspiratory pressure, max expiratory pressure, quad force, 6MWD, max work load, max O2 uptake, Chronic Respiratory Disease Questionnaire (HRQoL)</p>	<p>At 6 mo: training group showed improved 6MWD of 52m, maximal workload, max O2 uptake, quad force, inspiratory muscle force, and QOL. At 18 mo: differences persisted except for inspiratory muscle strength.</p>	<p>6 month outpatient rehab program that involved moderate to high training intensity did not alter pulmonary function, but did improve functional and maximal exercise performance, peripheral and respiratory muscle strength, and QOL when compared to usual care of COPD patient. Benefits of training in this study persisted for 12 months after training program ended.</p>	<p>An outpatient rehab program can benefit patients with severe COPD awaiting lung transplant. For these patients who are preparing for LTx, a pre-LTx program (<12 mo before transplant) can help improve their baseline prior to post-transplant decline. For patients who have longer waiting periods these results could benefit them until they receive their LTx, which will improve the pulmonary function component.</p>

<p>Laporta et al. 2008 <i>Arch. Bronconeumol.</i></p>	<p>Clinical and functional characteristics of patients prior to lung-transplantation : report of experience at the Clinica Puerta de Hierro</p>	<p>To present clinical and functional characteristics in which patients are accepted for lung transplant; Retrospective</p>	<p>N= 100, patients who received lung transplant between Jan 2002 and Sep 2005. Mean BMI was 24 kg/m2, mean age 45 years, 57% men; 67% bilateral lung transplant, 33% unilateral lung transplant; 35% COPD</p>	<p>Analyzed variables based on their influence on selection for lung transplant: FEV1, FVC, TLC, RV, PaO2, PaCO2, pulmonary artery systolic pressure estimated by echocardiography, and 6MWD.</p>	<p>Baseline: lung function tests (spirometry, plethysmography, CO2 diffusing capacity), arterial bld gas, 6MWD, heart function tests (electrocardiogram, echocardiogram, & cardiac catheterization with coronary arteriography for pts with cardiovascular risk factors); BODE index</p>	<p>COPD most often led to lung transplant compared to other diagnoses. 74% of patients with COPD had a BODE index of 7 or higher (4-year survival rate of COPD patients with score of 7 or higher is only 30%.</p>	<p>The patients who received lung transplants in this hospital were in advanced phases of their disease and met the inclusion criteria accepted by the various medical associations when they were placed on the waiting list. Many COPD patients may not be placed on transplant list until their disease progresses to untreatable states.</p>	<p>Because many COPD patients are not added to the list until their disease is untreatable, it is important to maintain their baseline measurements or slow the progression of their disease in order to ensure better outcomes post-LTx. COPD patients with BODE index score of 7 or higher have 30% 4-year survival rate, with lung transplant they have 50%, therefore, maintaining or improving this score until transplant is critical in outcomes post-LTx.</p>
<p>Berry et al. 2003 <i>Journal of Cardiopulmonary Rehabilitation</i></p>	<p>Randomized, controlled trial comparing long-term and short-term exercise in patients with chronic obstructive pulmonary disease</p>	<p>To compare effects of short-term (3 mo) and long-term (18 mo) exercise program with the (REACT); RCT</p>	<p>N= 140; COPD patients; 2 groups: short-term intervention group (n=70, 39 male, 31 female), long-term intervention (n=70, 39 male, 31 female).</p>	<p>All subjects completed 3-month program. Afterwards, randomized into 2 groups (short-term and long-term). The long-term group continued to exercise for an additional 15 mo: aerobic and upper extremity resistance training 3x/wk for 1hr. The short-term group was encouraged to exercise on their own without a program or supervision.</p>	<p>Baseline, 9 mo, 15 mo, 18 mo follow up: pulmonary function, smoking status, comorbid illness, and income, self-reported physical disability, 6MWD, peak O2 uptake, Physical Activity Scale for the Elderly (PASE)</p>	<p>Long-term intervention group reported 12% less disability, walked 6% farther during 6MWD, climbed steps 11% faster, and completed overhead tasks 8% faster than the short-term group</p>	<p>Early identification and intervention in patients with COPD is needed to prevent or forstall early morbidity and mortality. Improvements of physical function and self-reported disability as a result of participating in an exercise program must be continued in order to maintain improvements.</p>	<p>For COPD patients who are lung transplant candidates or recipients, a rehab program before and after LTx will benefit their post-surgery outcomes by preventing or forstalling morbidity and mortality. COPD patients can maintain their improvements form short-term or long-term exercise training as long as their program is continued. Therefore, a pre- and post-transplant program will improve their outcomes more so than just post-LTx alone.</p>