15es JOURNÉES FRANCOPHONES Alvéole

Réadaptation (respiratoire) post transplantation pulmonaire

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alvéole
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Réadaptation post transplantation pulmonaire (TPx)

- Pas de lien d’intérêt concernant cette présentation

Les données de la littérature
Quelques points particuliers
La pratique
Expérience locale
Conclusion

Les données de la littérature

Quelques points particuliers

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Conclusion

2010 - Exercise training after LTx : a systematic review

Table 1 Summary of Studies

Author, year	Study design	Sample size	Interventions	Outcome measures	Findings
Data from Braith,[19] 2007	RCT	30	Alendronate and lumbar resistance exercises	Lumbar BMD 	BMD: 14.1% ± 3.9% below baseline (controls; $p \leq 0.05$); 1.4% ± 1.1% above baseline (alendronate only; $p \geq 0.05$); 10.8% ± 2.3% above baseline (alendronate + resistance; $p \leq 0.05$)
Data from Mitchell,[20] 2003	RCT	16	Lumbar resistance exercises	Lumbar BMD 	BMD: 19.5% below baseline (controls; $p \leq 0.05$); 5 % below baseline (intervention; $p \leq 0.05$)
Data from Munro,[21] 2009	Prospective cohort	36	exercise ation	TM6 FE C, 6  	Significant increase in 6MWD (92 m, $p < 0.0001$), FEV_1 and FVC ($p < 0.0001$), HRQOL ($p < 0.05$)
Data from Maury,[22] 2008	Prospective cohort	36	ercise	TM6 QF HGF FI  	Significant increase in 6MWD (140 ± 91 m, $p < 0.05$), QF (51% ± 28% vs 59% ± 26% pred, $p < 0.05$), HGF (63% ± 20% vs 73% ± 21% pred, $p < 0.05$)
Data from Stiebellehner,[23] 1998	Prospective cohort			VO2max Pmax	Significant increase in VO_{2peak} (1.13 ± 0.26 vs 1.26 ± 0.27 liters/min, $p < 0.05$) and W_{peak} (66 ± 22 vs 81 ± 22 W, $p < 0.05$)
Data from Ross,[15] 1993	Prospective cohort	8	Aerobic exercise	VO2max odynamic	Increased VO_{2max} (9.2 ± 0.8 vs 13.4 ± 0.8 ml/kg/min, $p < 0.05$) and W (21 ± 3 vs 52 ± 6 W, $p < 0.05$)
Data from Guerrero,[24] 2005	Controlled trial (healthy controls)	12	Aerobic exercise	VO2max T_{end}  	Significant increase in bioenergetics at cellular level (apparent Km 94 ± 34 vs 203 ± 62 um, $p < 0.001$), W_{max} (85 ± 43 vs 98 ± 42 W, $p = 0.04$), endurance time (20 ± 10 vs 31 ± 14 min, $p = 0.01$); VO_{2max} increased (1.2 ± 0.56 vs 1.4 ± 0.5 liters/min, $p = 0.06$)

6MWD, 6-minute walk distance; BMD, bone mineral density; FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; HGF, handgrip force; HRQOL, health-related quality of life; pred, predicted; QF, quadriceps force; RCT, randomized controlled trial; SF36, Short-Form 36 questionnaire; $VO_{2\ peak}$, peak oxygen consumption; VO_{2max}, maximal oxygen consumption; W, workload.

Endurance, résistance, seul ou associés
De 6 se à 6 mois
de 1 à 6 mois post TPx

Résultats :

VO2	Pmax	T_{end}	TM6	Force M	DO
				↗	↗
				↗	↗
			↗		
			↗	↗	
↗	↗				
↗	↗				
↗	↗	↗			

(1) Wickerson L, Mathur S, Brooks D. Exercise training after lung transplantation: a systematic review. J Heart Lung Transplant. 2010 May;29(5):497-503. doi: 10.1016/j.healun.2009.12.008. Epub 2010 Feb 4. PMID: 20133160.

2010 - Exercise training after LTx : A systematic review

DateEtudeMentionnée	2009_Wickerson	Résultats:	Conclusion de la revue:
1993	Ross	amélioration VO2max, Pmax	**- effet favorable sur:** **- la densité osseuse,** **- la capacité d'exercice,** **- la fonction musculaire.** **RHB devrait être proposée dans la PEC des TPx.**
1998	Stiebellehner	amélioration significative VO2max, Pmax	
2003	Mitchell	densité osseuse améliorée par renforcement mécanique lombaire	
2005	Guerrero	amélioration Pmax, Tend, et indicateurs de respiration mitochondriale*	
2007	Braith	densité osseuse normalisée par RHB, potentialisée par alendronate	
2008	Maury	amélioration significative TM6 (140m), Force main et quadriceps	
2009	Munro	amélioration significative TM6 (92m), CV, VEMS, QDV	

(1) Wickerson L, Mathur S, Brooks D. Exercise training after lung transplantation: a systematic review. J Heart Lung Transplant. 2010 May;29(5):497-503. doi: 10.1016/j.healun.2009.12.008. Epub 2010 Feb 4. PMID: 20133160.

ATS/ERS: Key Concepts and Advances in Pulmonary Rehabilitation 2013

TABLE 3. (CONTINUED)

Population	Evidence for PR	Outcomes of PR	Special Considerations	Specific Assessment Tools
Lung transplantation	Pretransplant PR: One RCT comparing interval versus continuous training (323); small uncontrolled trials evaluate benefits of pretransplant PR, including Nordic walking (324, 753–755)	Pretransplant PR: Improved exercise tolerance and well-being (753–755)	Exercise prescription must be tailored to patients with severe end-stage lung disease and to specific considerations pertaining to the disease for which the transplant is being considered. 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 appropriate for the individual disease state
	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.

(1) Spruit MA, Singh SJ, Garvey C, et.al, ATS/ERS Task Force on Pulmonary Rehabilitation. An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. Am J Respir Crit Care Med. 2013 Oct 15;188(8):e13-64. doi: 10.1164/rccm.201309-1634ST. Erratum in: Am J Respir Crit Care Med. 2014 Jun 15;189(12):1570. PMID: 24127811.

2020 - Revue systématique (pré) & post TPx

	Auteur	Mode	Type	Durée, rythme	Gr. Intervention	Gr. controle	Evaluation1	Evaluation2
1998	Stiebellehner	ambulatoire	Cohorte	3-5x/se,6se	Endurance + Resistance		VO2pic%	
2008	Maury	ambulatoire	Cohorte	3x/se,12se	Endurance + Resistance		TM6%	
2009	Munro	ambulatoire	Cohorte	12 se	Endurance + Resistance		TM6%	SF-36
2011	Ihle	HC	essai contrôlé	23±5 j	Endurance + Resistance	kiné ambulatoire	TM6%, *V* O2pic%, Pmax%	SF-36, SGRQ
2011	Vivodtzev	domicile + telephone	essai contrôlé	3x/se, 12 se	Endurance + Resistance		VO2pic%, Tend	
2012	Langer	ambulatoire	essai contrôlé	3X/se, 12se	Endurance + Resistance	conseils (6 x 30')	TM6%, *V* O2pic%, Pmax%	SF-36, HADS
2015	Gloeckl	HC	essai contrôlé	4-5X/se, 4se	Endurance + Resistance + plateforme vibrante	Endurance + Resistance	TM6%, Pmax%	CRQ, HADS
2016	Choi	domicile + telemed	étude pilote	8 se	Endurance + Resistance		TM6%	
2017	Fuller	ambulatoire & domicile	essai contrôlé	3×/se, 14se	entrainement supervisé 14se	entrainement supervisé 7se, domicile 7se	TM6%	SF-36
2017	Schneeberger	HC	Cohorte	5-6x/se,6se	Endurance + Resistance		TM6%	SF-36
2019	Candemir	ambulatoire, semi supervisé	Cohorte	12 se	Endurance + Resistance		ISWT and ESWT	SGRQ, CRQ, HADS
2019	Andrianopoulos	HC	étude pilote	3 se	Endurance + Resistance		TM6%	

(1) Hume E, Ward L, Wilkinson M, Manifield J, Clark S, Vogiatzis I. Exercise training for lung transplant candidates and recipients: a systematic review. Eur Respir Rev. 2020 Oct 28;29(158):200053. doi: 10.1183/16000617.0053-2020. PMID: 33115788; PMCID: PMC9488968.

2020 - Revue systématique (pré) & post TPx: résultats

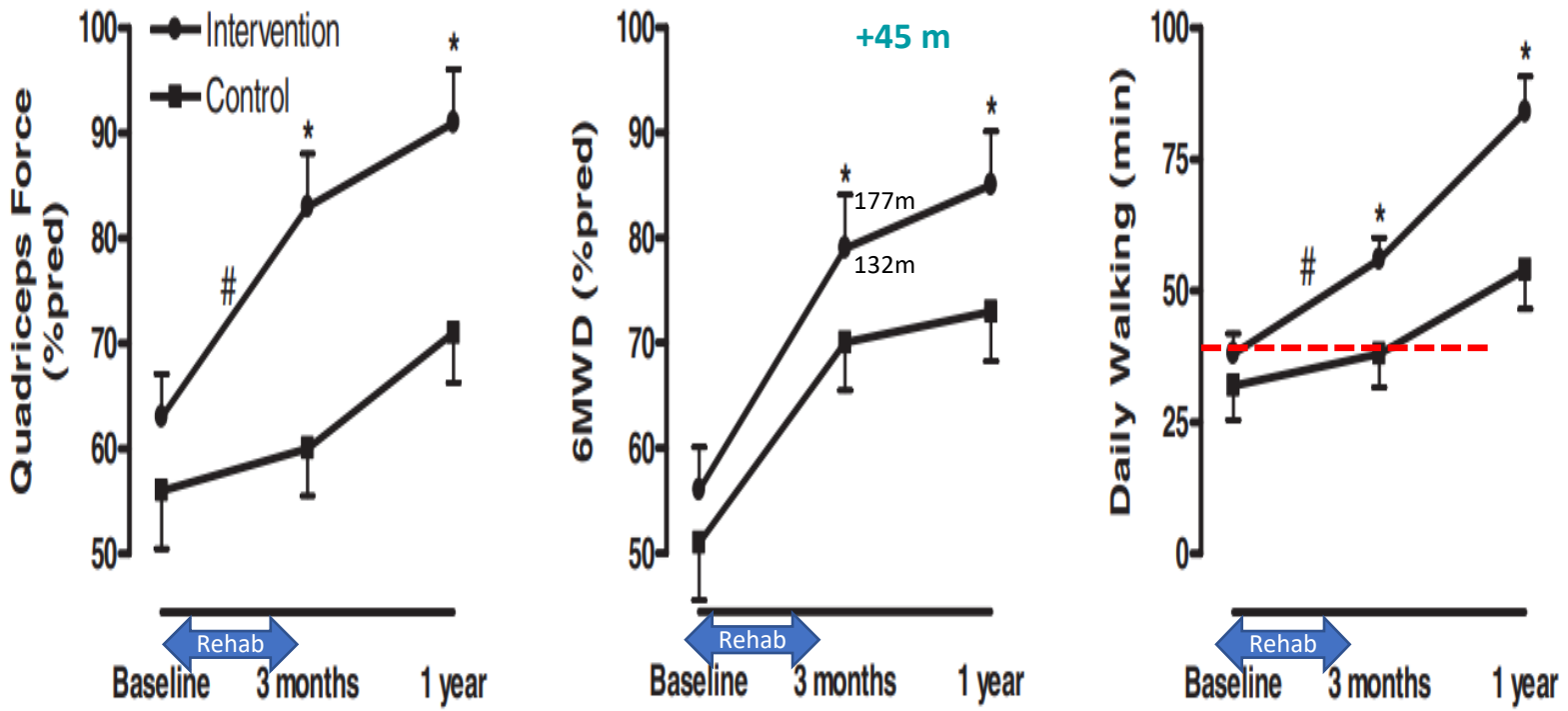
TABLE 3 Effects of pre- and post-transplant exercise training interventions on measures of exercise capacity

First author [ref.]	N	Duration	Measure	Intervention/comparison	Δ (mean±SD where reported)	Pre–post p-value	Between group p-value	Effect size
Ihle *et al.* [23]	60	23±5 days	6MWT (m)	ET (inpatient)	45	p<0.001	p=0.214	INT>CON; 0.24
				Control (outpatient physiotherapy)	24	p<0.001		
			V_{O_2}peak (mL·min^{-1}·kg^{-1})	ET (inpatient)	1.3	p=0.039	p=0.293	INT<CON; −0.19
				Control (outpatient physiotherapy)	2.2	p=0.005		
			PWR (W)	ET (inpatient)	7.3	p=0 022	p=0.600	INT>CON; 0.09
				Control (outpatient physiotherapy)	4.7	p=0.070		
Langer *et al.* [22]	36	12 weeks	6MWT (% pred)	ET	23	-	p=0.008	INT>CON; 0.37
				Control (PA counselling)	19	-		
			V_{O_2}peak (% pred)	ET	16	-	p=0.149	INT>CON; 0.20
				Control (PA counselling)	12	-		
			PWR (% pred)	ET	16	-	p=0.093	INT>CON; 0.26
				Control (PA counselling)	11	-		
Fuller *et al.* [24]	66	14 weeks	6MWT (m)	14 weeks supervised ET	149±169	-	p=0.36	INT<CON; −0.44
				7 weeks supervised ET	202±72	-		
Gloeckl *et al.* [30]	80	4 weeks	6MWT (m)	ET+WBVT	83.5	p<0.001	p=0.029	INT>CON; 0.54
				ET	55.2	p<0.001		
			PWR	ET+WBVT	16.8	p<0.001	p=0.042	INT>CON; 0.38
				ET	12.6	p<0.001		
Candemir *et al.* [25]	23	12 weeks	ISWT (m)	ET	103	p<0.001	-	PRE<POST; 0.87
			ESWT (min)		8	p<0.01	-	PRE<POST; 1.33
Munro *et al.* [46]	36	12 weeks	6MWT (m)	ET	92	p<0.001	-	PRE<POST; 0.79
Maury *et al.* [47]	36	12 weeks	6MWT (m)	ET	129	p<0.05	-	PRE<POST; 0.97
Stiebellehner *et al.* [48]	9	6 weeks	V_{O_2}peak (mL·min^{-1}·kg^{-1})	ET	1.9	p<0.05	-	PRE<POST; 0.49
Schneeberger *et al.* [26]	722	6 weeks	6MWT (m)	ET in COPD SLTx	109±68	p<0.001	-	PRE<POST; 1.60
				ET in COPD DLTx	117±82	p<0.001	-	PRE<POST; 1.43
				ET in ILD SLTx	115±79	p<0.001	-	PRE<POST; 1.46
				ET in ILD DLTx	132±77	p<0.001	-	PRE<POST; 1.71
Andrianopoulos *et al.* [27]	24	3 weeks	6MWT (m)	ET	86±77	p<0.001	-	PRE<POST; 0.73
Choi *et al.* [29]	4	8 weeks	6MWT (m)	ET Tele-rehabilitation	71	-	-	PRE<POST; 0.62
Vivodtzev *et al.* [28]	12	12 weeks	V_{O_2}peak (L·min^{-1})	Home-based ET	0.13±0.22	p=0.059	-	PRE<POST; 0.59
			Endurance time (65% PWR) (min)		9±12	p<0.05	-	PRE<POST; 0.75

ET: exercise training; WBVT: whole body vibration training; 6MWT: 6 min walk test; ISWT: Incremental Shuttle Walk Test; ESWT: Endurance Shuttle Walk Test; V_{O_2peak}: peak oxygen uptake; PWR: Peak Work Rate: SLTx: single lung transplant; DLTx: double lung transplant; COPD: Chronic Obstructive Pulmonary Disease; INT: intervention; CON: control; PRE: Pre-intervention; POST: Post-intervention; UTC: unable to calculate; (Δ): change from baseline.

Efficacité de RHB et activité physiques ? Langer 2012

- **Objectifs:**
  - **évaluer l'effet de RHB ambulatoire pdt 3 mois débuté à la sortie post TPx**
- **Methode:**
  - randomisé,
  - 40-65 ans, séjour<6se non compliqué.
  - GR. Intervention: 3X/se de 90', 3 mois.
    - cyclo = 60 % Pmax;
    - marche = 75 % de la vitesse moyenne du TM6;
    - RM: 3 x 8répét. à 70 % de Pmax.
  - Gr.témoin: instructions individuelles.
- **Résultats:**
  - 40 patients
  - Diff. significatives à 3 mois et 1 an
- **Conclusions:**
  - **RHB précoce améliore la récupération fonctionnelle** après TPx non compliquée.



(1) D. Langer et. al, Exercise Training After Lung Transplantation Improves Participation in Daily Activity. American Journal of Transplantation. 2012; 12: 1584–1592

Conclusion

- **AUCUNE étude franchement défavorable**
- **Toutes les modalités semblent efficaces.**
- Reco ATS/ERS 2015 sur l'usage de réadaptation:
  - Randomized controlled trials demonstrating its beneficial effects on exercise capacity, symptoms, and/or healthrelated quality of life are available in interstitial lung disease, bronchiectasis, asthma, cystic fibrosis, ***lung transplantation,*** lung cancer, and pulmonary hypertension

(1) Rochester CL, Vogiatzis I, Holland AE, Lareau SC, Marciniuk DD, Puhan MA, Spruit MA, Masefield S, Casaburi R, Clini EM, Crouch R, Garcia-Aymerich J, Garvey C, Goldstein RS, Hill K, Morgan M, Nici L, Pitta F, Ries AL, Singh SJ, Troosters T, Wijkstra PJ, Yawn BP, ZuWallack RL; ATS/ERS Task Force on Policy in Pulmonary Rehabilitation. An Official American Thoracic Society/European Respiratory Society Policy Statement: Enhancing Implementation, Use, and Delivery of Pulmonary Rehabilitation. Am J Respir Crit Care Med. 2015 Dec 1;192(11):1373-86. doi: 10.1164/rccm.201510-1966ST. PMID: 26623686.

Les données de la littérature

Quelques points particuliers

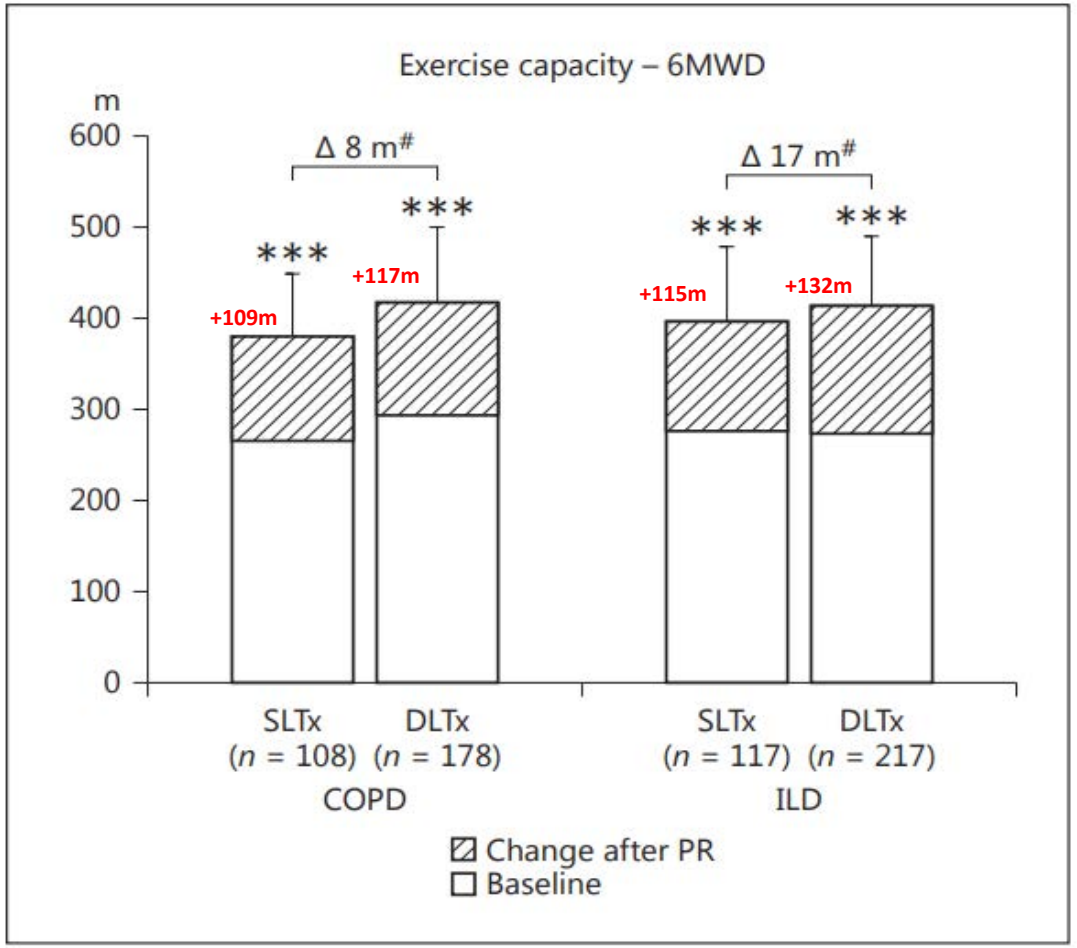
La pratique

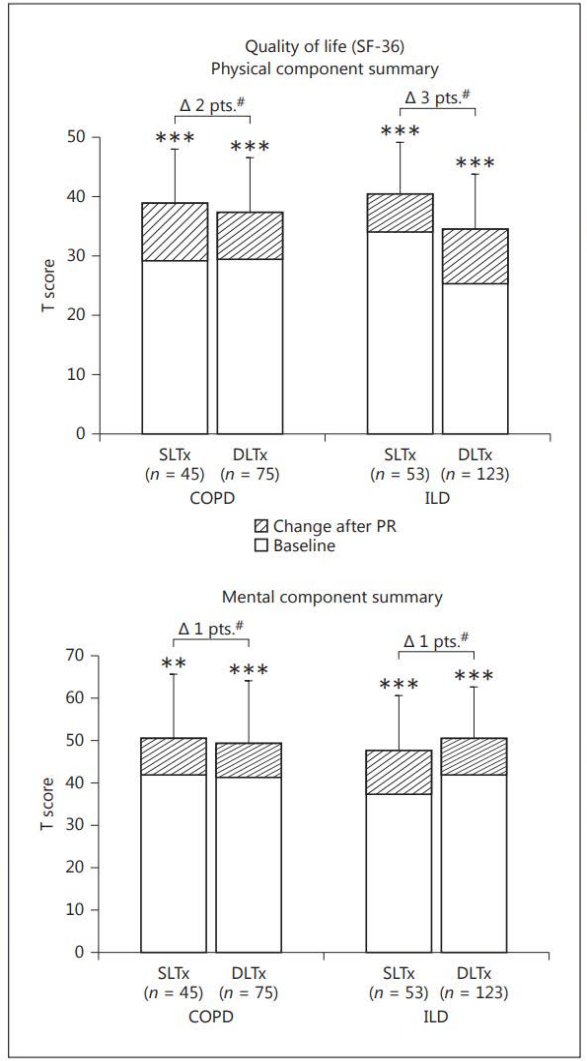
Expérience locale

Conclusion

Efficacité de RHB selon le type de chirurgie (uniP/biP)

- analyse retrospective
  - n=722,
  - RHB en HC
  - dans l'année postTPx
- Résultats: NS
  - capacité d'exercice ↗
  - qualité de vie ↗





Schneeberger T, Gloeckl R, Welte T, Kenn K. Pulmonary Rehabilitation Outcomes after Single or Double Lung Transplantation in Patients with Chronic Obstructive Pulmonary Disease or Interstitial Lung Disease. Respiration. 2017;94(2):178-185. doi: 10.1159/000477351. Epub 2017 Jun 10. PMID: 28601868.

Efficacité de RHB selon selon la durée d'hospitalisation ?

- analyse retrospective
  - n=138,
  - RHB en HC
  - 42 j: (75e percentile de DMS)
- résultats:
  - bénéfice fonctionnel des 2 groupes.
    - Pmax,
    - TM6,
    - Nb étages,
    - SF36phy (p<0,05)
  - Écart intergroupe signif.

	Length of stay > 42 days (*n* = 30)			Length of stay ≤ 42 days (*n* = 108)			Intergroup comparison (*P*)
	Baseline	Completion	*P*	Baseline	Completion	*P*	
Body weight, kg	56 (46–69)	56 (47–67)	0.6	62 (54–72)	63 (53–72)	0.9	n.s.
BMI, kg/m²	19 (17–23)	20 (17–24)	0.4	21 (19–24)	22 (18–24)	0.8	n.s.
VC, % pred.	45 (36–65)	58 (45–79)	<0.001	56 (45–65)	66 (57–80)	<0.001	n.s.
FEV1, % pred.	49 (39–60)	56 (49–74)	<0.001	55 (46–68)	65 (52–78)	<0.001	n.s.
Peak work rate, W	29 (13–37) +8W	37 (30–48)	<0.001	43 (34–52) +10W	53 (39–71)	<0.001	**
VO_{2max}, ml/min/kg	11 (10–14)	13 (11–16)	0.03	12 (11–15)	14 (12–16)	<0.001	n.s.
6-MWD, m	262 (115–345) +123m	385 (260–454)	<0.001	390 (282–460) +85m	475 (423–540)	<0.001	**
ADL (Barthel's index)	100 (90–100)	100 (100)	0.002	100 (100)	100 (100)	<0.001	n.s.
Floors, no.	0 (0–1) +1	2 (1–4)	<0.001	1 (0–2) +3	4 (3–5)	<0.001	**
SF36							
Physical functioning	15 (5–31)	55 (39–70)	<0.001	30 (15–50)	70 (50–85)	<0.001	*
Role physical	0 (0–25)	50 (50–100)	<0.001	0 (0–50)	75 (50–100)	<0.001	n.s.
Bodily pain	73 (55–100)	94 (67–100)	0.04	58 (34–71)	78 (62–100)	<0.001	n.s.
Gen. health perception	47 (37–57)	67 (51–72)	0.01	47 (40–62)	67 (52–72)	<0.001	n.s.
Vitality	43 (25–61)	65 (49–71)	<0.001	50 (35–65)	65 (55–75)	<0.001	n.s.
Social functioning	75 (38–88)	75 (63–100)	0.03	75 (50–100)	88 (63–100)	<0.001	n.s.
Role emotional	100 (0–100)	100 (92–100)	0.004	100 (0–100)	100 (100–100)	<0.001	n.s.
Mental health	76 (61–84)	82 (71–92)	0.002	76 (59–85)	70 (50–85)	<0.001	n.s.
HADS							
Anxiety	3 (1–9)	2 (1–6)	0.04	5 (3–7)	4 (2–6)	<0.001	n.s.
Depression	4 (2–7)	4 (2–6)	0.07	4 (2–7)	2 (1–4)	<0.001	n.s.
Complications							
Total (%)		18 (60)			62 (57)	0.9	n.s.
Acute rejection		8 (27)			32 (30)	1.0	n.s.
Infection		4 (13)			14 (13)	1.0	n.s.
Airway obstruction		2 (7)			3 (3)	0.2	n.s.
DIOS		1 (3)			4 (4)	1.0	n.s.
Other		3 (10)			9 (8)	0.7	n.s.
Duration of rehab., days		28 (21–35)			21 (21–28)		n.s.

Dierich M, Tecklenburg A, Fuehner T, Tegtbur U, Welte T, Haverich A, Warnecke G, Gottlieb J. The influence of clinical course after lung transplantation on rehabilitation success. Transpl Int. 2013 Mar;26(3):322-30. doi: 10.1111/tri.12048. Epub 2013 Jan 7. PMID: 23294442.

Jeux Olympiques des transplantés: *"Yes you can !"*

	All subjects (n=128)	Kidney (n=76)	Liver (n=16)	Heart (n=19)	Lungs (n=6)	Pancreas/ kidney (n=7)	Bone marrow (n=4)
Female (%)	41.4	40.7	50.0	21.3	83.3	28.6	50.0
Age (yr)	45.9±11.2	44.8±11.1	47.5±9.6	50.5±12.5	48.6±11.7	45.8±6.5	32.5±9.9
Time post-Tx (yr)	8.1±10.5	9.8±11.7	3.8±2.3	7.7±11.8	3.0±1.0	7.2±5.9	2.2±1.3
Highest level of education (yr)	15.5±2.3	15.3±2.4	15.4±2.0	15.8±2.3	15.6±2.3	15.5±1.2	15.2±2.2
Active[a] (%)	76.6	72.4	100.0	68.4	100.0	57.1	100.0

[a] Active = self-reported regular exercise three times per week or more: 20 or more minutes per session

	All subjects (n=128)	Kidney (n=76)	Liver (n=16)	Heart (n=19)	Lungs (n=6)	Pancreas/ kidney (n=7)	Bone marrow (n=4)
% Reporting bone/joint discomfort	39.8	43.2	25.0	36.8	16.6	71.4	25.0
Prednisone dose (mg/day) (No. of patients)	7.5±3.3 (n=109)	8.5±3.2 (n=70)	4.5±1.7 (n=11)	6.0±2.8 (n=16)	7.1±2.9 (n=7)	7.5±2.9 (n=5)	0
Cyclosporine dose (mg/day) (No. of patients on Sandimmune or Neoral)	173.8±91 (n=99)	188.2±98 (n=54)	152±68 (n=9)	122±56 (n=14)	231±51 (n=5)	200±139 (n=3)	0
Azathiorpine dose (mg/day) (No. of patients)	92.6±99.4 (n=69)	86.8±42.9 (n=42)	93.7±31.4 (n=4)	120.5±67.8 (n=17)	75.0±26.4 (n=5)	75.0±20.4 (n=4)	0
% of patients on CellCept	7.0	7.8	6.2	5.2	16.7	0	0
% of patients on FK506	7.0	0	43.7	0	16.7	16.7	0

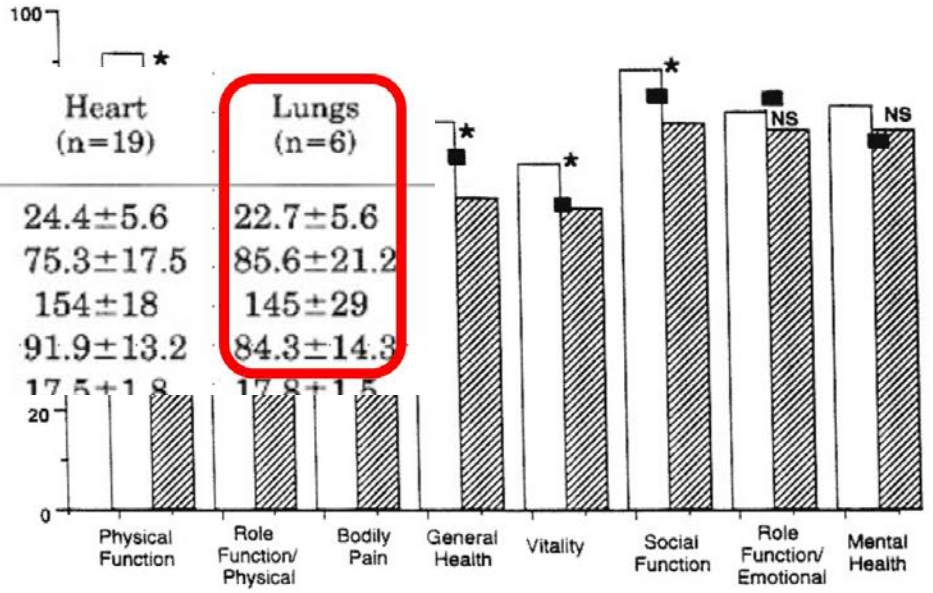
Concept/measure	Definition	No. of items	All subjects (mean ± SD)	SF-36 norms[a] (mean ± SD)
Physical Functioning	Extent to which health limits physical activities such as self-care, walking, climbing stairs, bending, lifting, and moderate and vigorous activities	10	89.0±14.9	84.6±21.1
Role Functioning/ Physical	Extent to which physical health interferes with usual daily activities, such as work, housework, and schoolwork	4	76.5±34.7	82.6±33.0
Bodily Pain	Extent to which pain is experienced and limits normal work inside and outside the home	2	75.6±23.3	73.1±24.0
General Health	Ratings of overall personal health	5	74.5±23.4	71.7±19.4
Vitality	Amount of time subject was tired, energetic, had enough energy to do things	4	67.4±18.7	61.8±20.9
Social Functioning	Limitations in normal social activities due to physical or emotional health	2	85.7±23.4	84.1±21.8
Role Functioning/ Emotional	Extent to which emotional health interferes with usual daily activities, such as work, housework, and schoolwork	3	79.1±32.3	83.6±31.4
Mental Health	Feelings of depression, anxiety, positive affect	5	80.2±15.6	75.3±17.8

[a] From Ware et al., 1993 (*44*).

	All subjects (n=128)	Kidney (n=76)	Liver (n=16)	Heart (n=19)	Lungs (n=6)
Peak VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	30.2±9.5	31.6±12.6	30.5±9.6	24.4±5.6	22.7±5.6
% Age-predicted peak VO_2	94.7±30.0	98.0±32.5	101.1±34.0	75.3±17.5	85.6±21.2
Peak heart rate (beats/min)	159±17	159±21	158±20	154±18	145±29
% Age-predicted heart rate	91.5±11.6	91.2±11.0	92.2±12.5	91.9±13.2	84.3±14.3
Peak RPE (units)	17.7±1.9	17.8±2.0	17.5±1.4	17.5±1.8	17.8±1.5

	All subjects (n=128)	All active subjects (n=98)	All inactive subjects (n=30)	*P* (active vs. inactive)	95% CI of difference interval Lower	Upper
Weight (kg)	73.1±15.4	72±15.9	76.8±13.5	0.16	−1.45	11.27
BMI	25.3±4.2	24.5±4.1	26.9±4.1	0.01	0.36	3.79
% Body fat	24.8±8.4	23.8±8.1	28.4±9.5	0.01	1.09	8.13
Peak VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	30.2±9.5	32.1±9.0	23.7±8.4	0.000	−12.15	−4.62
% Age-predicted peak VO_2	94.7±30.0	101.1±30.1	72.7±21.0	0.000	−0.41	−0.16
Peak heart rate (beats/min)	159±17	160±21	154±22	0.18	−15.18	3.01
% Age-predicted heart rate	91.5±11.6	92.2±11.6	89.3±11.4	0.24	−7.83	2.01
Peak RPE (units)	17.7±1.9	17.9±1.7	16.9±2.4	0.03	−1.87	−0.22
Peak systolic blood pressure (mmHg)	181±24	183±25	176±21	0.17	−17.43	3.18
Peak lactate (mMol/L)	6.6±2.8	6.9±2.8	5.7±2.9	0.09	−2.43	0.19
Peak RER	1.21±0.11	1.21±0.10	1.17±0.11	0.07	−0.09	0.002

[a] Abbreviations: RPE, rating of perceived exertion (0–20 scale); RER, respiratory exchange ratio.

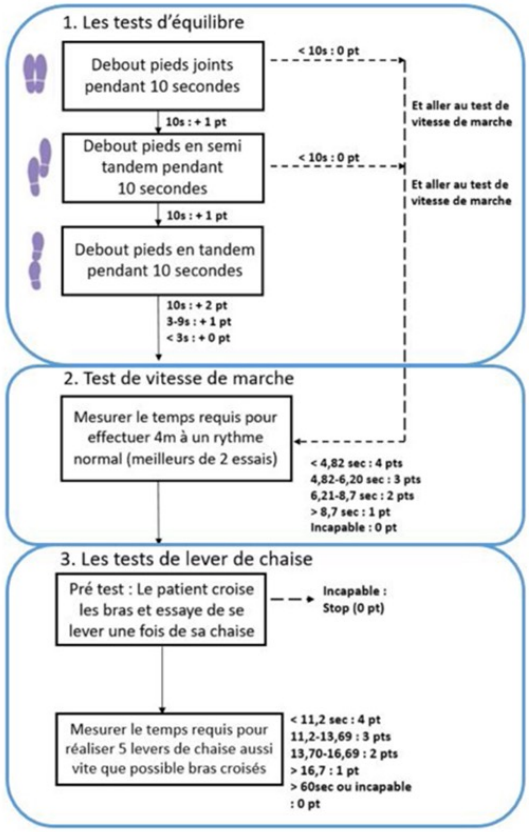


SF-36 scale scores. □, Active transplant; ■, inactive transplant; •, general population norms. *P<0.05.

Painter PL, Luetkemeier MJ, Moore GE, Dibble SL, Green GA, Myll JO, Carlson LL. Health-related fitness and quality of life in organ transplant recipients. Transplantation. 1997 Dec 27;64(12):1795-800. doi: 10.1097/00007890-199712270-00029. PMID: 9422422.

La fragilité préopératoire majore le risque de décès après TPx.

- Frailty =
  - déclin physiologique + vulnérabilité au stress
- prospective, n=318 TPx
  - fragilité préTPx / mortalité post TPx
- Résultats: sujets fragiles:
  - mortalité à 1 et 4 ans ↗
  - sur-risque 1ère année= 12 %
  - 1 pt = risque DC:+20 %



Short Physical Performance Battery [18]. La fragilité est définie par un score SPPB ≤ 7.

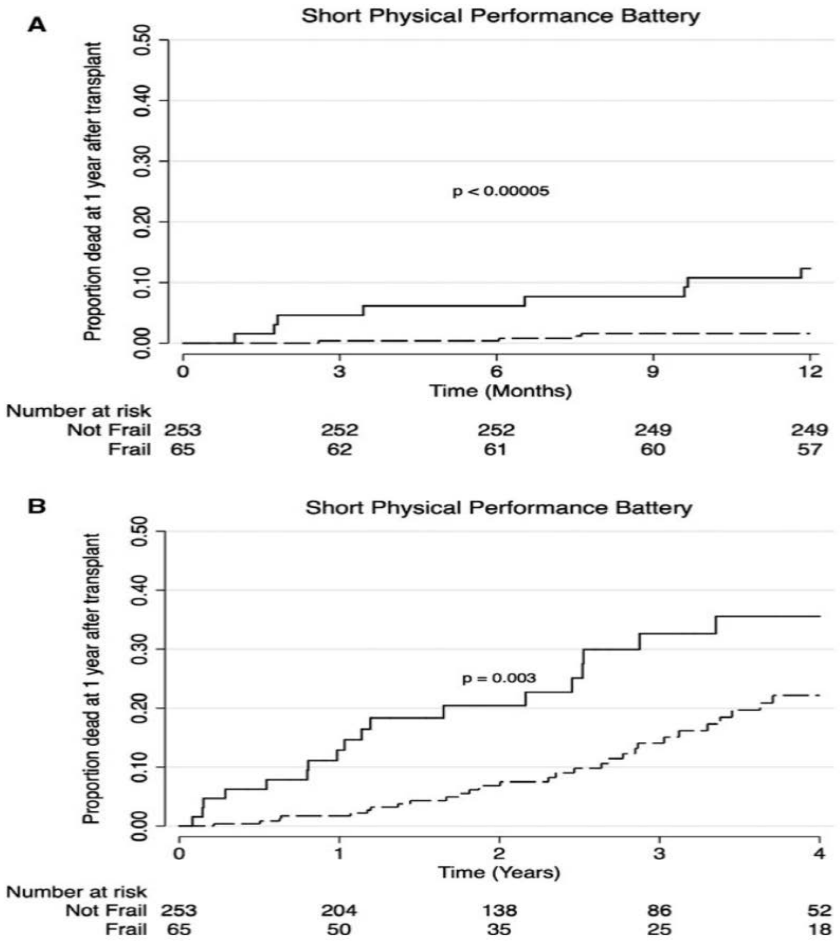


FIGURE 1 Time to death by Short Physical Performance Battery within the first year after transplant (A) and over four years after transplant (B). Solid lines = frail, dashed lines = not frail.

(1) Singer JP, et al. Frailty phenotypes and mortality after LTx: A prospective cohort study. Am J Transplant. 2018 Aug;18(8):1995-2004. doi: 10.1111/ajt.14873.

Devenir des patients initialement fragiles après TPx

- Suivi prospectif de candidats TPx
  - Sydney 2013-2017
- Fragilité évaluée en routine en liste d'attente
  - Fragile si mFFP>3
  - Réévaluation à 1 an si fragilité initiale (18/27)
- Post TPx:
  - RHB ambulatoire 12 se

Critères de Fragilité
proposés par Fried et al. J.Gerontol.A Biol.Sci.Med.Sci. 2001. 56: M146-M156

1 - Perte de poids
>=5% par an

2 - Fatigue subjective
Epuisé ou fatigué en permanence ou fréquemment ?

3 - Activité physique
Aucune activité physique ou moins de 1 à 2 marches par semaine

4 - Vitesse de marche
Difficulté à marcher 100 mètres

5 – Force «grip strength»

→ 3 ou plus = Fragile
1 ou 2 = Pre frail
0 = Non fragile

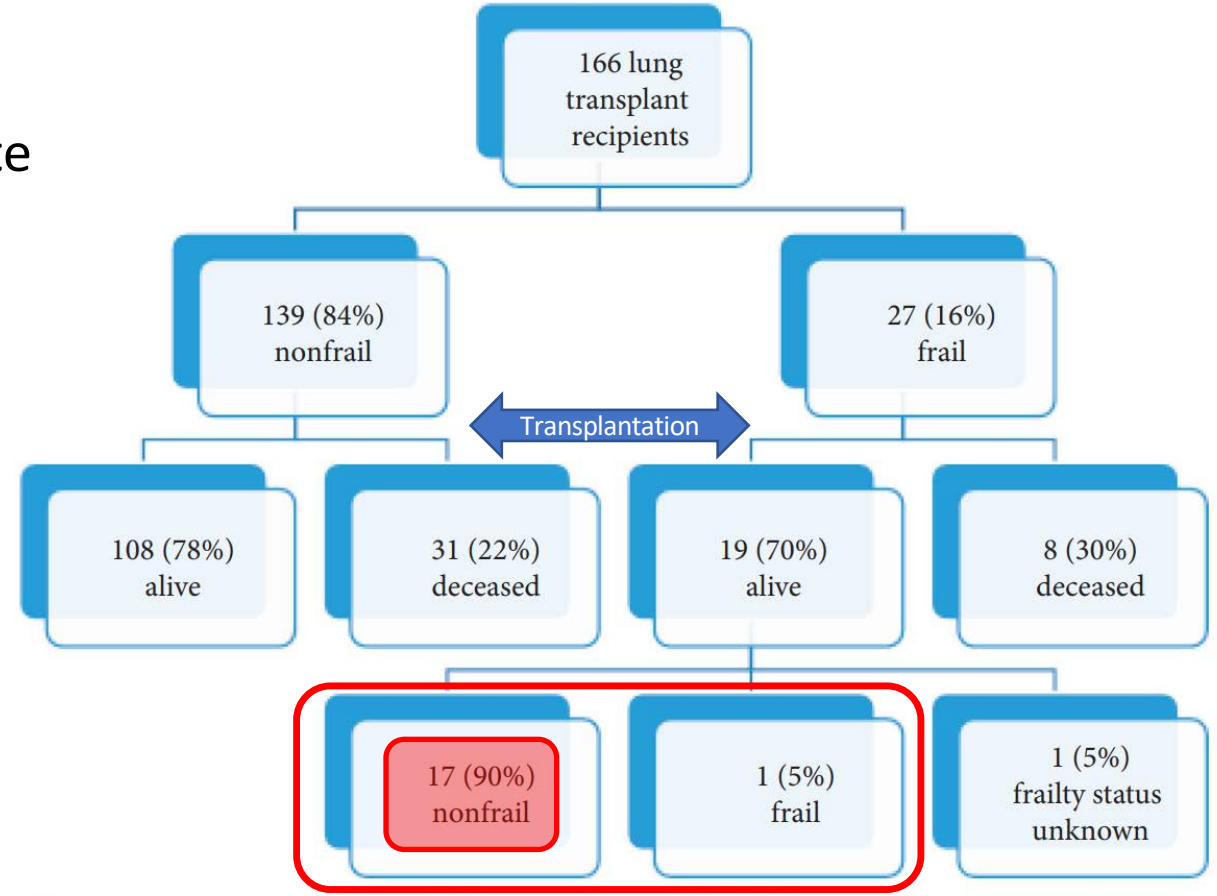


FIGURE 2: Outcome of nonfrail vs. frail patients post-LTX following reassessment of frail patients.

Montgomery E, Macdonald PS, Newton PJ, Chang S, Wilhelm K, Jha SR, Malouf M. Reversibility of Frailty after Lung Transplantation. J Transplant. 2020 Aug 7;2020:3239495. doi: 10.1155/2020/3239495. PMID: 32850137; PMCID: PMC7439792.

Devenir post TPx des survivants initialement fragiles

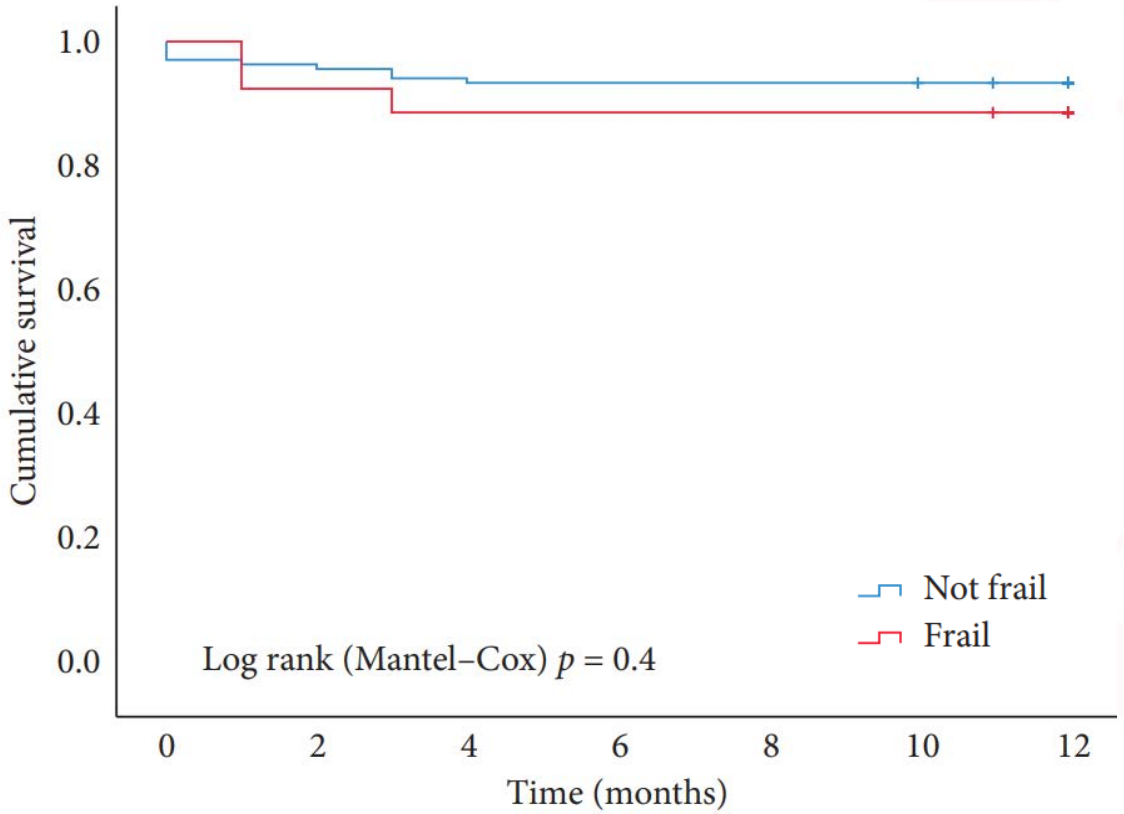
Données démographiques	
Fragilité associée à:	**Fragilité non liée à:**
Créatininémie ↓↓	Age
Hb ↓↓	Genre
Albuminémie ↓↓	Maladie initiale
Cognition altérée (MOCA<29/30)	IMC
Dépression (DMI-10 ≥9)	PaO2, VEMS, DLCO

Table 3: Comparison of clinical characteristics post-LTX of a study population stratified by physical frailty status.

	Total ($n = 166$)	Nonfrail ($n = 139$)	Frail ($n = 27$)	p value
	Median (IQR)			
Intubation post-LTX (hours)	24 (69)	23 (71)	31 (66)	NS
ICU LOS (days)	5 (7)	5 (6)	4 (9)	NS
Hospital LOS (days)	20 (21)	19 (19)	24 (30)	NS

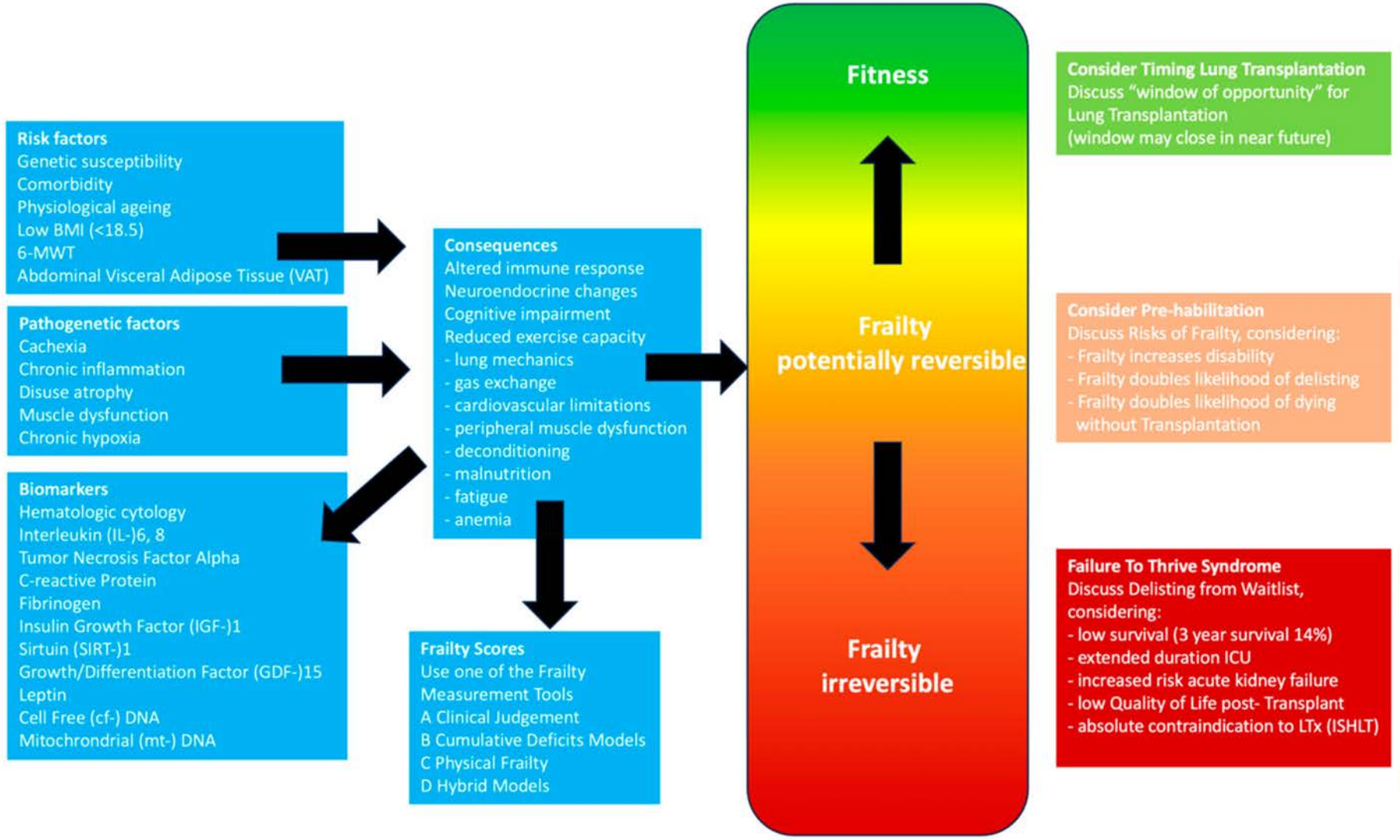
Values are median (interquartile range) for nonnormally distributed continuous data.

- Survie à 12 mois fragiles vs non fragiles: NS



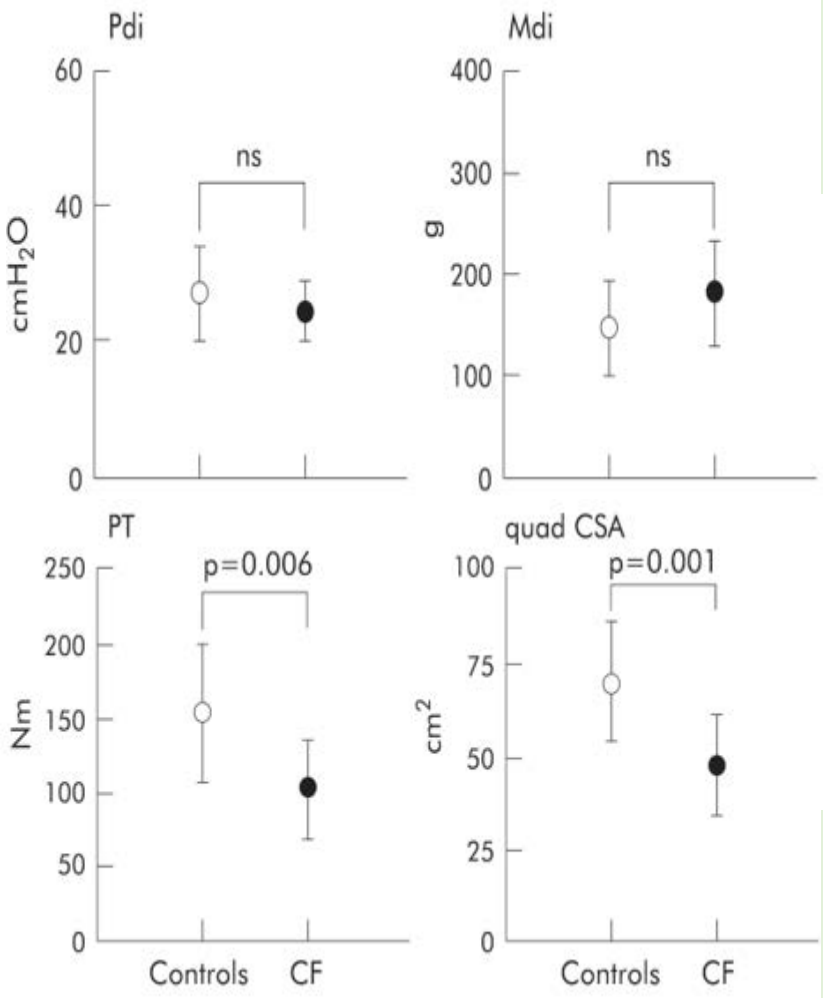
Montgomery E, Macdonald PS, Newton PJ, Chang S, Wilhelm K, Jha SR, Malouf M. Reversibility of Frailty after Lung Transplantation. J Transplant. 2020 Aug 7;2020:3239495. doi: 10.1155/2020/3239495. PMID: 32850137; PMCID: PMC7439792.

Les facettes de la fragilité



Hage R, Schuurmans MM. Frailty as a Prognostic Indicator in Lung Transplantation: A Comprehensive Analysis. Transplantology. 2024; 5(1):1-11. https://doi.org/10.3390/transplantology5010001

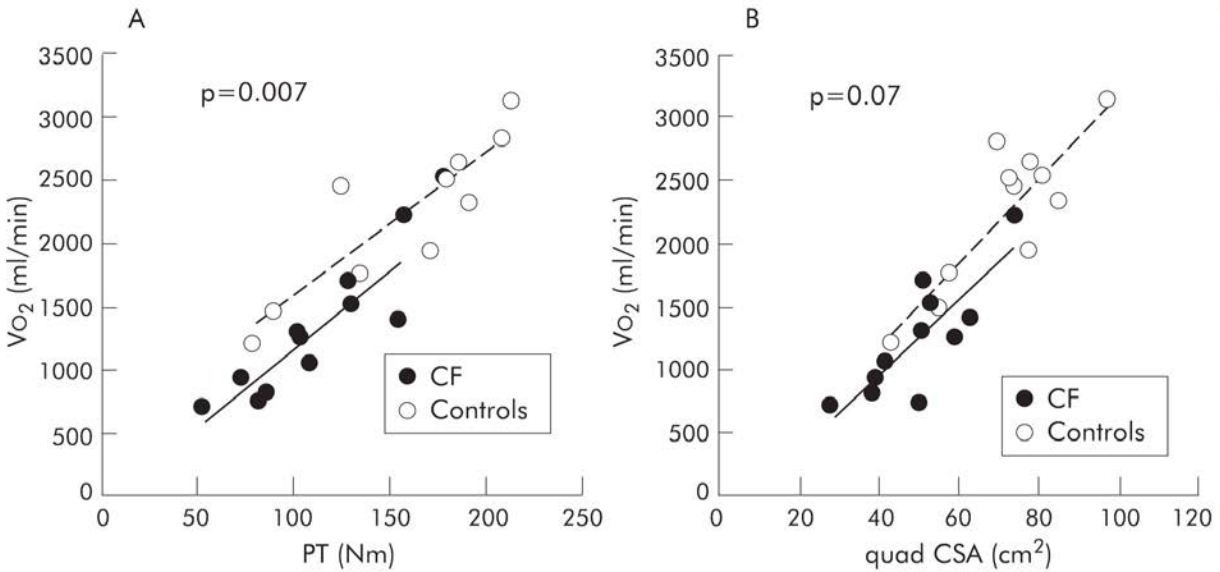
Sarcopénie, force musculaire et capacité d'exercice



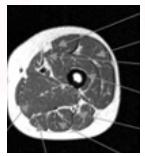
la force et le volume du diaphragme sont préservés après TPx

la force du quadriceps est diminuée par l'atrophie musculaire.

VO2max est corrélée avec la force et la section du quadriceps mais réduite dans le groupe TPx

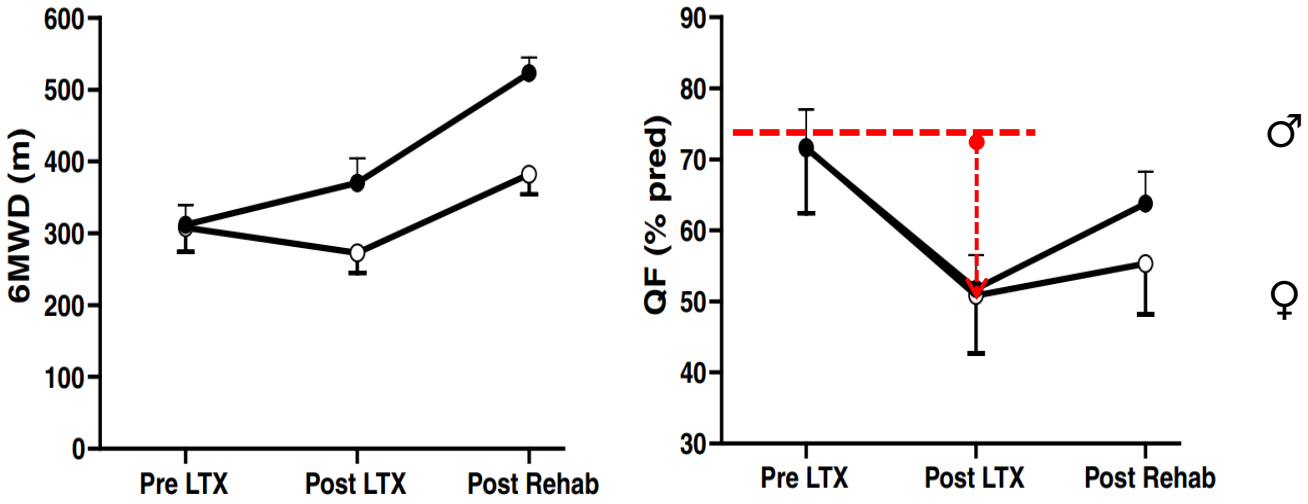


- 48 mois post TPx vs sujets sains:
  - PiMax & PeMax: ↔
  - force et section quadriceps < sujet sain
  - VO2 // force et section quadriceps



Pinet C, Scillia P, Cassart M, et al (2004) Preferential reduction of quadriceps over respiratory muscle strength and bulk after LTx for cystic fibrosis. Thorax 59:783–9

Force musculaire: bénéfice de la réadaptation ++



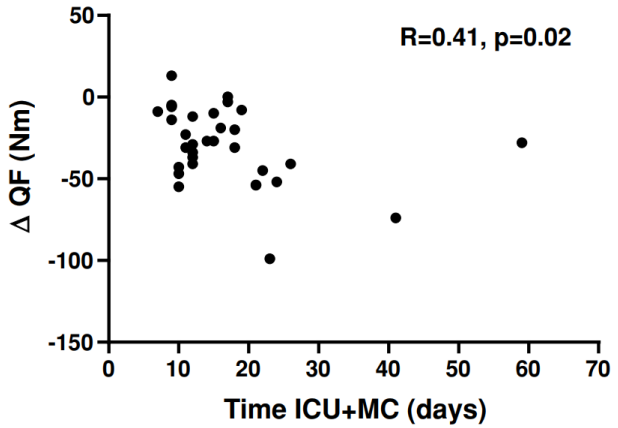


Figure 2: Six-min walking distance (6MWD in m, left panel: mean and SEM) and Quadriceps force (QF) (in % of the predicted value, right panel: mean and SEM) before lung transplantation (pre-LTX), after lung transplantation (post-LTX) and 3 months later (post-rehab) in male (•) and female (o) patients. 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).

- RHB ambulatoire, 3 séances/se pdt 12 se, n=36,

- **Force M ↘ post TPx puis ↗ après RHB**
- Moindre récupération inférieure:
  - Femme
  - Durée d'hospitalisation

Maury G, Langer D, Verleden G, et al (2008) Skeletal muscle force and functional exercise tolerance before and after LTx: a cohort study. Am J Transplant 8(6):1275–81

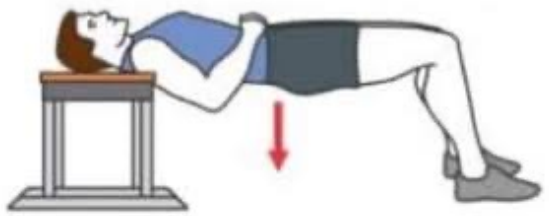
Transplantation et ostéoporose ++

- déminéralisation osseuse: présente AVANT et APRES TPx
  - Corticothérapies (dose totale) , IS
  - IMC bas, inactivité, hypoxémie, tabac.
- Post TPx: risque majoré [1–5]:
  - perte de densité: de 5 à 15 % les 6 premiers mois [2,3].
  - concerne 60 % des patients
  - squelette axial (lombaires),
- Risque fracturaire +++:
  - TPx incidence de fracture = 18 % à 1 an [4,5].
- Faible effet de la prophylaxie (calcium et de vitamine D)

(1) Aris RM, et al (1996) Severe osteoporosis before and after lung transplantation. Chest 109:1176–83 23.
(2) Braith RW, et al (2007) Comparison of alendronate vs al. plus mech. loading for osteoporosis in LTx recipients: a pilot study. J Heart Lung Transplant 26(2):132–7 24.
(3) Braith RW, et al (2003) Resistance exercise training and alend. reverse steroid-induced osteoporosis in heart transp. recipients. J Heart Lung Transplant 22(10):1082–90 25.
(4) Spira A, et al (2000) Osteoporosis and lung transplantation: a systematic review. Chest 117:476–81 26.
(5) Trombetti A, et al (2000) Bone mineral density in lung-transplant recipients before and after graft: prevention of lumbar spine post-transplantation-accelerated bone loss by pamidronate. J Heart Lung Transplant 19(8):736–43

Réadaptation et ostéoporose: 2 composantes

- Agents anti-résorption (alendronate, pamidronate),
- Renforcement musculaire (synthèse osseuse):
  - exercice résistif
  - groupes musculaires cibles de l'ostéoporose
    - tronc, hanches



+

- Association préventive
  - force des muscles lombaires,
  - densité vertébrale

(1) Braith RW, Conner JA, Fulton MN, et al (2007) Comparison of alendronate vs alendronate plus mechanical loading as prophylaxis for osteoporosis in lung transplant recipients: a pilot study. J Heart Lung Transplant 26(2):132–7 24.

(2) Braith RW, Magyari PM, Fulton MN, et al (2003) Resistance exercise training and alendronate reverse glucocorticoid-induced osteoporosis in heart transplant recipients. J Heart Lung Transplant 22(10):1082–90 25.

Les données de la littérature
Quelques points particuliers
La pratique
Expérience locale
Conclusion

Réadaptation dès le lendemain de la TPx

Post-transplant:
Acute hospitalization

Early mobility
On ICU and ward

Progression to independent function (transfers, walking, self-care, stairs)

Exercise training
Aerobic, resistance, flexibility exercise as tolerated

Oxygen titration
to support exercise/ activity

- Sevrage d'assistance ventilatoire puis extubation
  - élimination des sécrétions,
  - expansion pulmonaire
- Prévention des complications de décubitus
  - chgt. Positions,
  - verticalisation précoce,
  - 1er lever J1,
  - reprise de la déambulation.
- Sevrage de l'O2

1.Wickerson L, Rozenberg D, Janaudis-Ferreira T, Deliva R, Lo V, Beauchamp G, Helm D, Gottesman C, Mendes P, Vieira L, Herridge M, Singer LG, Mathur S. Physical rehabilitation for lung transplant candidates and recipients: An evidence-informed clinical approach. WJT 2016; 6(3): 517-531 [PMID: 27683630 DOI: 10.5500/wjt.v6.i3.517]
2.Downs AM. Physical therapy in lung transplantation. Phys Ther. 1996 Jun;76(6):626-42. doi: 10.1093/ptj/76.6.626. PMID: 8650277.

Améliorer la mécanique ventilatoire et le drainage bronchique

Post-transplant:
Acute hospitalization

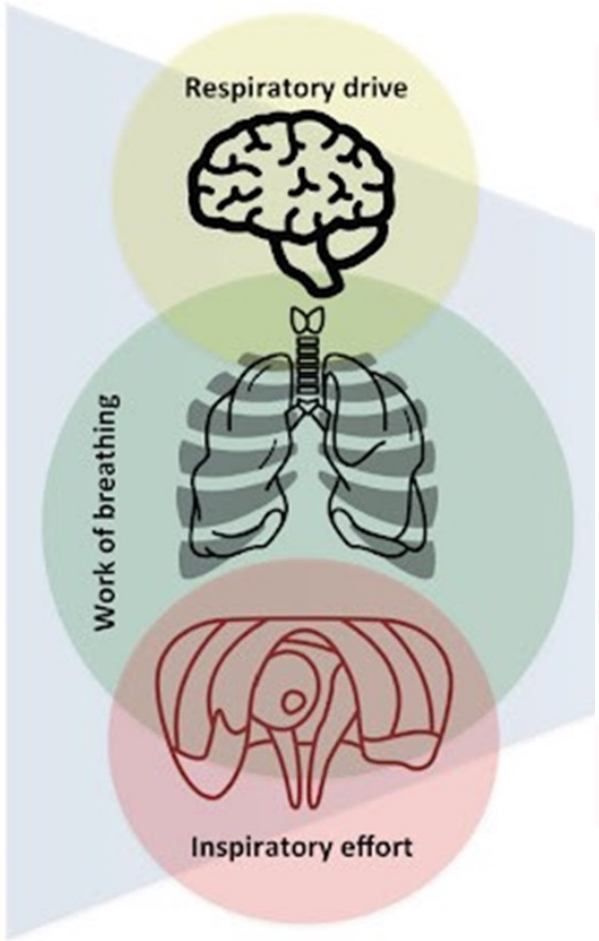
Early mobility
On ICU and ward

Progression to independent function (transfers, walking, self-care, stairs)

Exercise training
Aerobic, resistance, flexibility exercise as tolerated

Oxygen titration
to support exercise/ activity

- limiter l'hypoventilation réflexe
  - adaptation des antalgiques
- désencombrement bronchique actif
  - 1-4 séances de 20-30':
  - expectoration dirigée après nébulisation
  - drainage bronchique
- améliorer la mécanique ventilatoire :
  - Expiratoire
    - drainage pleural,
  - Inspiratoire
    - jeu diaphragmatique,
    - prévention des atélectasies,
  - spirométrie incitative
- (re)découvrir la ventilation normale
  - restaurer un schéma ventilatoire longtemps altéré
    - accompagner l'expérience de proprioception



1ère période: récupérer la mobilité

Post-transplant:
Acute hospitalization

Early mobility
On ICU and ward

Progression to independent function (transfers, walking, self-care, stairs)

Exercise training
Aerobic, resistance, flexibility exercise as tolerated

Oxygen titration
to support exercise/ activity

- Mouvements segmentaires:
  - Amplitude des membres supérieurs et inférieurs,
  - Force segmentaire
- Activités de base pour:
  - Transferts,
  - Reprise de la marche.
- participation active du patient à son autonomisation
- Retrait des drains, passage en Pneumologie
- Sevrage de l'oxygénothérapie (repos, effort)

Wickerson L, Rozenberg D, Janaudis-Ferreira T, Deliva R, Lo V, Beauchamp G, Helm D, Gottesman C, Mendes P, Vieira L, Herridge M, Singer LG, Mathur S. Physical rehabilitation for lung transplant candidates and recipients: An evidence-informed clinical approach. World J Transplant 2016; 6(3): 517-531 [PMID: 27683630 DOI: 10.5500/wjt.v6.i3.517]

2ème période: cercle vertueux du reconditionnement

Post-transplant:
Early (1-6 mo)

Uncomplicated course:
Exercise training using FITT-P: Aerobic, resistance, flexibility

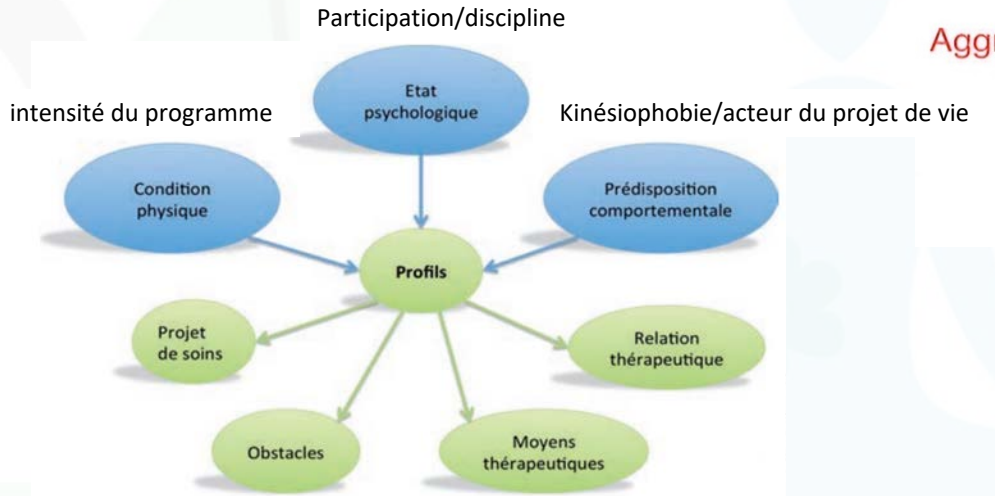
Complicated Course (Long-stay ICU/acute care):

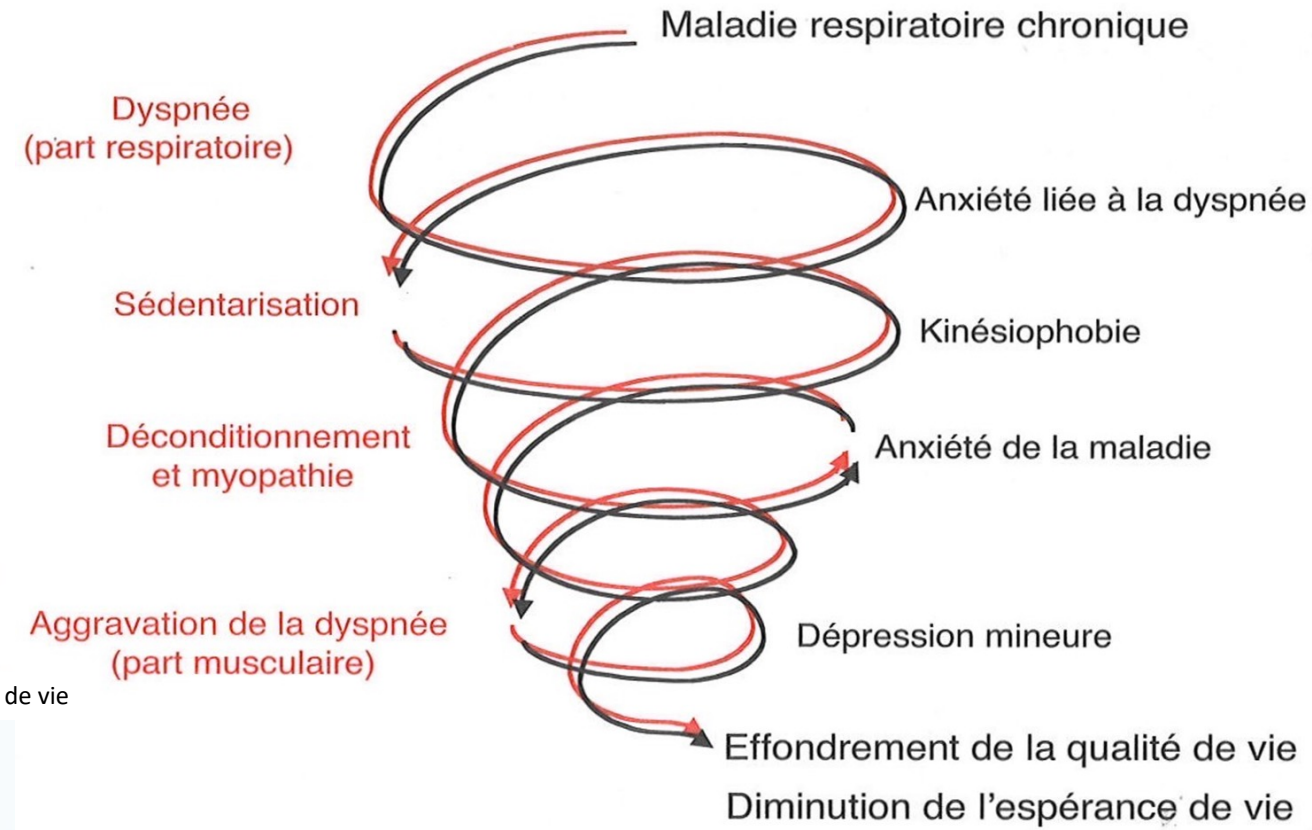
Progression to independent function (transfers, walking, self-care, stairs)

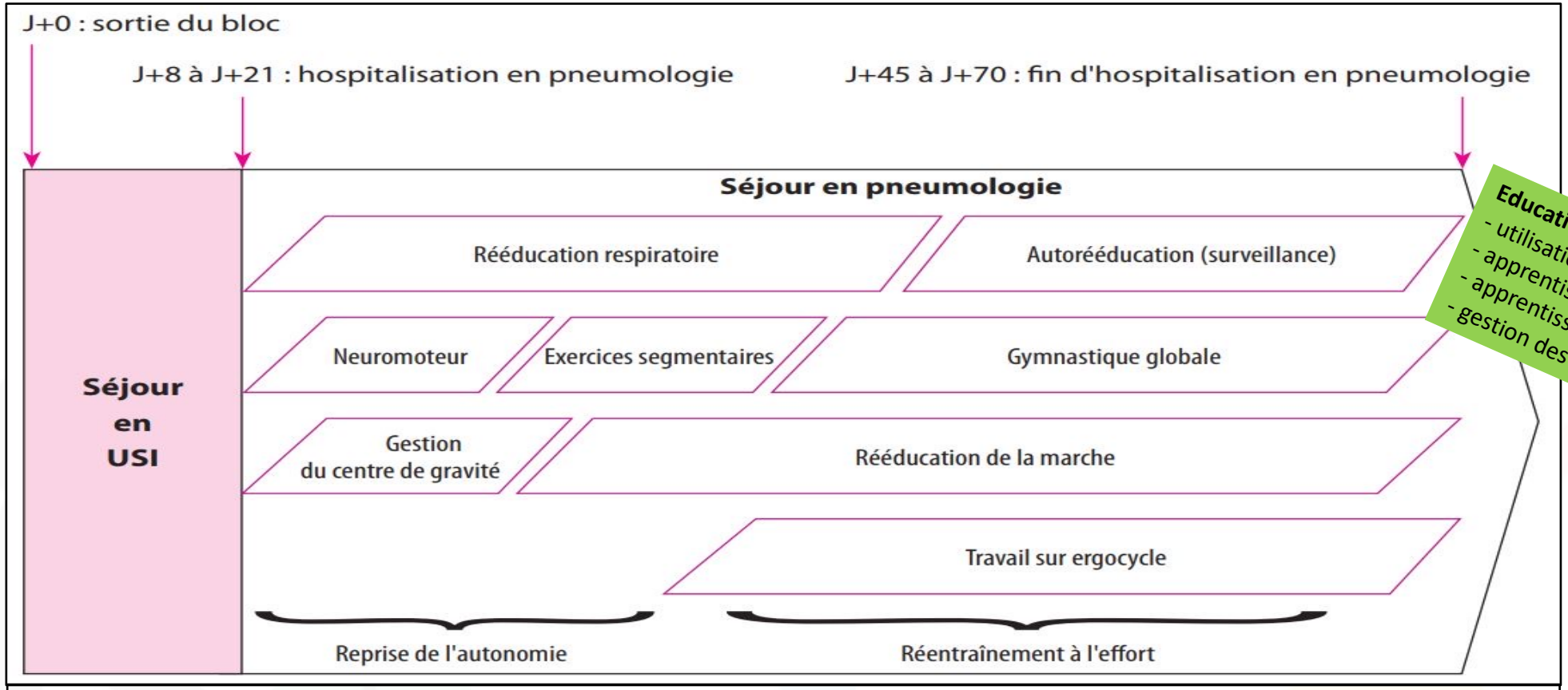
Referral to inpatient rehab (if required)

Exercise training
Aerobic, resistance flexibility exercise as tolerated balance training

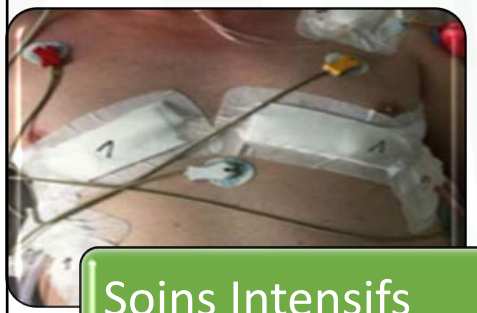
- autonomie de chambre
  - Mobilisations, étirements, tonus,
  - transferts, reprise de la marche,
  - augmentation journalière.
- autonomie de couloir
  - rééducation de la déambulation,
  - travail dans les escaliers,
  - Autonomie



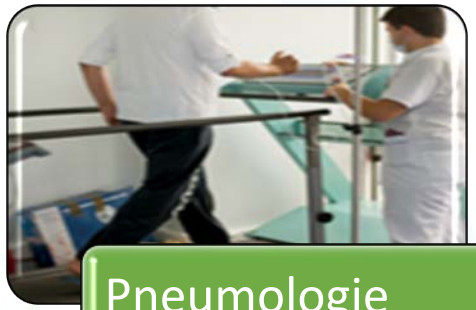




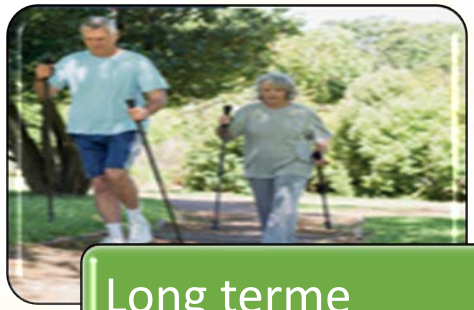
Education thérapeutique +++:
- utilisation du spiromètre
- apprentissage des signes de dégradation
- apprentissage des précautions
- gestion des médicaments



Soins Intensifs
- 1ers jours



Pneumologie
- 1er mois



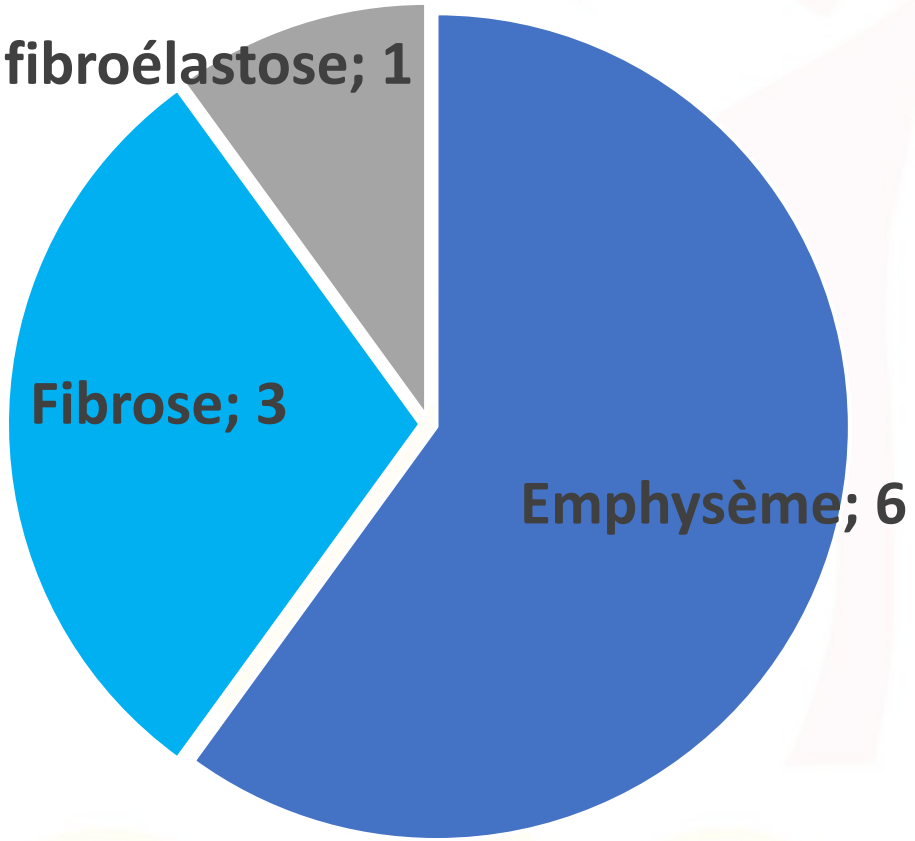
Long terme
- 1ère année

Quelle kinésithérapie pour le patient transplanté pulmonaire ? Nicolas DOUMECQ-LACOSTE Benoît TISSOT Kinésithér Scient 2014;551:23-33

Les données de la littérature
Quelques points particuliers
La pratique
Expérience locale
Conclusion

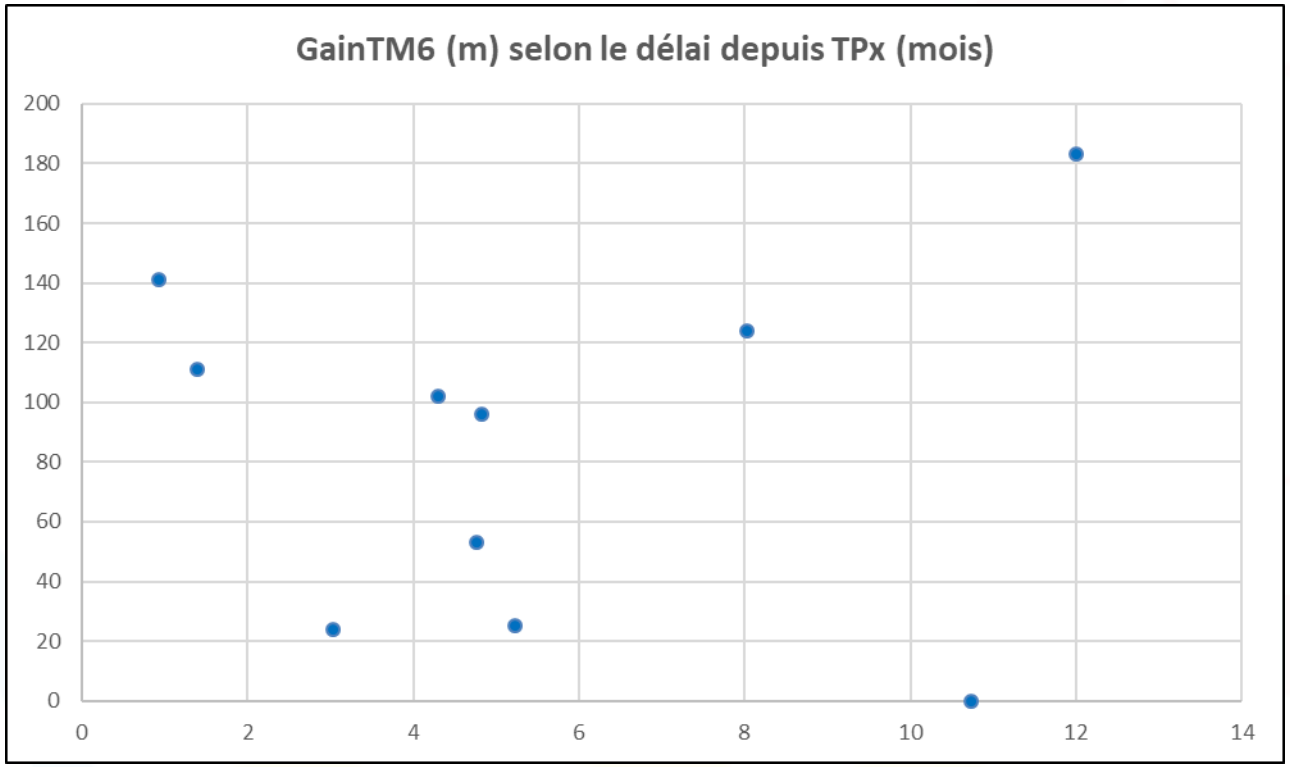
Statistiques locales 3 ans (2021-2023): description

- 10 patients / 14 séjours en HC.
- 3 femmes, 7 hommes
- âge moyen: 58 ans (44-65)
- 6 monoP, 4 BiP
- délai depuis TPx: 4 mois (1-12)
- durée séjour: 27 j (7-64)



Statistiques locales 3 ans (2021-2023): résultats

- Type Prise en charge (sur 14 séjours):
  - Soins de suite: 3
  - Réadaptation: 11
- TM6 réalisable: 10 séjours / 14
- Gain TM6:
  - 86 m (0-183)
- IntensitéDernièreSéance (W):
  - 22 W (5-65)
  - Médiane < 20 W



Les profils des patients accueillis

Profil soins de suite

- Impotence fonctionnelle
  - Neuropathie post réanimation
- Asthénie +++, découragement
- Réticence à bouger, épuisement
- Gastroparésie
  - Gêne à l'alimentation
  - Rejet des cp
- Matériel
  - Trachéotomie, gastrostomie

Profil réadaptation

- Motivé
- Peu de complications persistantes

Les données de la littérature
Quelques points particuliers
La pratique
Expérience locale
Conclusion

Répondre aux besoins des transplantés pulmonaires

- Le parcours est long et complexe:
  - de nombreux aléas:
    - rejet,
    - infection,
    - troubles métaboliques,
    - séquelles de la réanimation,
    - diabète,
    - dysfonction de greffon,
    - douleurs,
    - ES des médicaments,
    - sténoses bronchiques…
  - de nombreux professionnels de santé,
- Le patient doit apprendre sa nouvelle vie, son nouveau corps
  - traitements, prévention, hygiène

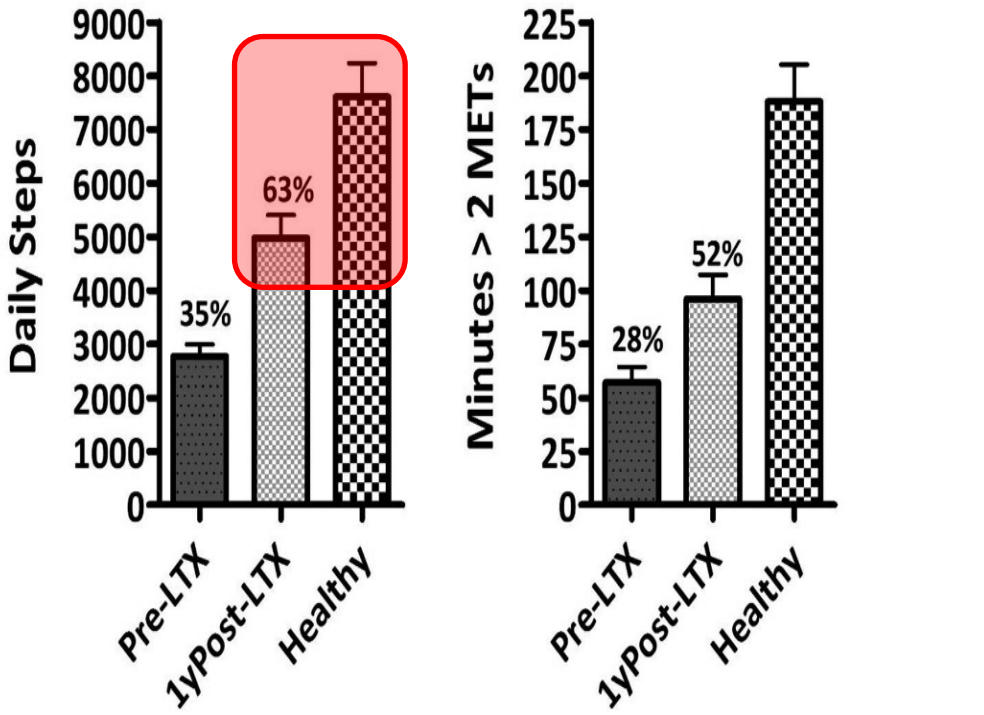


Figure 1. Participation in daily physical activity in patients before (Pre-LTX) and 1 year after (1yPost-LTX) lung transplantation in comparison with healthy, age-matched control subjects (Healthy). Daily step count is illustrated in the left panel and time spent in at least light intense activities requiring more than two metabolic equivalents (METs) is summarized in the right panel. Percentages given above Pre-LTX and 1yPost-LTX columns refer to averages in these groups expressed relative to healthy controls. Graphs constructed with data from previous studies.[60,64]

Addressing the changing rehabilitation needs of patients undergoing thoracic surgery. Daniel Langer, Chronic Respiratory Disease 2021 18: https://doi.org/10.1177/1479973121994783

Take Home Message

- PréTPx: pour de meilleures conditions chirurgicales

- **PostTPx: pour la meilleure santé possible**
  - **quel programme pour quel patient ?**
  - **le TM6 surestime-il l'aptitude physique du transplanté pulmonaire ?**

- Merci pour leur aide à :
  - Daniel Veale
  - François Philit
  - Marylise Ginoux
  - Sandrine Stelianides