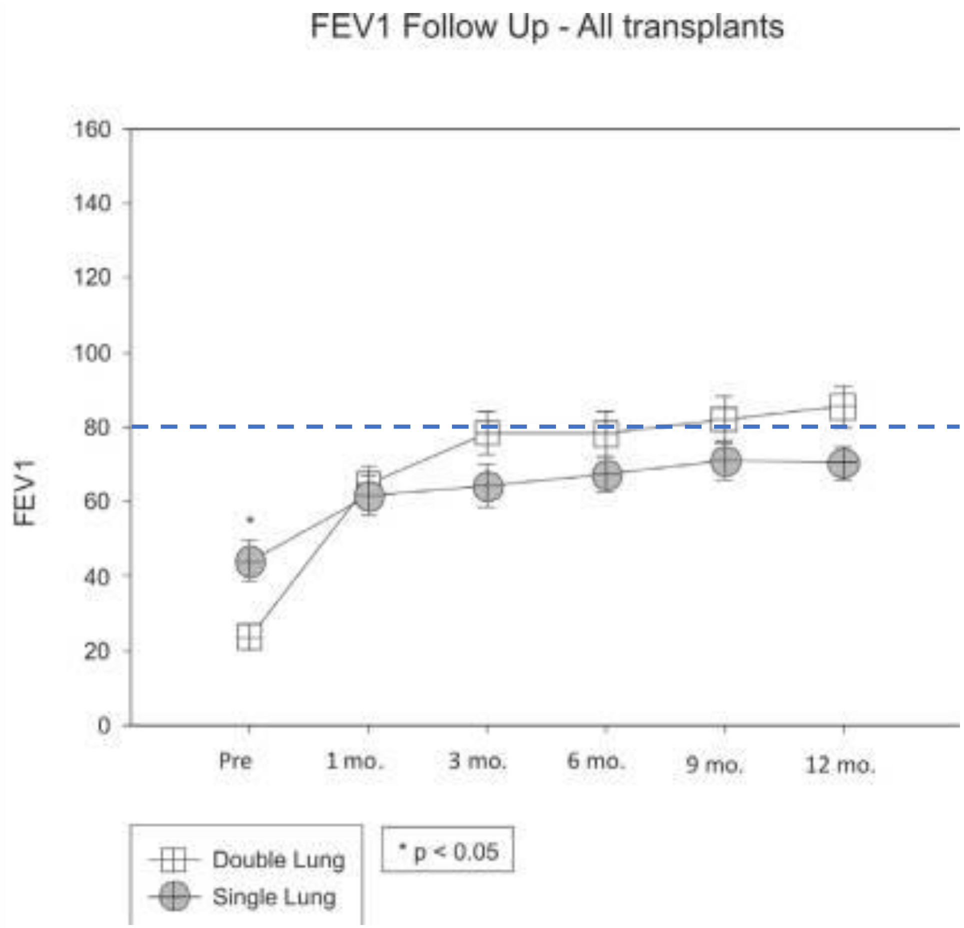
La prise en charge pré- et post-transplantation pulmonaire par le kinésithérapeute

Gregory Reychler

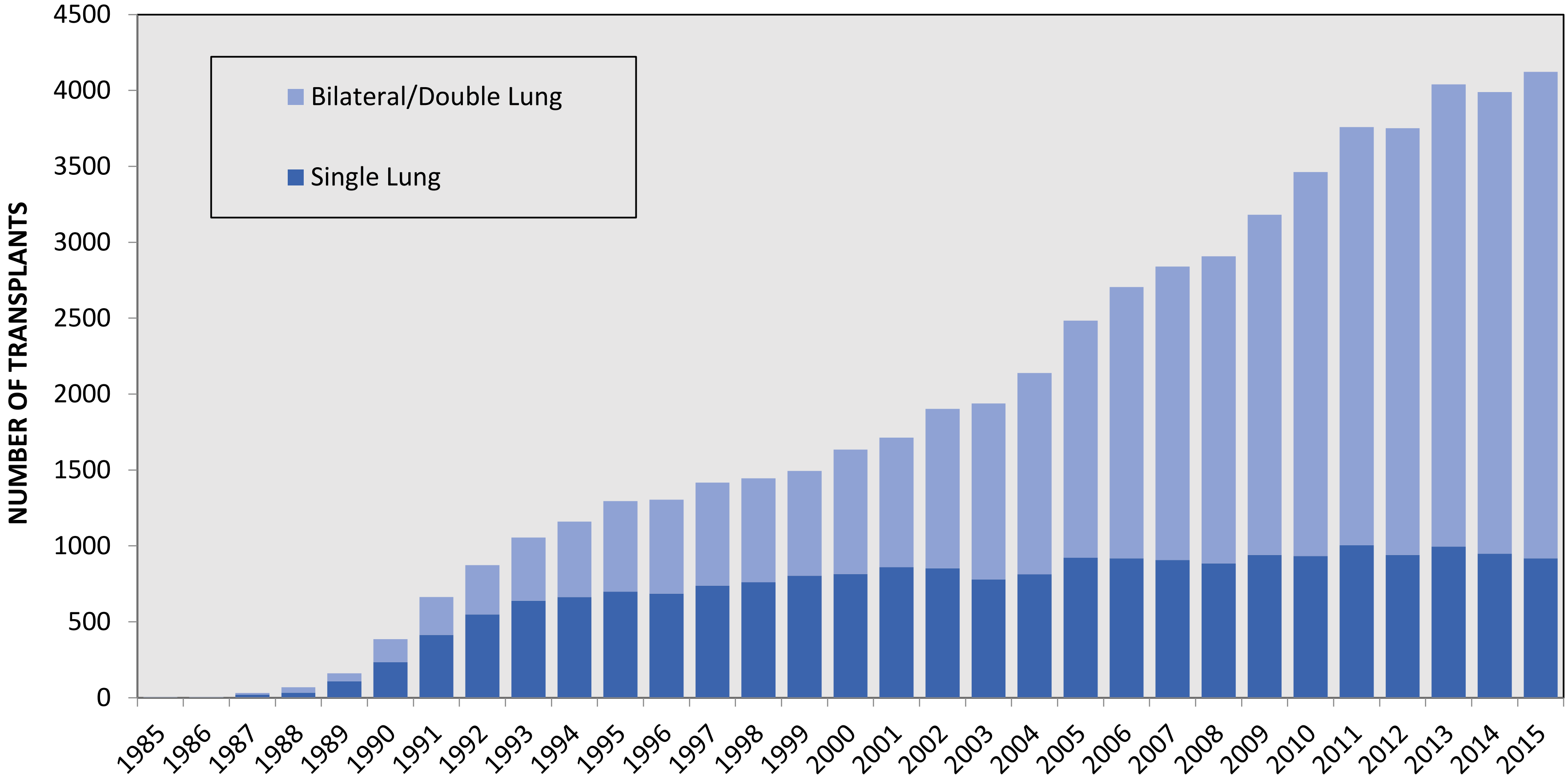
Service de pneumologie

Cliniques universitaires - Bruxelles

La situation…



Adult Lung Transplants
Number of Transplants by Year and Procedure Type



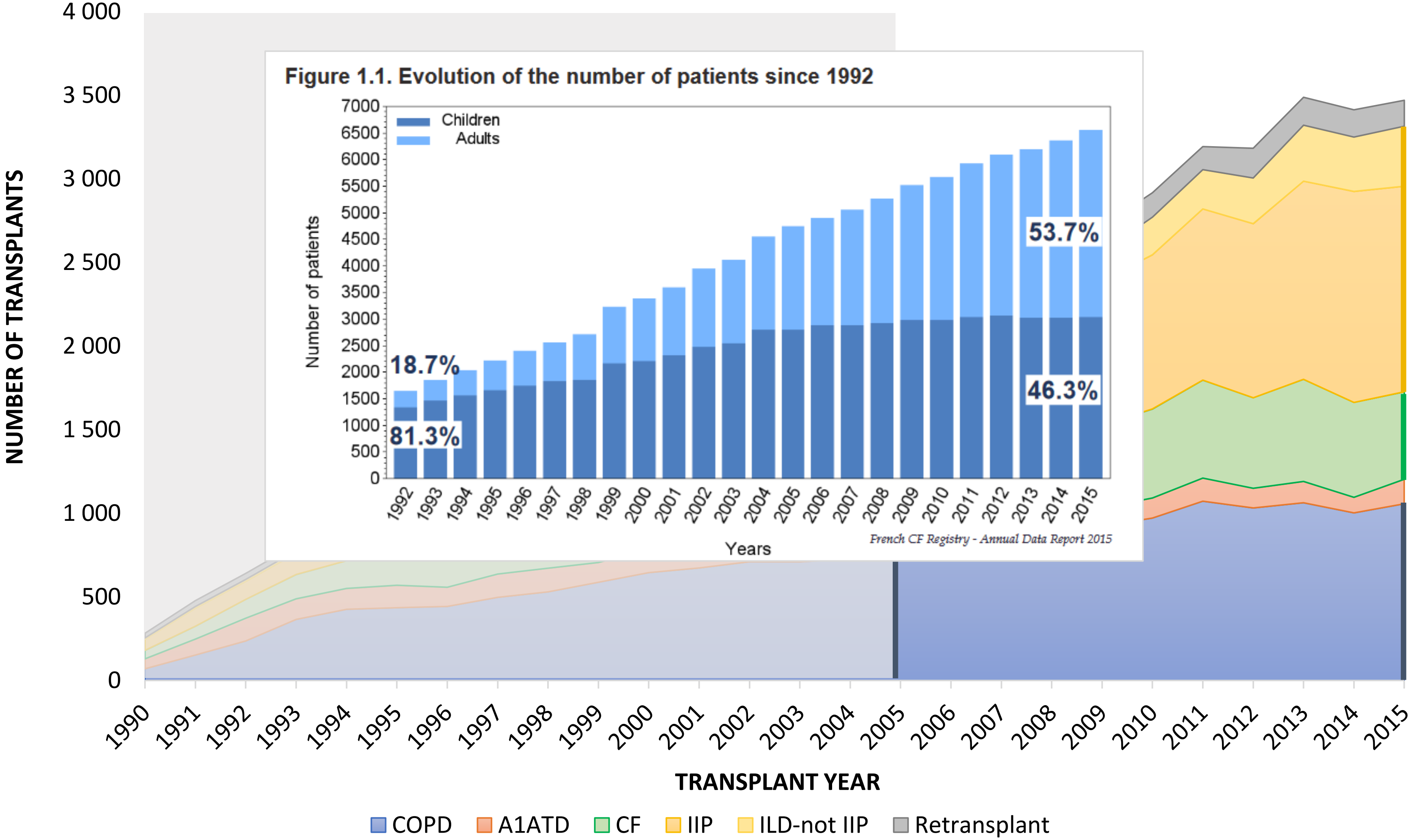
NOTE: This figure includes only the adult lung transplants that are reported to the ISHLT Transplant Registry. As such, this should not be construed as representing changes in the number of adult lung transplants performed worldwide.

Adult Lung Transplants

Indications (Transplants: January 1995 – June 2016)

Diagnosis	SLT (N=18,207)	BLT (N=36,046)	TOTAL (N=54,253)
COPD	7,266 (39.9%)	9,539 (26.5%)	16,805 (31.0%)
IIP	6,449 (35.4%)	6,990 (19.4%)	13,439 (24.8%)
CF	218 (1.2%)	8,266 (22.9%)	8,484 (15.6%)
ILD-not IIP	1,078 (5.9%)	1,925 (5.3%)	3,003 (5.5%)
A1ATD	797 (4.4%)	1,912 (5.3%)	2,709 (5.0%)
Retransplant	922 (5.1%)	1,269 (3.5%)	2,191 (4.0%)
IPAH	88 (0.5%)	1,481 (4.1%)	1,569 (2.9%)
Non CF-bronchiectasis	67 (0.4%)	1,413 (3.9%)	1,480 (2.7%)
Sarcoidosis	312 (1.7%)	1,026 (2.8%)	1,338 (2.5%)
PH-not IPAH	135 (0.7%)	690 (1.9%)	825 (1.5%)
LAM/tuberous sclerosis	146 (0.8%)	381 (1.1%)	527 (1.0%)
OB	73 (0.4%)	395 (1.1%)	468 (0.9%)
CTD	140 (0.8%)	282 (0.8%)	422 (0.8%)
Cancer	7 (0.0%)	27 (0.1%)	34 (0.1%)
Other	509 (2.8%)	450 (1.2%)	959 (1.8%)

Adult Lung Transplants
Major Indications by Year (Number)



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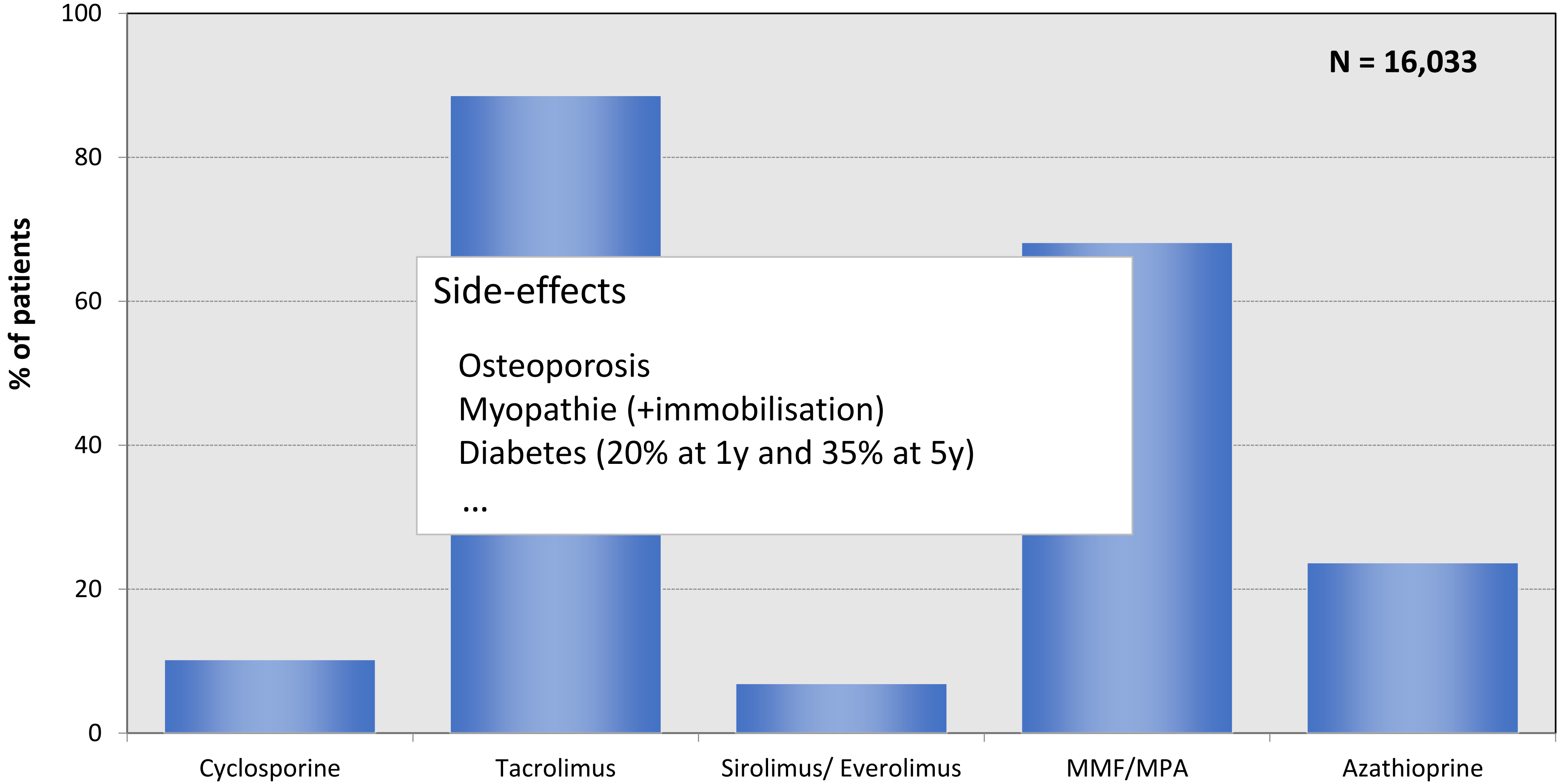
Adult Lung Transplants

Maintenance Immunosuppression at Time of 1 Year Follow-up

Analysis limited to patients receiving prednisone

(Follow-ups: January 2004 – June 2016)



Side-effects

- Osteoporosis
- Myopathie (+immobilisation)
- Diabetes (20% at 1y and 35% at 5y)
- ...

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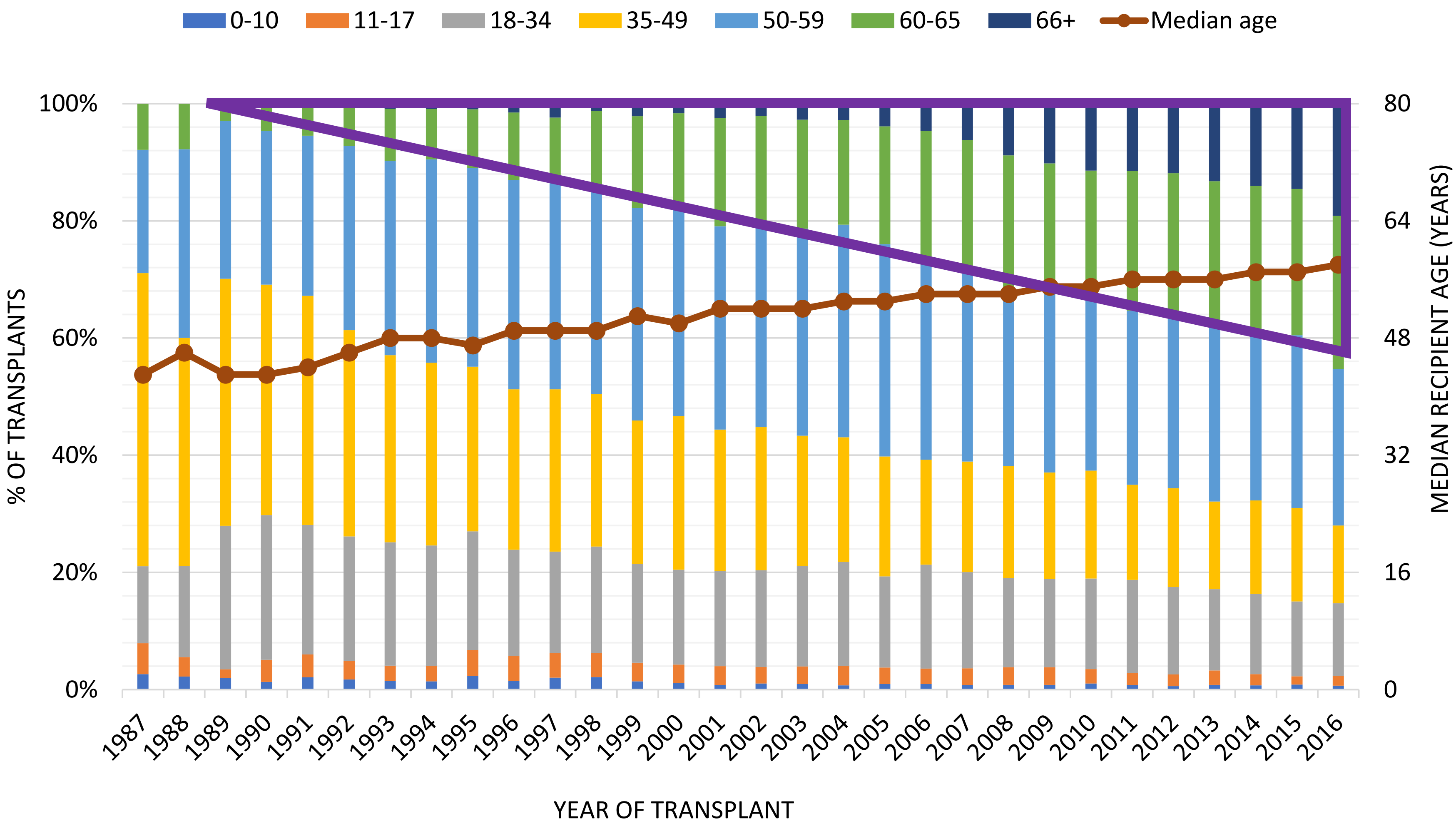
Analysis is limited to patients who were alive at the time of the follow-up.

Adult and Pediatric Lung Transplants

Recipient Age by Year (Transplants: January 1987 – June 2016)



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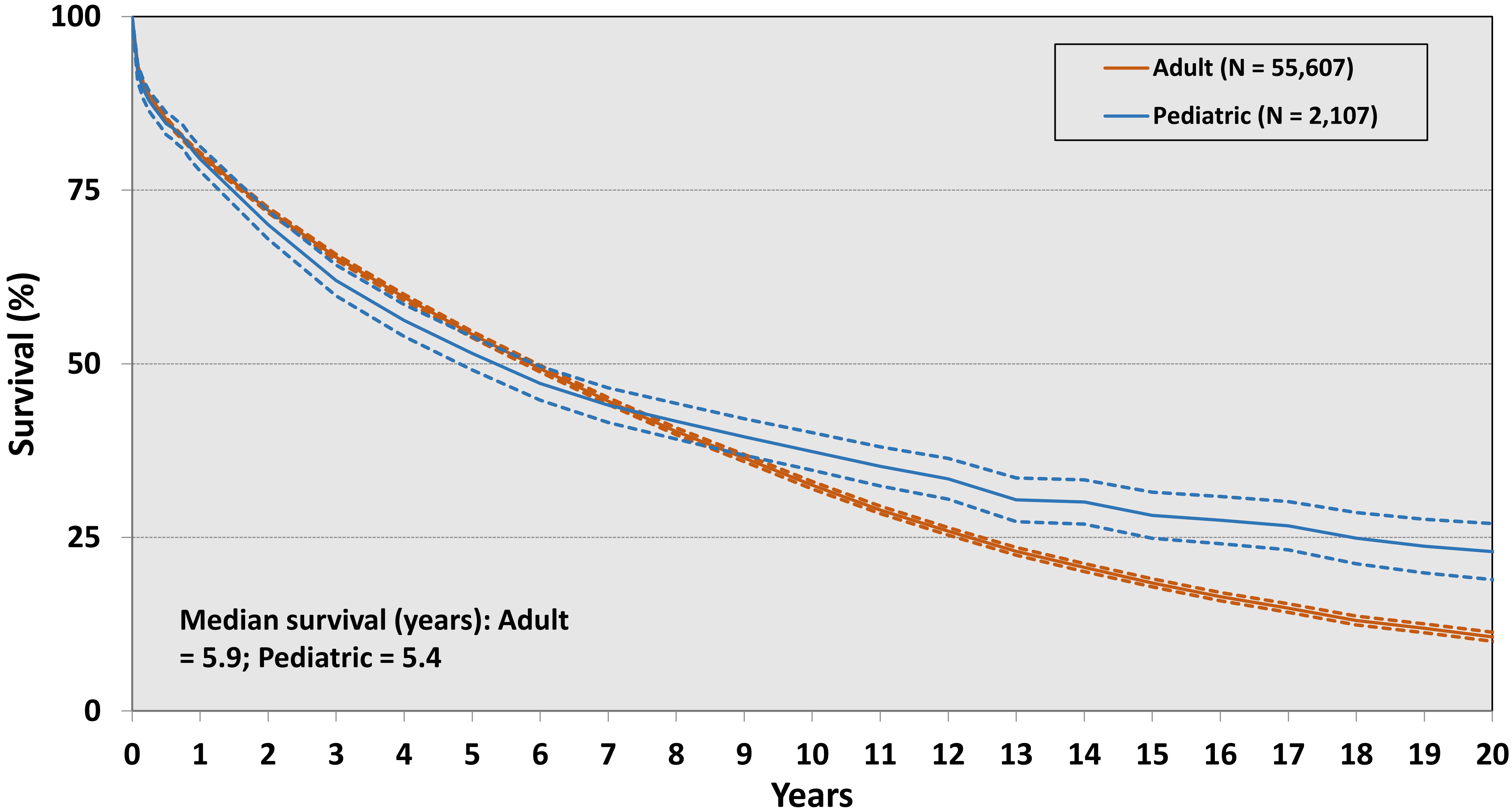
Adult and Pediatric Lung Transplants
Kaplan-Meier Survival by Age Group
(Transplants: January 1990 – June 2015)



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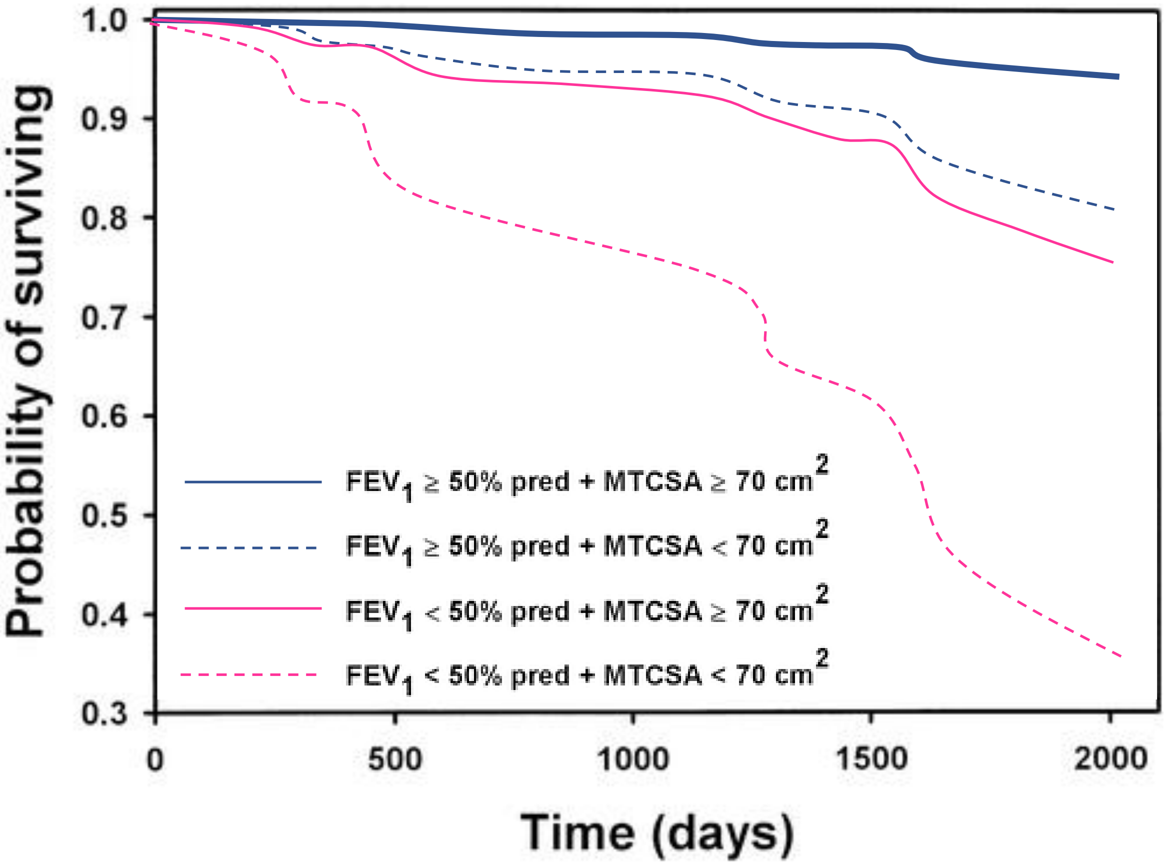
Muscles, fonction pulmonaire et survie



Marquis K et al. Am J Respir Crit Care Med 2002;166:809-813

Pre-transplant wasting (as measured by muscle index) is a novel prognostic indicator in lung transplantation

Kelm DJ, Bonnes SL, Jensen MD, Eiken PW, Hathcock MA, Kremers WK, Kennedy CC. Pre-transplant wasting (as measured by muscle index) is a novel prognostic indicator in lung transplantation.

Abstract: Background: Frailty in non-transplant populations increases morbidity and mortality. Muscle wasting is an important frailty characteristic. Low body mass index is used to measure wasting, but can over- or underestimate muscle mass. Computed tomography (CT) software can directly measure muscle mass. It is unknown if muscle wasting is important in lung transplantation.

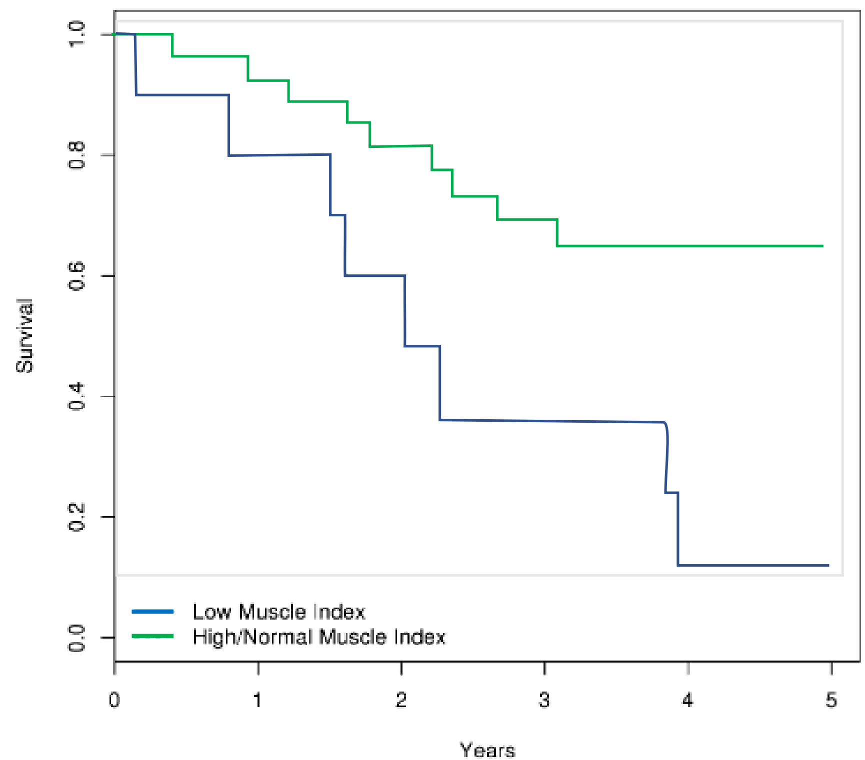


Fig. 3. Kaplan–Meier survival curve in those with low and normal/high muscle index. Muscle index (cm^2/m^2) was calculated by dividing the cross-sectional area at L2–L3 (in cm) by the body surface area (m^2). Those below the 25th percentile separated by sex were considered to have low muscle mass, ≤ 30.5 cm^2/m^2 for females and ≤ 41 cm^2/m^2 for males (solid line). Normal or high muscle index defined as those >30.5 cm^2/m^2 for females and >41 cm^2/m^2 for males (dotted line). Adjusted hazard ratio 3.83 (95% CI 1.42–10.3; $p = 0.007$).

Clin Transplant 2016: 30: 247–255

Evaluation of Pulmonary Function and Exercise Performance by Cardiopulmonary Exercise Testing Before and After Lung Transplantation

Matthew N. Bartels, MD, MPH; Hilary F. Armstrong, MA; Renee E. Gerardo, MA; Aimee M. Layton, MA; Benjamin O. Emmert-Aronson, MS; Joshua R. Sonett, MD; and Selim M. Arcasoy, MD, FCCP

Table 1—*Subject Demographics and PFT and CPET Pretransplant and Posttransplant*

	Pre-LTx	Post-LTx	*P* Value
Age, y	51 ± 14	53 ± 14	< .001
BMI, kg/m²	24.30 ± 4.57	26.23 ± 4.70	< .001
Bilateral LTx, %	78	...	...
Female, %	49	...	...
FVC, L	1.89 ± 0.71 (59 ± 16)	3.23 ± 1.00 (84 ± 19)	< .001 (< .001)
FEV_1, L	1.14 ± 0.67 (37 ± 21)	2.66 ± 0.92 (86 ± 24)	< .001 (< .001)
MVV, L	53.01 ± 33.09 (44 ± 27)	102.15 ± 33.31 (86 ± 24)	< .001 (< .001)
TLC,[a] L	5.02 ± 2.40 (86 ± 38)	5.23 ± 2.43 (81 ± 21)	.502 (.136)
DLCO,[b] mL/mm Hg/min	9.03 ± 5.53 (30 ± 16)	17.60 ± 6.88 (57 ± 14)	< .001 (< .001)
$\dot{V}O_2$ peak, L/min	0.95 ± 0.41 (43 ± 18)	1.13 ± 0.38 (52 ± 16)	< .001 (< .001)
$\dot{V}CO_2$ peak, L/min	0.90 ± 0.44	1.35 ± 0.47	< .001
Work peak	40.69 ± 26.71 (27 ± 17)	72.65 ± 29.88 (50 ± 16)	< .001 (< .001)
VT, L[c]	43.90 ± 24.00	42.50 ± 15.99	.757
$\dot{V}E/\dot{V}CO_2$	39.77 ± 11.89	35.51 ± 5.80	< .001
RER peak	0.94 ± 0.19	1.19 ± 0.18	< .001
HR base, beats/min	95 ± 17	83 ± 14	< .001
HR peak, beats/min	125 ± 20	121 ± 22	.011
Dyspnea as cause of exercise termination, %	70	9	< .001
Test performed on supplemental oxygen, %	86	3	< .001
Days between LTx and CPET	288 ± 208	460 ± 166	...
Days between CPET and PFT	3 ± 123	6 ± 48	...

Data are presented as mean (% predicted ± SD) unless otherwise indicated. CPET = cardiopulmonary exercise testing; DLCO = diffusing capacity of the lung for carbon monoxide; HR = heart rate; LTx = lung transplant; MVV = maximum voluntary ventilation; PFT = pulmonary function test; RER = respiratory exchange ratio; TLC = total lung capacity; $\dot{V}CO_2$ = volume of CO_2; $\dot{V}E/\dot{V}CO_2$ = minute ventilation to volume of CO_2 produced; $\dot{V}O_2$ = volume of oxygen; VT = ventilatory threshold.

[a]Based on 90 patients who had a TLC test.

[b]Based on 82 patients who had a DLCO test.

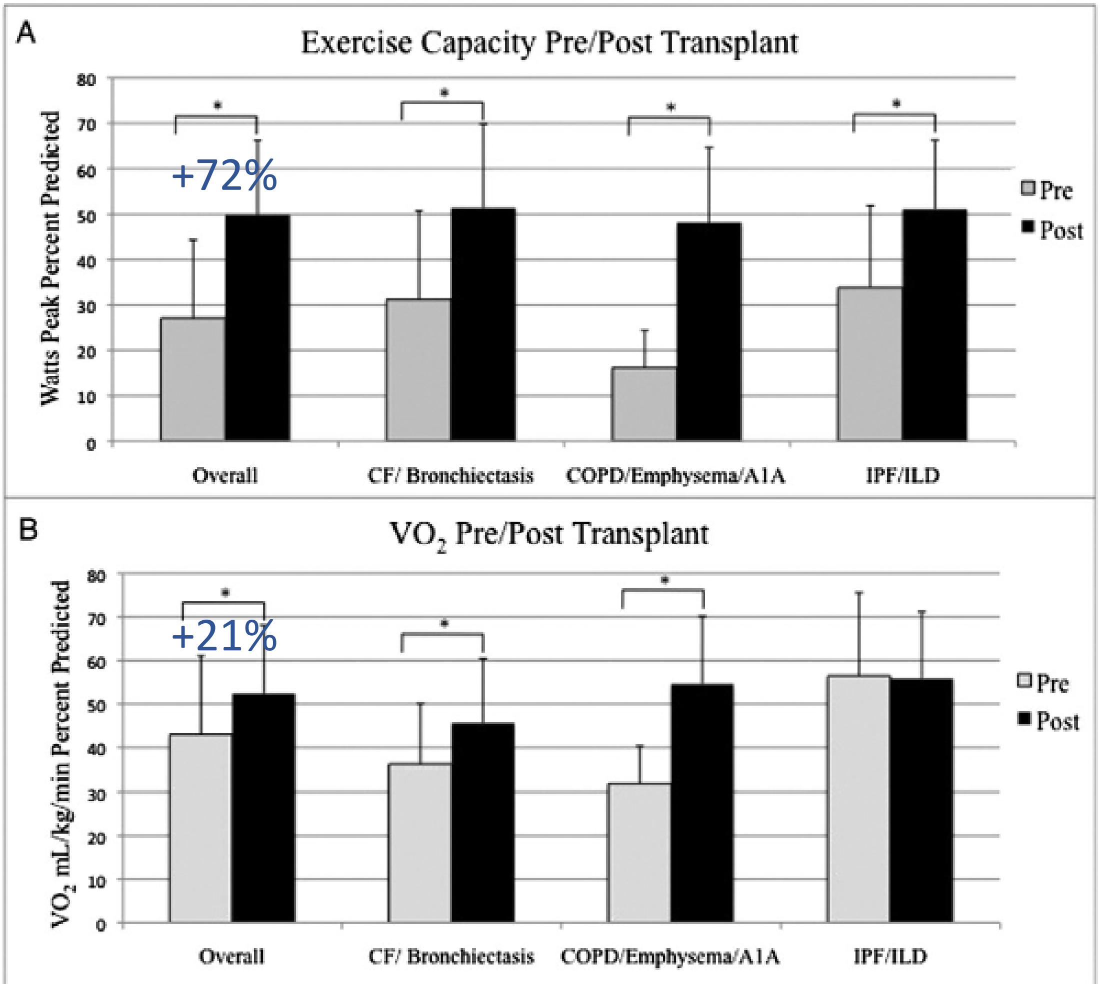
[c]Based on 37 subjects who had VT work measured before transplant. Other subjects were unable to reach VT before transplant.

→ Limitation respiratoire en pré-LTX… et limitation musculaire en post-LTX (?)

CHEST 2011; 140(6):1604–1611

Evaluation of Pulmonary Function and Exercise Performance by Cardiopulmonary Exercise Testing Before and After Lung Transplantation

Matthew N. Bartels, MD, MPH; Hilary F. Armstrong, MA; Renee E. Gerardo, MA; Aimee M. Layton, MA; Benjamin O. Emmert-Aronson, MS; Joshua R. Sonett, MD; and Selim M. Arcasoy, MD, FCCP



COPD : meilleur bénéfice

ILD : moindre bénéfice

Mais ça reste insuffisant en post-Tx

CHEST 2011; 140(6):1604–1611

Evaluation of Pulmonary Function and Exercise Performance by Cardiopulmonary Exercise Testing Before and After Lung Transplantation

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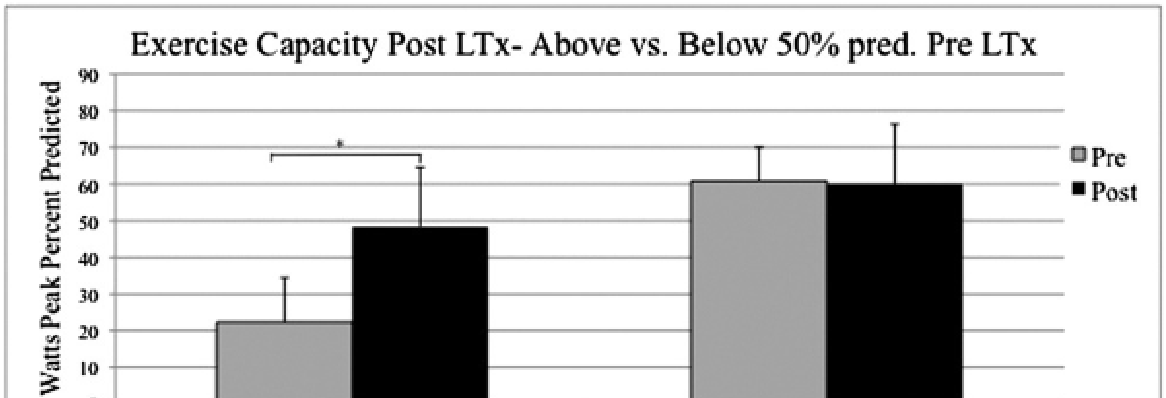


	50% pred. and below	Above 50% pred.
Pre	22.28	60.83
Post	48.39	60.06

FIGURE 3. Exercise capacity posttransplant in patients with greater than or less than 50% predicted capacity pretransplant. Maximum exercise capacity pretransplant above or below 50% of predicted shows that only those who were <50% predicted pretransplant have a significant improvement at up to 30 months. All values are reported in % predicted peak watts. *$P < .005$. LTx = lung transplant.

Sans surprise, les plus faibles s'améliorent le plus… mais les moyennement faibles ne gagnent rien!

CHEST 2011; 140(6):1604–1611

Core Muscle Size Predicts Postoperative Outcome in Lung Transplant Candidates

Thomas Weig, MD, Katrin Milger, MD, Birgit Langhans, MD, Silke Janitza, MS, Alma Sisic, Klaus Kenn, MD, Thomas Irlbeck, MD, Andreas Pomschar, MD, Thorsten Johnson, MD, Michael Irlbeck, MD, Jürgen Behr, MD, Stephan Czerner, MD, René Schramm, MD, PhD, Hauke Winter, MD, Claus Neurohr, MD, Lorenz Frey, MD, and Nikolaus Kneidinger, MD, PhD

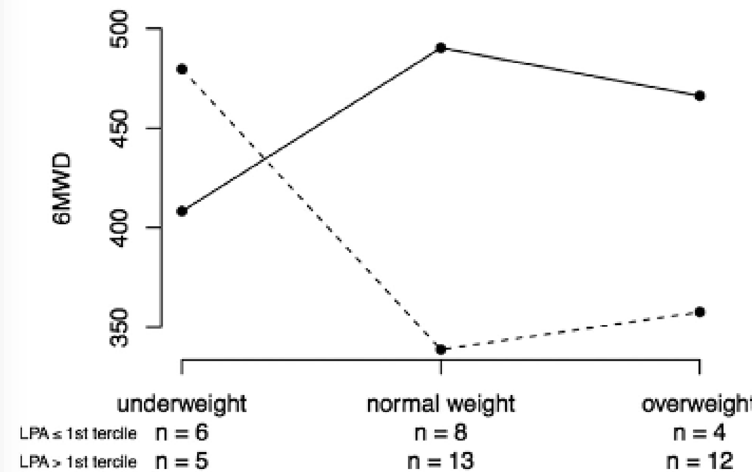
Table 1. Characteristics of Lung Transplant Candidates and Postoperative Outcome

	Female (n = 42)			Male (n = 61)		
Variables[a]	LPA ≤1st Tercile (n = 14)	LPA >1st Tercile (n = 28)	*p* Value	LPA ≤1st Tercile (n = 21)	LPA >1st Tercile (n = 40)	*p* Value
Age, y	42.8 ± 16.3	47.9 ± 13.6	0.27	52.6 ± 10.7	50.1 ± 12.7	0.61
BMI, kg/cm^2	20.6 ± 4.0	21.0 ± 3.6	0.83	22.0 ± 4.2	23.3 ± 4.0	0.23
BMI classification			0.61			0.28
Underweight	5 (35.7)	6 (21.4)		6 (28.6)	5 (12.5)	
Normal weigh	8 (57.1)	19 (67.9)		10 (47.6)	20 (50.0)	
Overweight	1 (7.1)	3 (10.7)		5 (23.8)	15 (37.5)	
Double LT	12 (85.7)	19 (67.9)	0.28	14 (66.7)	28 (70.0)	0.78
Underlying disease			0.005[b]			0.1
ILD	1 (7.1)	12 (42.9)		9 (42.9)	26 (62.5)	
COPD	5 (35.7)	9 (32.1)		9 (42.9)	6 (15.0)	
Cystic fibrosis	2 (14.3)	6 (21.4)		3 (14.3)	7 (17.5)	
Others	6 (42.9)	1 (3.6)		0 (0)	2 (5.0)	
Pre-LT ICU	3 (21.4)	4 (14.3)	0.67	5 (23.8)	6 (15.0)	0.49
Pre-LT ECMO	2 (14.3)	2 (7.1)	0.59	3 (14.3)	5 (12.5)	1
Lung allocation score	49.8 ± 21.4	45.0 ± 21.4	0.63	50.7 ± 19.6	48.7 ± 19.6	0.88
Operation time, min	316.5 ± 97.2	310.4 ± 135.1	0.8	312.6 ± 120.5	314.6 ± 119.7	0.99
Blood loss, mL	2,750.0 ± 1,858.3	3,917.9 ± 5,024.5	0.8	3,390.5 ± 4,392.7	3,391.2 ± 4,358.0	0.69
RBC transfusion, mL	1,410.7 ± 1,191.7	1,746.4 ± 2,835.6	0.58	1,514.3 ± 2,149.7	1,162.5 ± 1,760.1	0.81
Surgical revisions	5 (35.7)	8 (28.6)	0.73	6 (28.6)	13 (32.5)	1
LOMV, h	299.9 ± 314.7	262.4 ± 418.0	0.3	312.6 ± 120.5	219.3 ± 453.6	0.9
Tracheostomy	5 (35.7)	8 (28.6)	0.73	7 (33.3)	7 (17.5)	0.21
LOICU, d	24.8 ± 15.8	17.4 ± 20.1	0.04[b]	25.1 ± 38.1	16.5 ± 25.6	0.78
6MWD at end of PR, m	384.4 ± 86.9[d]	406.6 ± 121.3[e]	0.65	389.9 ± 146.9[f]	467.0 ± 128.2[f,g]	0.043[b]
Mortality						
ICU	1 (7.1)	3 (10.7)	1	2 (9.5)	1 (2.5)	0.27
1-year	1 (7.1)	3 (10.7)	1	4 (19.0)	7 (17.5)	1

[a] Continuous data are presented as the mean ± standard deviation and categoric data as number (%). [b] Statistically significant (

6MWD = 6-minute walking distance; BMI = body mass index; COPD = chronic obstructive lung disease; ECMO = ex brane oxygenation; ICU = intensive care unit; ILD = interstitial lung disease; LOICU = length of intensive care unit length of mechanical ventilation; LPA = lean psoas area; LT = lung transplant; PR = pulmonary rehabilitation; RB

Computed from [c]72 patients, [d]8 patients, [e]16 patients, [f]18 patients, and [g]30 patients.



Ann Thorac Surg 2016;101:1318-25

VO2 max = ventilatory capacity + maximal cardiac output + O2 consumption

Table 4—*Ventilatory and Gas Exchange Variables in Single (SLT) and Double (DLT) Lung Transplant Recipients*

Variables	Exercise Level	SLT (N = 6)	DLT (N = 6)	SLT vs DLT*
f, breaths/min	Rest	22.4 ± 5.2	16.0 ± 3.7	s
	Max	33.3 ± 2.8	25.5 ± 2.9	s
V_T, ml	Rest	625 ± 187	661 ± 80	ns
	Max	1204 ± 446	1345 ± 135	ns
V_T/VC, %	Rest	24.0 ± 5.9	21.6 ± 4.2	ns
	Max	44.4 ± 7.7	44.2 ± 9.2	ns
$\dot{V}_E$, L/min	Rest	13.2 ± 1.6	10.4 ± 1.3	s
	Max	40.2 ± 15.6	33.8 ± 5.3	ns
$\dot{V}_E$/MVV, %	Rest	16.8 ± 5.0	10.6 ± 2.8	s
	Max	46.8 ± 6.7	33.4 ± 5.3	s
$\dot{V}_E/\dot{V}_{O_2}$	Rest	48.3 ± 5.5	40.0 ± 3.4	s
	Max	45.9 ± 3.3	38.9 ± 6.2	s
$\dot{V}_E/\dot{V}_{CO_2}$	Rest	56.6 ± 5.4	48.0 ± 4.2	s
	Max	43.2 ± 5.7	35.2 ± 4.4	s
$P_{ET}CO_2$, mm Hg	Rest	31.3 ± 2.9	32.5 ± 4.2	ns
	Max	34.8 ± 2.7	37.7 ± 6.1	ns
SaO_2, %	Rest	97.2 ± 1.3	97.2 ± 0.4	ns
	Max	94.3 ± 2.0	96.7 ± 0.5	s

*ns = not significantly different; s = significantly different.

Table 5—*Comparison of Cardiopulmonary Parameters at Maximum Exercise in Single (SLT), Double (DLT), and Heart-Lung Transplant (HLT) Recipients*

	SLT	DLT	HLT*
Patients, N	6	6	10
Follow-up, mo	18	10	12
$\dot{V}_{O_2}$,			
ml/min/kg	12.8 ± 2.7	13.8 ± 1.3	19.4 ± 1.5
% pred max	44.2 ± 9.2	48.5 ± 5.0	49.3 ± 3.4
Heart rate			
beats/min	118.0 ± 13	126.0 ± 9.0	149.4 ± 4.1
% pred max	68.9 ± 8.3	70.5 ± 4.9	78.9 ± 1.7
O_2 pulse			
ml/kg/beat	0.109 ± 0.021	0.111 ± 0.013	0.130 ± 0.009
% pred max	64.6 ± 14.6	69.6 ± 8.0	62.2 ± 4.4
$\dot{V}_E$, L/min	40.2 ± 15.6	33.8 ± 5.3	46.7 ± 5.2
$\dot{V}_E$/MVV	0.47 ± 6.7	0.33 ± 5.3	0.47 ± .011†

*Data from Theodore et al[6] except as indicated.
†Datum from Sciurba et al[7] and represents V_I/MVV. V_E/MVV not cited in Theodore et al[6] for 12-month follow-up.

		Pre-LTX	Post-LTX	Post-rehabilitation
BMI	kg/m^2	22.7 ± 4.2	21.7 ± 4.2	23.1 ± 3.7
Weight	kg	62.7 ± 13.8	60.2 ± 13.5*	62.6 ± 13.6
FEV1	**L**	**0.85 ± 0.47**	**1.96 ± 0.85***	**2.20 ± 0.99***
	%pred	**31 ± 15**	**70 ± 21***	**78 ± 25***
6MWD	**m**	**311 ± 124**	**320 ± 138**	**449 ± 128*,†**
	%pred	**45 ± 19**	**46 ± 19**	**65 ± 17*,†**
QF	**%pred**	**72 ± 30**	**51 ± 28***	**59 ± 26*,†**
HGF	**%pred**	**83 ± 20**	**63 ± 20***	**73 ± 21*,†**

BMI: Values for body mass index; FEV1: Forced expiratory volume in 1 second, lung function; 6MWD: Six-minute walking distance; QF: quadriceps force; HGF: handgrip force; pre-LTX: in patients before; Post-LTX: after lung transplantation; and after 3 months of pulmonary rehabilitation (postrehabilitation). In bold are the variables with a significant time effect in repeated measures ANOVA. For body weight the repeated measures ANOVA did not reach significance (p = 0.10). Similarly, for BMI there was a trend for a time effect (p = 0.07). Post-hoc analysis revealed a significant reduction in body weight after transplantation, which recovered after rehabilitation. P values refer to the post-hoc tests as follows:
*p < 0.05 vs. pre-LTX.
†p < 0.05 vs. post-LTX.

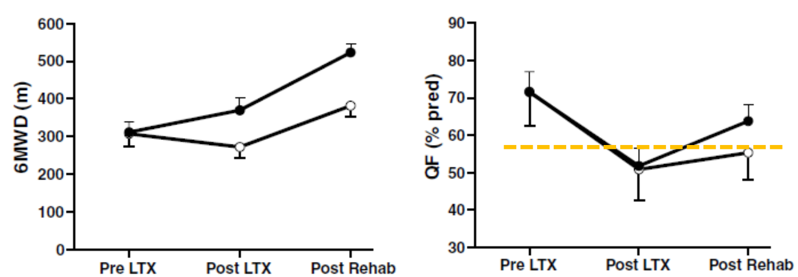
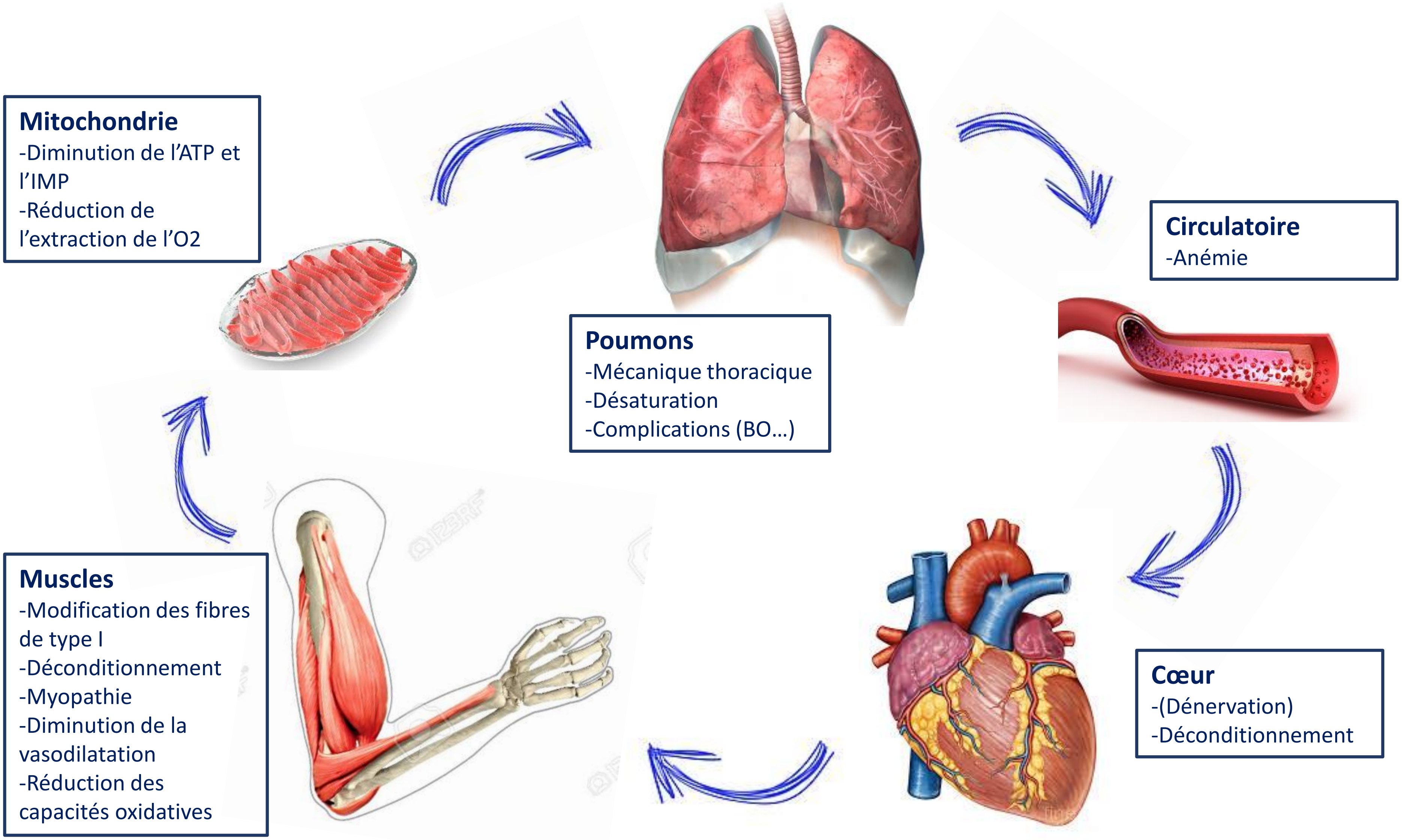


Figure 2: Six-min walking distance (6MWD in m, left panel: mean and SEM) and Quadriceps force (QF) (in % of the predicted value, right panel: mean and SEM) before lung transplantation (pre-LTX), after lung transplantation (post-LTX) and 3 months later (post-rehab) in male (●) and female (o) patients. For the 6MWD, a significant 'gender' × 'time' interaction was found, indicative of a different profile of recovery between male and female recipients (see text and Table 1 for detailed statistics).

Chest. 2011 Dec;140(6):1604-1611

American Journal of Transplantation 2008; 8: 1275–1281

En résumé : limitations possibles…



BMJ Open

Effects of pulmonary rehabilitation in lung transplant candidates: a systematic review

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ABSTRACT

Objectives: The aim of this systematic review of randomised controlled trials (RCTs), and quasi-experimental and retrospective studies is to investigate the effects of pulmonary rehabilitation (PR) in patients with advanced chronic disease on the waiting list for lung transplantation.

Setting: PR performed for inpatient or outpatient lung transplant candidates.

Intervention: PR programme including aerobic exercise training and/or resistance exercise training.

Primary and secondary outcomes: Quality of life and exercise capacity (primary outcomes). Survival rate after transplant surgery; pulmonary function; respiratory muscle strength; psychological aspects; upper and lower extremity muscle strength and adverse effects (secondary outcomes). Two review authors independently selected the studies, assessed study quality and extracted data. Studies in any language were included.

Results: This was a systematic review and studies were searched on the Cochrane Library, MEDLINE, EMBASE, CINAHL and PEDro. Experimental and retrospective studies evaluating the effects of PR in candidates for lung transplantation (>18 years old) with any lung diseases were included. 2 RCTs, and two quasi-experimental and two retrospectives studies, involving 1305 participants were included in the review. 5 studies included an enhancement reported in quality of life using the Short Form 36 questionnaire and showed improvements in some domains. All studies included exercise capacity evaluated through 6 min walk test and in five of them, there were improvements in this outcome after PR. Owing to the different characteristics of the studies, it was not possible to perform a meta-analysis.

Conclusions: Studies included in this review showed that PR is an effective treatment option for patients on the waiting list for lung transplantation and can improve quality of life and exercise capacity in those patients. Although individual studies reported positive effects of PR, this review shows that there is a need for more studies of a high methodological quality addressing PR effects in lung transplant candidates.

Trial registration number: PROSPERO CDR42015025110.

Strengths and limitations of this study

- This was the first systematic review focused on pulmonary rehabilitation (PR) before lung transplantation.
- The results of this review show that the literature does not adequately address the effects of PR in patients on a waiting list for lung transplantation. It is known that PR has been considered standard care for patients with pulmonary chronic diseases who might be included on a transplant list.
- Only a few studies could be included in this systematic review, which shows a need for more studies designed to evaluate the objectives of the study.
- A meta-analysis could not be performed due to the insufficient number of studies included.

INTRODUCTION

Rationale

Patients with different pulmonary conditions such as chronic obstructive pulmonary disease (COPD), cystic fibrosis, idiopathic pulmonary fibrosis and pulmonary arterial hypertension can progress to advanced lung disease that causes a pronounced impact on life. Usually patients with advanced lung disease have a higher degree of ventilatory limitation and disability, and a greater risk of complications.[1] They also have reduced exercise tolerance, which is associated with dyspnoea and fatigue.[2 3] Lung transplantation is a well-accepted therapy designated for a range of severe lung conditions, and evidence supports its success in improving survival and quality of life. It is known that the number of organ donors is much lower than the number of patients with severe lung conditions. Therefore, a patient selected to undergo transplantation must be a candidate with expectations for a good long-term outcome.[4]

Access to lung transplantation, a complex procedure, is becoming a more reasonable

Conclusions: Studies included in this review showed that PR is an effective treatment option for patients on the waiting list for lung transplantation and can improve quality of life and exercise capacity in those patients. Although individual studies reported positive effects of PR, this review shows that there is a need for more studies of a high methodological quality addressing PR effects in lung transplant candidates.

Evaluer les patients!

Table 1 Physical assessment of lung transplant candidates and recipients

Measured construct	Clinical tests	Clinical utility
Exercise capacity	Lab-based test: Cardiopulmonary exercise test on cycle or treadmill Field-based walk tests: 6MWT, ISWT[19,27] Upper extremity endurance capacity: UULEX[28]	Cause of exercise limitation Assess need for oxygen Assess functional capacity Outcome measure pre-post rehab and pre-post transplant Exercise prescription
Muscle function (strength, endurance)	Peripheral muscles: Manual muscle testing or hand held dynamometry Handgrip force 1-repetition maximum Respiratory muscles: MIP/MEP	Assess muscle strength and/or muscle endurance Outcome measure Exercise prescription (1-RM for peripheral muscles, MIP for IMT)
Physical performance and mobility	Gait speed (over 4 m)[110] Sit-stand tests (*e.g.*, 30 s sit to stand; 5 times sit to stand)[111,112] Short Physical Performance Battery[113] Timed Up and Go[114] Balance tests (*e.g.*, Berg balance scale, BESTest)[115,116] FIM[117] Tests specifically for ICU/inpatients: Egress test[118] Various ICU physical function tests[119-121]	Assess mobility, balance and physical function Assess need for gait aid Outcome measure Exercise prescription Discharge planning
Physical activity	Physical Activity questionnaires, *e.g.*, PASE[122]; IPAQ[123]; DASI[124] Pedometers or accelerometers	Assess physical activity Outcome measure Set activity goals (*e.g.*, target daily step count)

	Intervention (mean + SD)	Control (mean + SD)	Adjusted difference[1] (95% CI)	p-Value
Sedentary (min/day)[2]				
Pre-LTx	497 ± 94	504 ± 113		
Baseline	508 ± 90	525 ± 106		
3 months	435 ± 108	495 ± 99	−51 (−118 to 17)	0.133
1 year	402 ± 106	459 ± 108	−48 (−114 to 17)	0.147
Standing (min/day)[2]				
Pre-LTx	182 ± 75	181 ± 101		
Baseline	167 ± 19	149 ± 22		
3 months	216 ± 100	176 ± 82	28 (−28 to 86)	0.313
1 year	225 ± 103	193 ± 85	23 (−40 to 85)	0.465
Walking (min/day)[2]				
Pre-LTx	36 ± 21	29 ± 21		
Baseline	36 ± 16	32 ± 26		
3 months	56 ± 24	38 ± 23	14 (4 to 24)	0.008
1 year	85 ± 27	54 ± 30	26 (8 to 45)	0.006
MI walking (m/s^2)[2]				
Pre-LTx	1.85 ± 0.22	1.71 ± 0.17		
Baseline	1.85 ± 0.25	1.66 ± 0.28		
3 months	2.13 ± 0.07	1.89 ± 0.15	0.18 (0.01 to 0.35)	0.044
1 year	2.23 ± 0.18	1.91 ± 0.16	0.27 (0.14 to 0.39)	0.001
Daily steps[2]				
Pre-LTx	3225 ± 2039	2426 ± 1747		
Baseline	3094 ± 1458	2701 ± 2216		
3 months	5194 ± 1586	3451 ± 2175	1376 (481 to 2269)	0.004
1 year	7406 ± 2574	4462 ± 2518	3017 (1185 to 4849)	0.002
Time > 3 METs (min/day)[3]				
Pre-LTx	20 ± 21	20 ± 26		
Baseline	24 ± 24	17 ± 25		
3 months	69 ± 45	38 ± 58	18 (−2 to 38)	0.077
1 year	98 ± 67	58 ± 70	27 (1 to 54)	0.047

[1] Comparisons adjusted for baseline value.
[2] Measured with the DynaPort activity monitor.
[3] Measured with the SenseWear activity monitor.
CI = confidence interval; Sedentary = time spent lying and sitting; MI = movement intensity; METs = metabolic equivalents; Time > 3 METs = time spent in physical activity of at least moderate intensity.

Am J Transplant 2012

American Thoracic Society Documents

An Official American Thoracic Society/European Respiratory Society Statement: Key Concepts and Advances in Pulmonary Rehabilitation

Martijn A. Spruit, Sally J. Singh, Chris Garvey, Richard ZuWallack, Linda Nici, Carolyn Rochester, Kylie Hill, Anne E. Holland, Suzanne C. Lareau, William D.-C. Man, Fabio Pitta, Louise Sewell, Jonathan Raskin, Jean Bourbeau, Rebecca Crouch, Frits M. E. Franssen, Richard Casaburi, Jan H. Vercoulen, Ioannis Vogiatzis, Rik Gosselink, Enrico M. Clini, Tanja W. Effing, François Maltais, Job van der Palen, Thierry Troosters, Daisy J. A. Janssen, Eileen Collins, Judith Garcia-Aymerich, Dina Brooks, Bonnie F. Fahy, Milo A. Puhan, Martine Hoogendoorn, Rachel Garrod, Annemie M. W. J. Schols, Brian Carlin, Roberto Benzo, Paula Meek, Mike Morgan, Maureen P. M. H. Rutten-van Mölken, Andrew L. Ries, Barry Make, Roger S. Goldstein, Claire A. Dowson, Jan L. Brozek, Claudio F. Donner, and Emiel F. M. Wouters; on behalf of the ATS/ERS Task Force on Pulmonary Rehabilitation

This official statement of the American Thoracic Society (ATS) and the European Respiratory Society (ERS) was approved by the ATS Board of Directors, June 2013, and by the ERS Scientific and Executive Committees in January 2013 and February 2013, respectively

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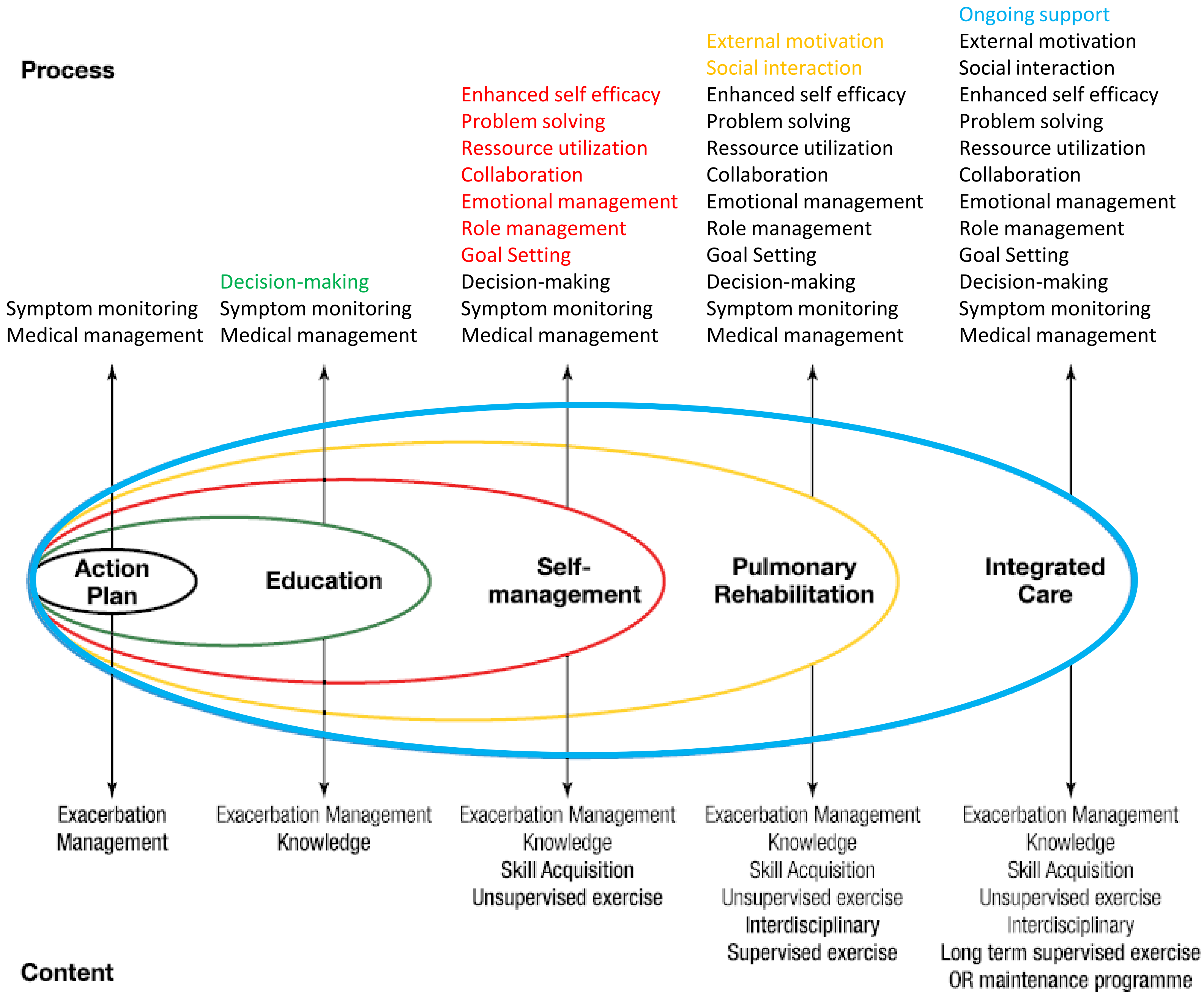

Process
Symptom monitoring
Medical management
Decision-making
Symptom monitoring
Medical management
Enhanced self efficacy
Problem solving
Ressource utilization
Collaboration
Emotional management
Role management
Goal Setting
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Symptom monitoring
Medical management
Action Plan
Education
Self-management
Pulmonary Rehabilitation
Integrated Care
Exacerbation Management
Exacerbation Management
Knowledge
Exacerbation Management
Knowledge
Skill Acquisition
Unsupervised exercise
Exacerbation Management
Knowledge
Skill Acquisition
Unsupervised exercise
Interdisciplinary
Supervised exercise
Exacerbation Management
Knowledge
Skill Acquisition
Unsupervised exercise
Interdisciplinary
Long term supervised exercise
OR maintenance programme
Content

TABLE 3. (CONTINUED)

Population	Evidence for PR	Outcomes of PR	Special Considerations	Specific Assessment Tools
Lung cancer	Preoperative PR: Small, uncontrolled observational studies (311, 312)	Improved exercise tolerance (311, 312), possible change in status from noncandidate for surgical resection to operative candidate	Short duration e.g. 2-4 wk), up to 5 times per week, needed to avoid delay in potential curative surgery	Functional Assessment of Cancer Therapy-Lung Cancer (FACT-L) (747, 748)
	Postoperative PR: Small uncontrolled trials (308, 315, 316); two RCTs comparing aerobic training, resistive training or both in postsurgical lung cancer patients is ongoing (317, 318); one systematic review (307)	Increased walking endurance, increased peak exercise capacity, reduced dyspnea and fatigue (308, 315, 316). Variable impact on quality of life (307)		Trial Outcome Index (748, 749) Functional Assessment of Cancer Therapy Fatigue Scale (750, 751)
	Medical treatment: Case series of patients with nonresectable stage III or IV cancer (309)	Improved symptoms and maintenance of muscle strength (309)		
Lung volume reduction surgery	Prospective observational study (321); analysis of data from the National Emphysema Treatment Trial; a small case series (efficacy of home-based PR before LVRS) (320)	Pre-LVRS PR and exercise training: Improved exercise capacity (peak workload, peak $\dot{V}o_2$, walking endurance), muscle strength, dyspnea, and quality of life (320, 321)	Oxygen saturation should be monitored. Explanations of the surgical procedure, postoperative care including chest tubes, lung expansion, secretion clearance techniques and importance of early postoperative mobilization should be included in the educational component of PR.	Quality of Well Being Score (319, 752) Usual outcome assessments for COPD, such as CRQ (516) and SGRQ (515), are appropriate. Consider generic tools such as SF-36 (571) to allow comparison with population normative values postoperatively.
Lung transplantation	Pretransplant PR: One RCT con… con… unc… ben… incl… 753–755)	Pretransplant PR: Improved …	Exercise prescription must be … Patients may require lower intensity or interval training. Hemodynamic parameters and oxygenation should be monitored closely; O_2 should be available. Educational component should cover surgical techniques, risks, benefits of the surgery, postoperative care (controlled cough, incentive spirometry, chest tubes, wound care, secretion clearance techniques, importance of early mobilization), risk and benefits of immunosuppressive agents.	SF-36 and other assessment tools …
	Post-transplant PR: Two RCTs; a few cohort studies; one systematic review assessed PR after lung transplantation (153, 327, 334, 756)	Post-transplant PR: Increased muscle strength, walking endurance, maximal exercise capacity, and quality of life (153, 327, 334, 756)		

Definition of abbreviations: BP = blood pressure; CF = cystic fibrosis; COPD = chronic obstructive pulmonary disease; CRQ = Chronic Respiratory Questionnaire; IPF = interstitial pulmonary fibrosis; LVRS = lung volume reduction surgery; PR = pulmonary rehabilitation; RCT = randomized controlled trial; Sa_{O_2} = oxygen saturation; SF-36 = Short Form-36; SGRQ = St. George's Respiratory Questionnaire; $\dot{V}o_2$ = aerobic capacity; WHO = World Health Organization.

As a preparation and immediately (24-48h) after the lung transplantation

Programme

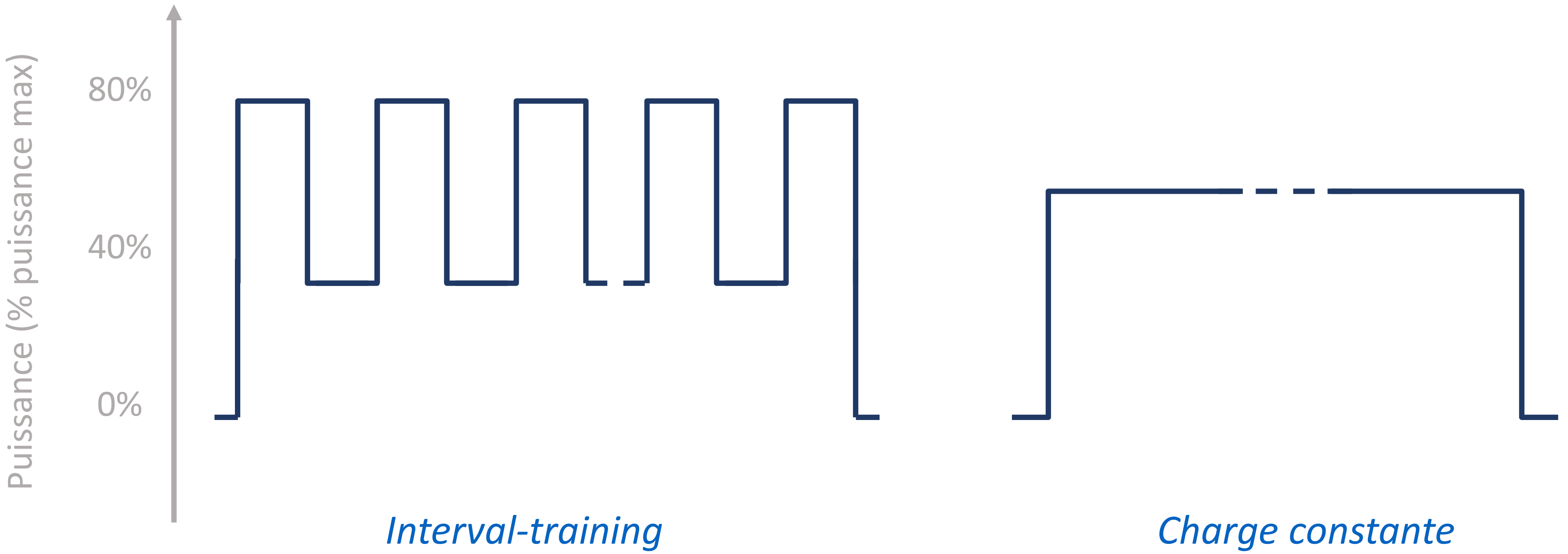
- Durée
  - Pas de consensus
  - Influencée par
    - Remboursement
    - Ressources
    - Progrès

Optimal duration of pulmonary rehabilitation for individuals with chronic obstructive pulmonary disease – a systematic review

Marla K Beauchamp[1,2], Tania Janaudis-Ferreira[2], Roger S Goldstein[2,3,4], and Dina Brooks[1,2,3]

Beauchamp, Chron Respir Dis. 2011;8(2):129-40

Quel type de travail? *Interval-training ou à charge constante*



Diminution de l'hyperinflation dynamique d'où intensité de travail plus élevée!

Eur Respir Rev 2013; 22: 128, 178–186
DOI: 10.1183/09059180.00000513

SERIES "THEMATIC REVIEW SERIES ON PULMONARY REHABILITATION"
Edited by M.A. Spruit and E.M. Clini
Number 1 in this Series

TABLE 2 Practical recommendations for the implementation of continuous and interval endurance training programmes

	Continuous endurance training	Interval endurance training
Frequency	3–4 days·week^{-1}	3–4 days·week^{-1}
Mode	Continuous	Interval modes: 30 s of exercise, 30 s of rest or 20 s of exercise, 40 s of rest
Intensity	Initially 60–70% of PWR Increase work load by 5–10% as tolerated Progressively try to reach ~80–90% of baseline PWR	Initially 80–100% of PWR for the first three to four sessions Increase work load by 5–10% as tolerated Progressively try to reach ~150% of baseline PWR
Duration	Initially 10–15 min for the first three to four sessions Progressively increase exercise duration to 30–40 min	Initially 15–20 min for the first three to four sessions Progressively increase exercise duration to 45–60 min (including resting time)
Perceived exertion	Try to aim for a perceived exertion on the 10-point Borg scale of 4 to 6	Try to aim for a perceived exertion on the 10-point Borg scale of 4 to 6
Breathing technique	Suggest pursed-lip breathing or the use of PEP devices to prevent dynamic hyperinflation and to reduce breathing frequency	Suggest pursed-lip breathing or the use of PEP devices to prevent dynamic hyperinflation and to reduce breathing frequency

PWR: peak work rate; PEP: positive expiratory pressure. Adapted from [30].

Eur Respir Rev 2013; 22: 128, 178–186
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TABLE 3 Practical indications for considering the use of an interval training approach

Interval training may be more appropriate when the patient presents with:
A severe airflow obstruction (FEV_1 <40% pred)
A low exercise capacity (peak work rate <60% pred)
A total time at a constant work rate test of <10 min
A marked oxygen desaturation during exercise (S_{pO_2} <85%)
An intolerable dyspnoea during continuous endurance training

FEV_1: forced expiratory volume in 1 s; % pred: % predicted; S_{pO_2}: arterial oxygen saturation measured by pulse oximetry.

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TABLE 4 Practical recommendations for the implementation of strength training

Frequency	2–3 days·week^{-1}
Objective	Targeting for local muscular exhaustion within a given number of repetitions for major muscle groups of upper and lower extremities
Mode	Two to four sets of six to 12 repetitions
Intensity	50–85% of one repetitive maximum as a reference point
	Increase work load by 2–10% if one to two repetitions over the desired number are possible on two consecutive training sessions
Speed	Moderate (1–2 s concentric and 1–2 s eccentric)

Data from [53].

Eur Respir Rev 2013; 22: 128, 178–186
DOI: 10.1183/09059180.00000513

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TABLE 5 Practical recommendations for the implementation of inspiratory muscle training (IMT)

Frequency	5–7 days·week^{-1}
Objective	To increase inspiratory muscle strength in patients with inspiratory muscle weakness (P_{Imax} <60 cmH_2O)
Mode	Most commonly threshold loading
Intensity	Initially ≥30% of P_{Imax}
	Increase load as tolerated
Duration	For example, using an interval approach with 7× 2 min of IMT and 1 min of rest between each interval

P_{Imax}: maximal inspiratory pressure. Data from [60, 62].

Take home message

"…larger muscle mass measures before lung Tx have shown to be protective with respect to functional outcomes."

"…exercise limitations after lung Tx is multifactorial, and largely due to skeletal muscle changes rather than solely secondary to cardio-pulmonary factors."

"Following lung Tx, there are substantial improvements in LF and exercise capacity. However, peak exercise remains reduced to 40% to 60%pred up to 2 years."

"Rehabilitation following LT has been shown to improve skeletal muscle force as well as exercise tolerance and should be initiated as early as possible in the transplant process"

"With an understanding of exercise limitation, physiotherapists will be able to design and implement effective PR that leads to improvements in functional capacity in this population."