Réhabilitation et nutrition

Université de Montpellier
Faculté de Médecine
Montpellier-Nîmes

Dr. Pablo Lucas Massanet
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AER

ORIGINAL

Physical declines occurring after hospital discharge in ARDS survivors: a 5-year longitudinal study

Elizabeth R. Pfoh[1,2], Amy W. Wozniak[3], Elizabeth Colantuoni[3,4], Victor D. Dinglas[4,5], Pedro A. Mendez-Tellez[4,6], Carl Shanholtz[7], Nancy D. Ciesla[4], Peter J. Pronovost[4,6,8,9] and Dale M. Needham[4,5,10*]

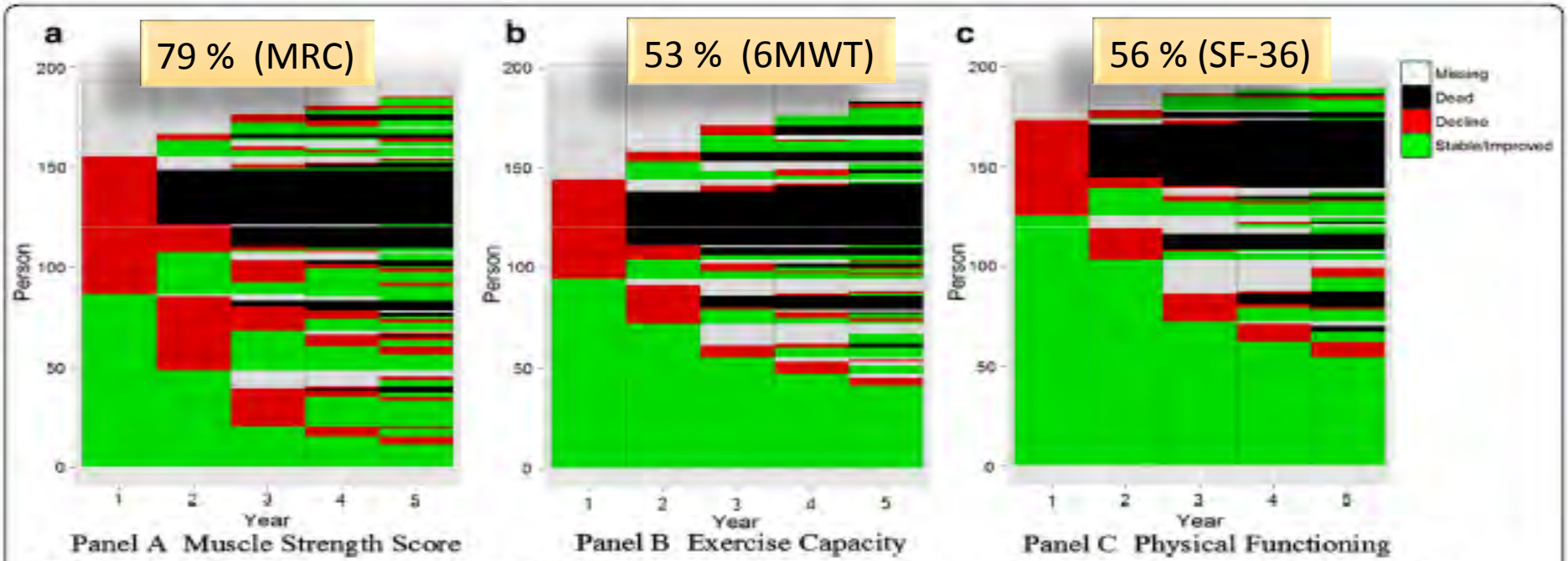
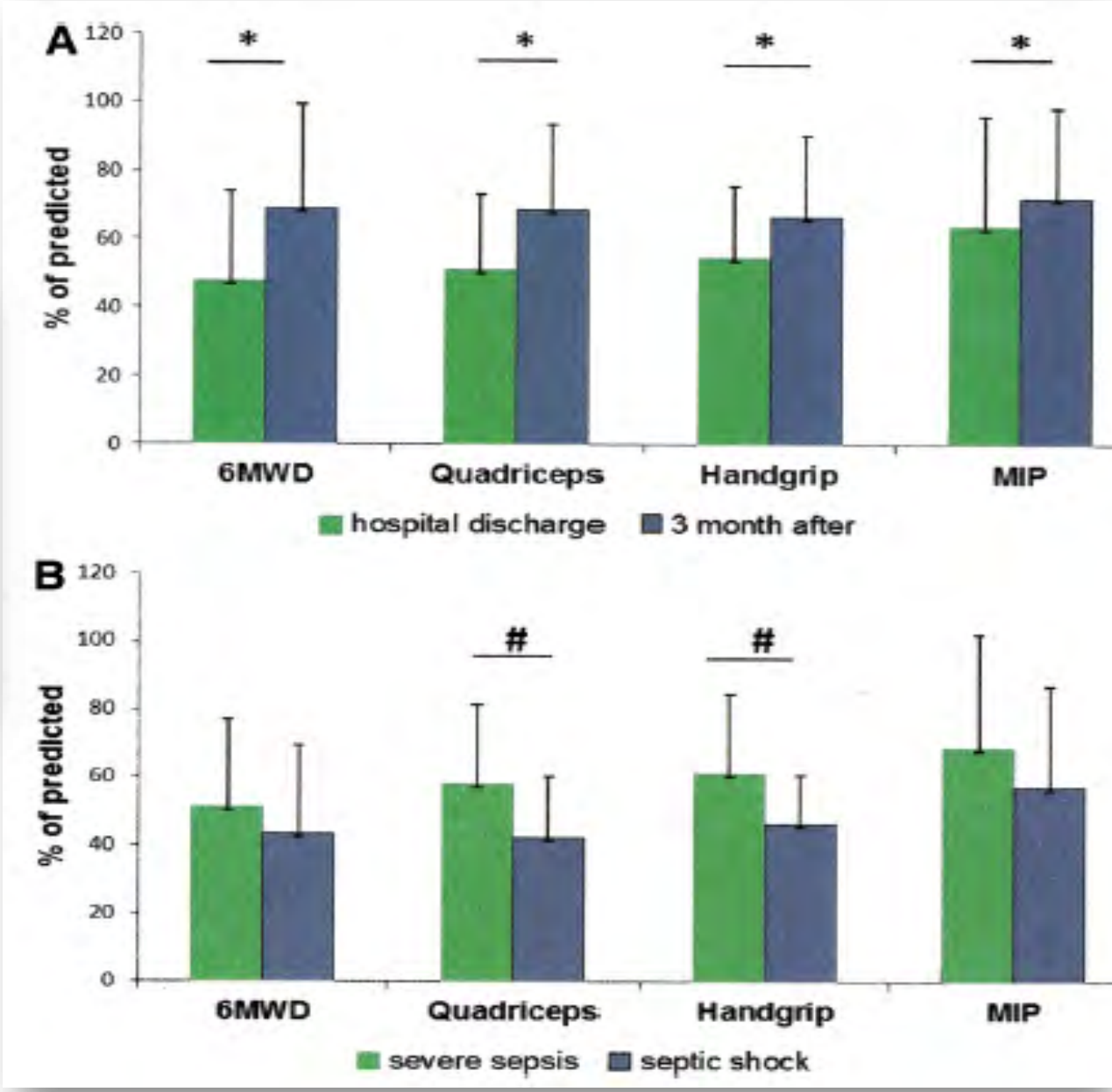


Fig. 3 Physical status outcome measure for each ARDS survivor over 5-year annual follow-up. **a** Muscle strength score, **b** exercise capacity, **c** physical functioning. Each *row* within each figure illustrates the outcome (e.g., decline, stable/improved) of one ARDS survivor at each assessment point between years 1 to 5. For each of the three physical status measures, the outcome for each individual patient was defined as "declined" if their current versus immediate prior score demonstrated a decrease greater than the Reliable Change Index [21] for the physical status measure or if the patient had died, as done in prior research [19, 20]. Cells shaded black represent a patient who died during the previous assessment and therefore no additional information is available. These graphs illustrate that, of the entire population, 153 patients (79 %) had ≥1 decline(s) in muscle strength (MRC sumscore), 103 (53 %) had ≥1 decline(s) in exercise capacity (6MWT), and 109 (56 %) had ≥1 decline(s) in self-reported physical functioning (SF-36 PF); declines in all outcomes include death as described in the "Methods" section

rqueira Borges
Carvalho
Siqueira Colombo
Pereira da Silva Borges
Garcia Soriano

Physical activity, muscle strength, and exercise capacity 3 months after severe sepsis and septic shock



Int Care Med 20

1)EXERCICE

2)METABOLISME / NUTRITION

3)ETAT MUSCULAIRE BASAL (NUTRITIONNEL??)

EXERCICE

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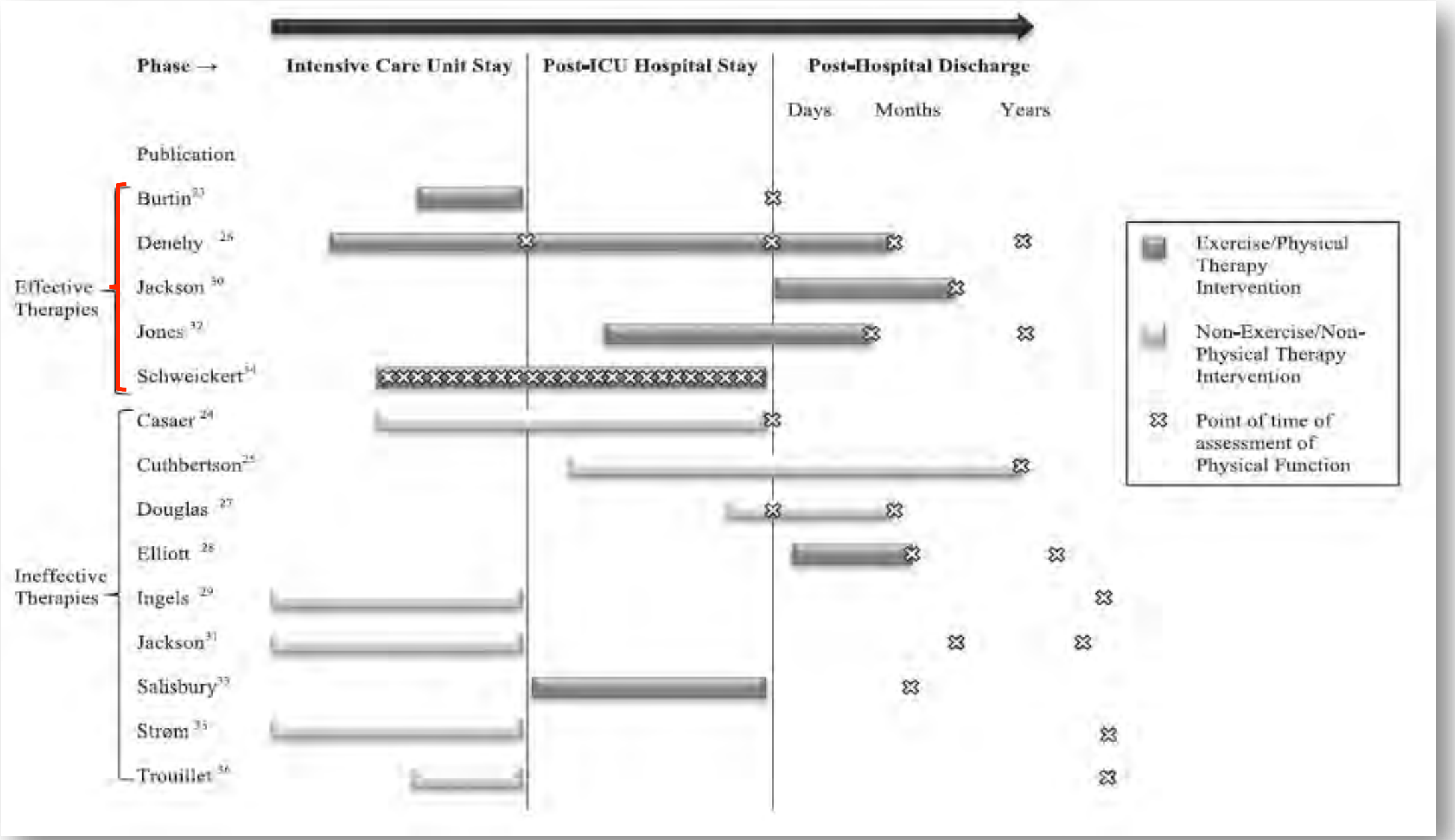
Faculté de Médecine
Montpellier-Nîmes

AER



Calvo Ayala E et col. CHEST 2013

MOBILISATION ACTIVE / PASIVE

Patients en cours de sevrage respiratoire, mobilisation active (x 10/seance + 5 + 5… Tolérance: échelle de BORG)

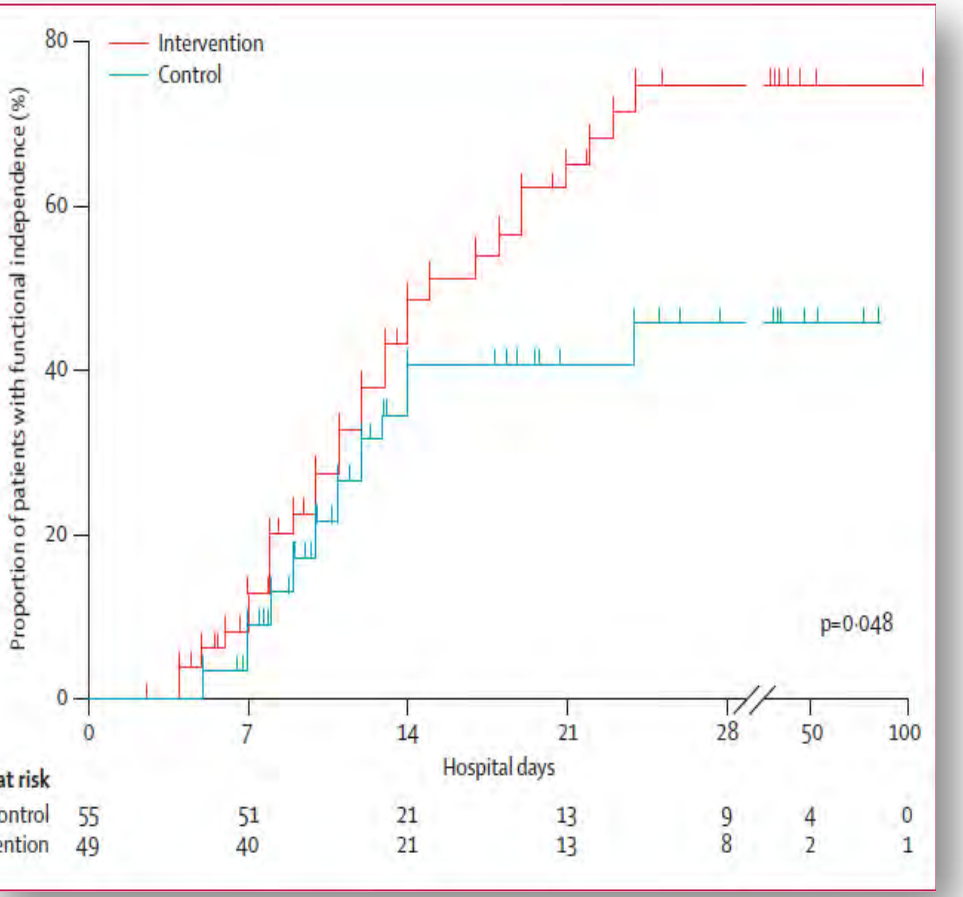
ble 2.
mparison of Limb and Respiratory Muscle Strength at Baseline at the Third and Sixth Weeks of Rehabilitation Between Control and Treatment Groups[a]

	Baseline		Third Week		Sixth Week	
	Control Group	Treatment Group	Control Group	Treatment Group	Control Group	Treatment Grou
houlder flexors, kg	2.0 (1.4–4.5)	3.2 (2.2–4.2)	0.9 (0.7–3.1)[b]	4.1 (3.2–5.6)[b,c]	0.9 (0–1.8)[b,d]	4.5 (4.0–5.8)[b,c,d]
bow flexors, kg	4.5 (2.1–6.0)	4.3 (3.2–6.0)	1.8 (1.2–3.2)[b]	6.6 (4.5–8.0)[b,c]	1.1 (0.7–3.2)[b]	7.3 (5.4–7.8)[b,c,d]
nee extensors, kg	4.1 (2.3–6.0)	4.1 (3.1–7.5)	2.0 (1.1–4.5)[b]	6.6 (4.0–8.7)[b,c]	1.8 (0.7–3.0)[b,d]	7.3 (4.4–8.9)[b,c]
max, cm H_2O	38.0 (29.0–59.3)	46.0 (30.0–60.0)	34.0 (27.0–45.0)	58.0 (35.0–63.5)[b]	30.0 (25.0–42.0)[b]	60.0 (40.5–71.5)[b]
Emax, cm H_2O	42.0 (30.5–56.5)	45.0 (37.0–64.5)	32.0 (27.0–47.0)	58.0 (45.0–71.0)[b,c]	35.0 (18.0–45.0)	62.0 (49.5–72.0)[b]
entilator-free time, hr	0 (0–0)	0 (0–0)	0 (0–21)[b]	6 (1–12)[b]	0 (0–0)	6 (3–13)[b]

ta are presented as median values with 25%–75% quartiles in parentheses. Pimax=maximum inspiratory pressure, Pemax=maximum expiratory pressure.
.05, compared with baseline.
.05, compared with control group.
.05, compared with third week.

Chiang L et col. Phys Ther 20

Mobilisation active / passive et arrêt de la sédation (tous les jours) VS soins courants



	Intervention (n=49)	Control (n=55)	p value
Time from intubation to first PT/OT session (days)	1·5 (1·0–2·1)	7·4(6·0–10·9)	<0·000
Independent ADLs total at ICU discharge	3 (0–5)	0 (0–5)	0·15
Independent ADLs total at hospital discharge	6 (0–6)	4 (0–6)	0·06
MRC examination score at hospital discharge	52 (25–58)	48 (0–58)	0·38
Hand-grip strength at hospital discharge (kg-force)	39 (10–58)	35 (0–57)	0·67
Greatest walking distance at hospital discharge (m)	33·4 (0–91·4)	0 (0–30·4)	0·004
Time from intubation to milestones achieved (days)			
Out of bed	1·7 (1·1–3·0)	6·6 (4·2–8·3)	<0·000
Standing	3·2 (1·5–5·6)	6·0 (4·5–8·9)	<0·000
Marching in place	3·3 (1·6–5·8)	6·2 (4·6–9·6)	<0·000
Transferring to a chair	3·1 (1·8–4·5	6·2 (4·5–8·4)	<0·000
Walking	3·8 (1·9–5·8)	7·3 (4·9–9·6)	<0·000

Data are median (IQR). ADLs=activities of daily living. ICU=intensive care unit. MRC=Medical Research Council. PT/OT=physical therapy and occupational therapy. MRC examination scale 0–60.

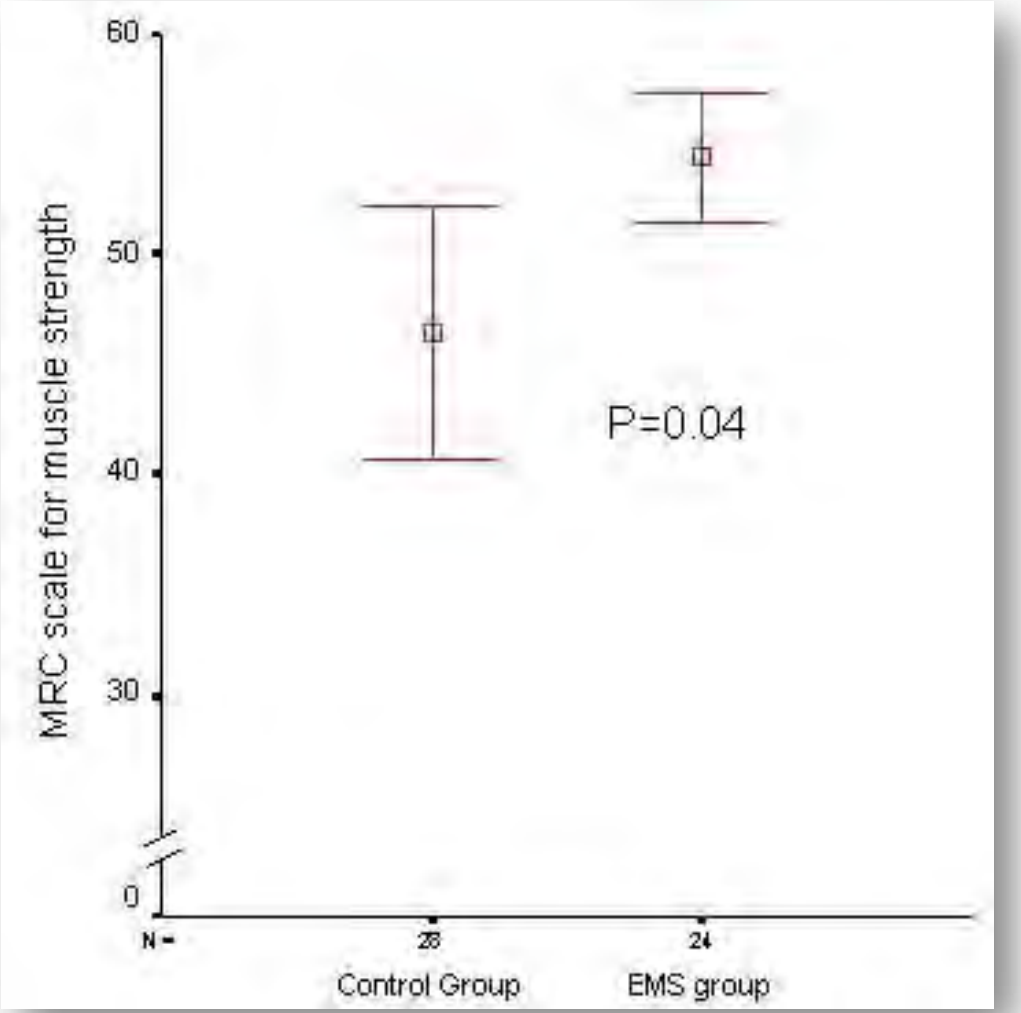
Table 4: **Function and muscle strength outcomes according to study group**

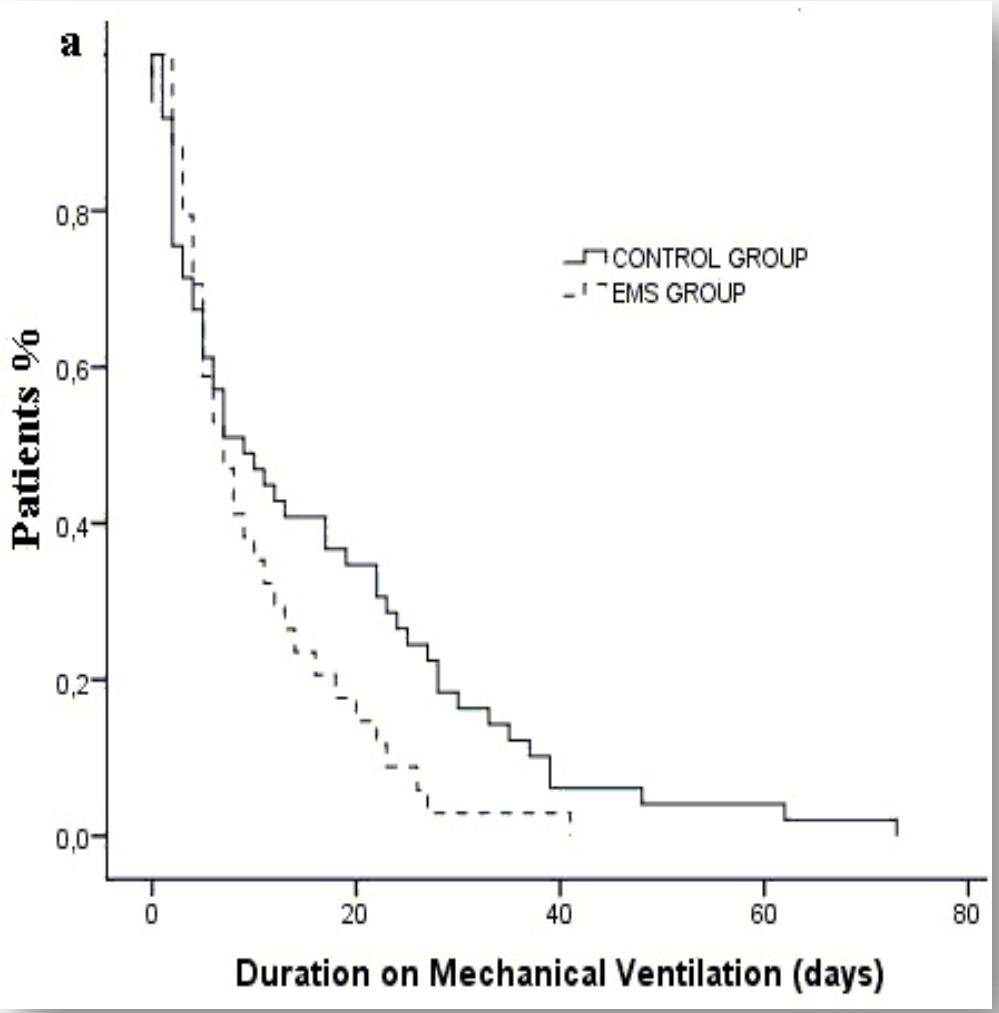
Schweickert W et col LANCET


SORTIE

ELECTROSTIMULATION

Electrostimulation MI tous les jours pendant 55 min (5 activité / 5 repos)





Routsi C et col. Crit Care 2010

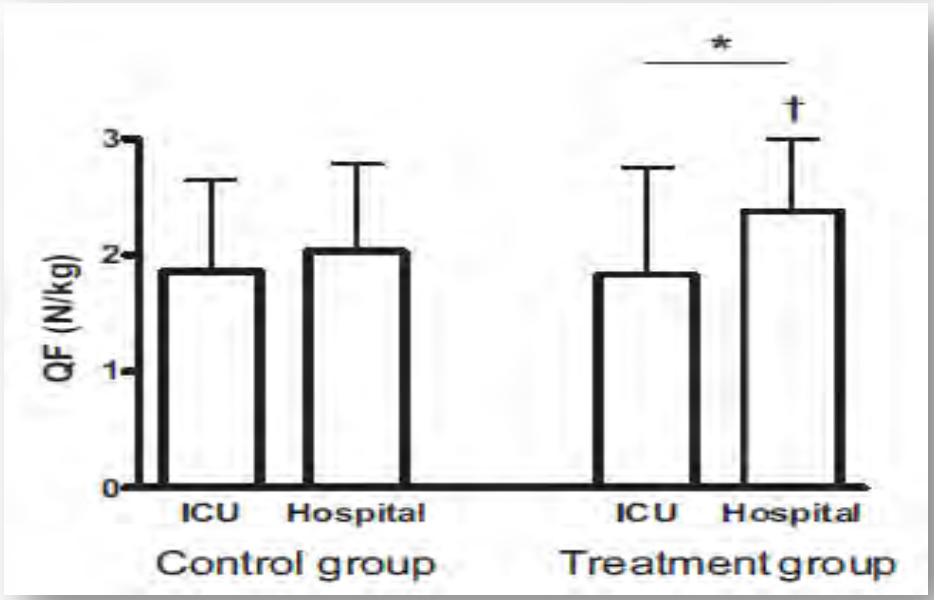
GOMETRE

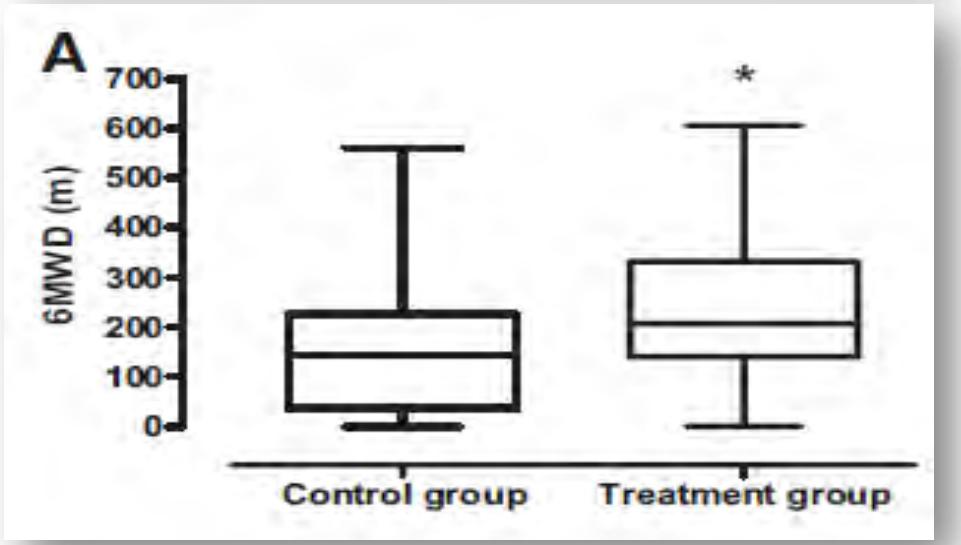
Lower extremity muscle thickness during 30-day 6 degrees head-down bed rest with isotonic and isokinetic exercise training.

Ellis S[1], Kirby LC, Greenleaf JE.

Aviat Space Environ Med. 1993 Nov;64(11):1011-5.

Séances x 4/semaine de 30 – 40 min (4% < saturation 90%)





Burtin C et col. CCM 2009

Functional electrical stimulation with cycling in the critically ill: A pilot case-matched control study

Selina M. Parry, PT [a], Sue Berney, PhD [b], Stephen Warrillow, MBBS [c], Doa El-Ansary, PhD [a], Adam L. Bryant, PhD [a], Nicholas Hart, PhD [d], Zudin Puthucheary, MD [e], Renè Koopman, PhD [f], Linda Denehy, PhD [a,*]

Table 2
Sedation, delirium, and general outcomes comparing intervention and controls

	Control median (IQR) (n = 8)	Intervention median (IQR) (n = 8)
Sedation and other medications		
Duration of sedation, d	7.0 (4.5-10.5)	5.0 (3.3-15.0)
Average daily propofol dose (mg/h)	95.5 (54.8-133.2)	81.4 (68.5-156.6)
GC, n (%)	3 (37%)	5 (62%)
Duration of GC, d*	10 (8-11)	5 (4-12.5)
Highest level of vasopressor (noradrenaline) support on day 1, μg/h in mean ± SD	12.3 ± 7.6	24.5 ± 20.3
Delirium		
Delirium incidence, n (%)	7 (87%)	2 (25%)
Duration of delirium, d†	6.0 (3.3-13.3)	0.0 (0.0-3.0)
Discharge destination and LOS		
DC dest‡		
Rehab	6 (86%)	3 (43%)
Home	1 (14%)	4 (57%)
Mortality, n (%)	1 (12%)	1 (12%)
ICU LOS, d	13.5 (10.5-31.0)	12.0 (5.5-21.5)
Hospital LOS, d	31.0 (21.5-62.3)	24.0 (19.5-40.8)

J Crit Care 2014

1)Type d’exercice?

2)Dose?

<u>Exercice idéal:</u>

- Développement des qualités musculair
- Moindre coups métabolique

exercise in rehabilitation: safety, feasibility, and application

ul LaStayo,[1] Robin Marcus,[1] Lee Dibble,[1] Fernando Frajacomo,[2] and Stan Lindstedt[3]
epartment of Physical Therapy, University of Utah, Salt Lake City, Utah; [2]Department of Pathology, University of Sao
ulo, Sao Paulo, Brazil; and [3]Department of Biology, Northern Arizona University, Flagstaff, Arizona

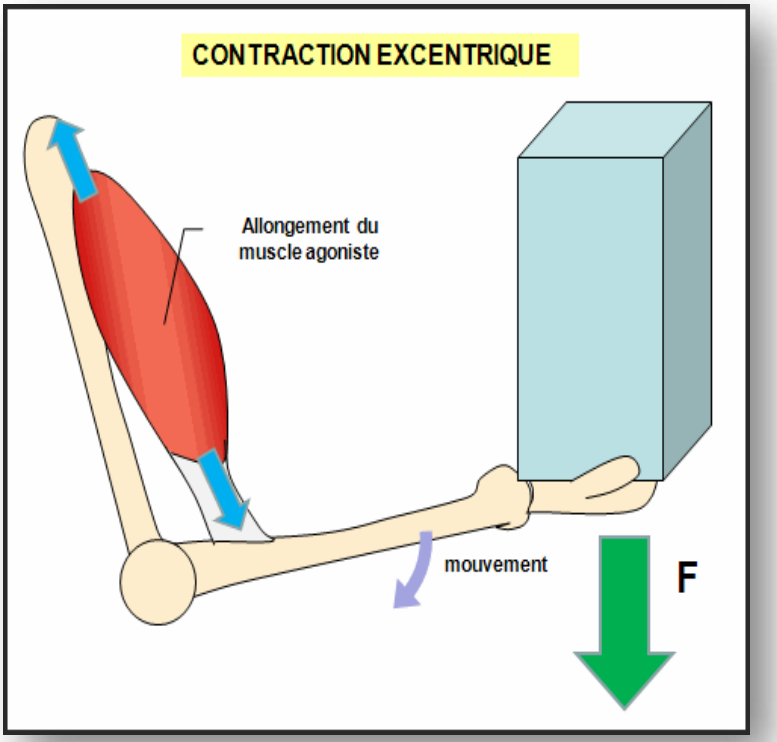


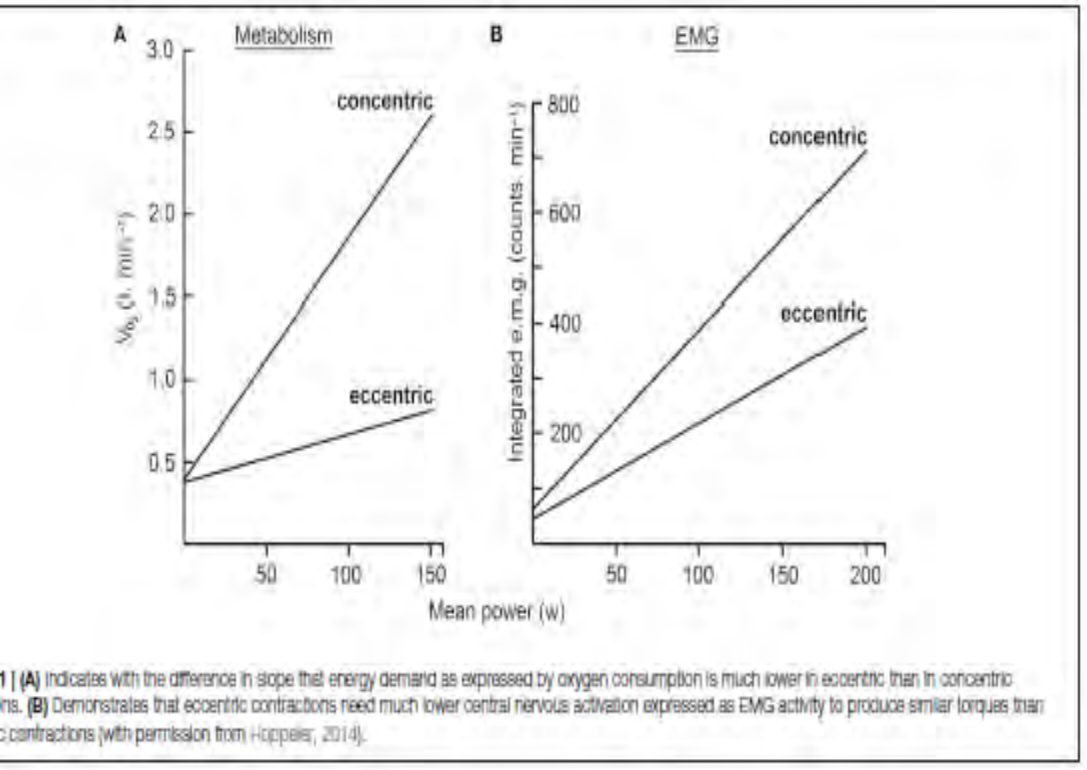
Fig. 1. Eccentric rehabilitation applications for individuals with a variety of age and/or medical-related conditions, all of which share muscle atrophy, weakness, and physical dysfunction as common impairments.

J Appl Physiol 201

Eccentric Exercise and the Critically Ill Patient

W. Kyle Mitchell[1]*, Tanja Taivassalo[2,3], Marco V. Narici[1] and Martino V. Franchi[1]

Front Physiol 2017



1 | (A) indicates with the difference in slope that energy demand as expressed by oxygen consumption is much lower in eccentric than in concentric ns. (B) Demonstrates that eccentric contractions need much lower central nervous activation expressed as EMG activity to produce similar torques than c contractions (with permission from Hoppeler, 2014).

Hoppeler H Front Physiol 2016

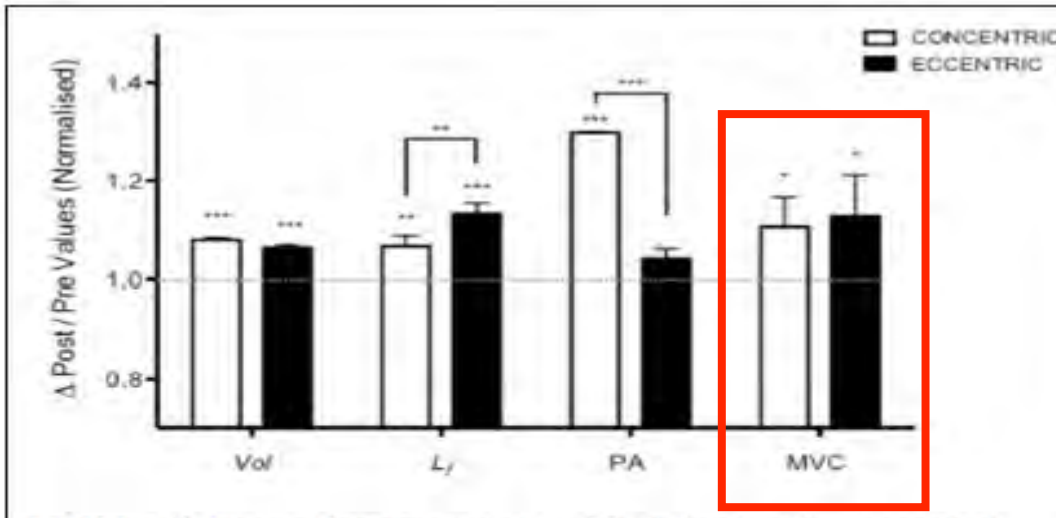


FIGURE 5 | Adapted from Franchi et al. (2014). Contraction-dependent muscle growth in response to eccentric and concentric resistive training in young males. Similar hypertrophy is achieved through two different patterns structural re-assembly (*$P < 0.05$, **$P < 0.001$, ***$P < 0.0001$). Y = 1 represent the baseline value, data are normalized to pre-exercise values (Vol Volume; Lf, fascicle length; PA, pennation angle; MVC, maximum voluntary contraction).

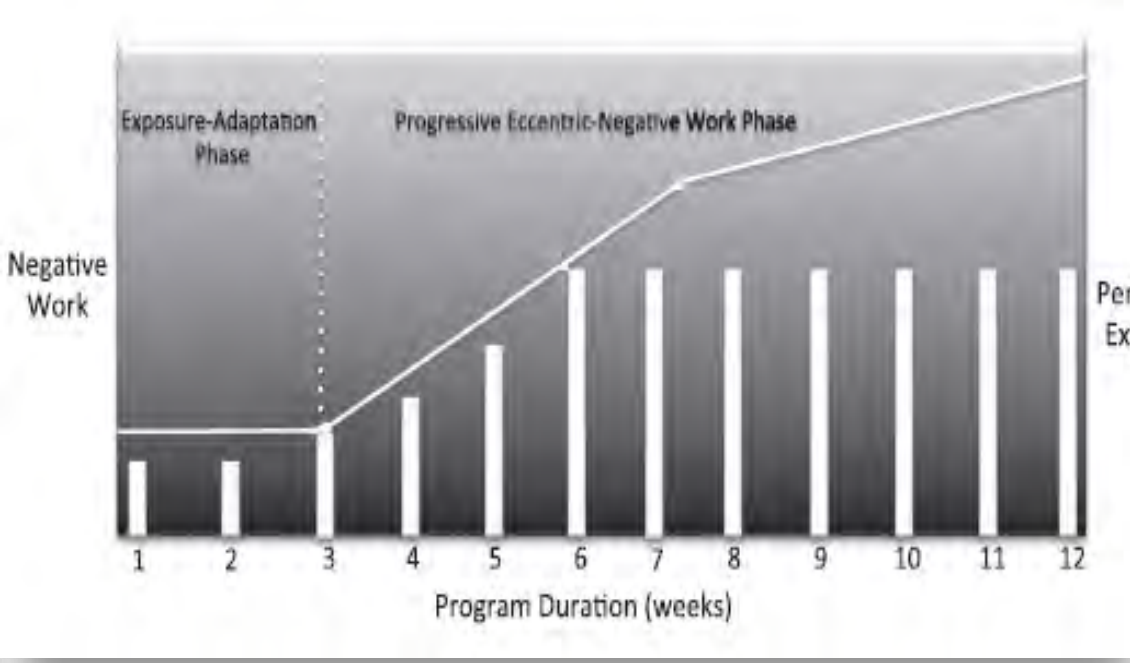
Franchi M Front Physiol 2

RESISTANCE EXERCISE VIA NEGATIVE ECCENTRIC WORK (RENEW)

ble 1. *Example of progression of total volume of eccentric rk on eccentric ergometer over 12 wk*

	Exposure-Adaptation Phase (*weeks 1–2*)	Progressive Eccentric-Negative Work Phase (*weeks 3–12*)
quency	2–3×/wk	2–3×/wk
ration	5–8 min/session	10–12 min/session, *weeks 3–4* 14–16 min/session, *weeks 5–6* 18–20 min/session, *weeks 7–12*
nsity	"Very light"	"Fairly light," *weeks 3–5* "Somewhat hard," *weeks 6–12*

Duration could be substituted with sets and repetitions of different eccentric rcises.



Protocole d'exercice excentrique avec une adaptation de 3 semaines, prévient les lésions musculaire et la douleur. Les charges maximales à la fin du protocole sont de 400 – 500 W (sportifs 1200 w), trois fois par semaine avec une durée de 20 – 30 min /s

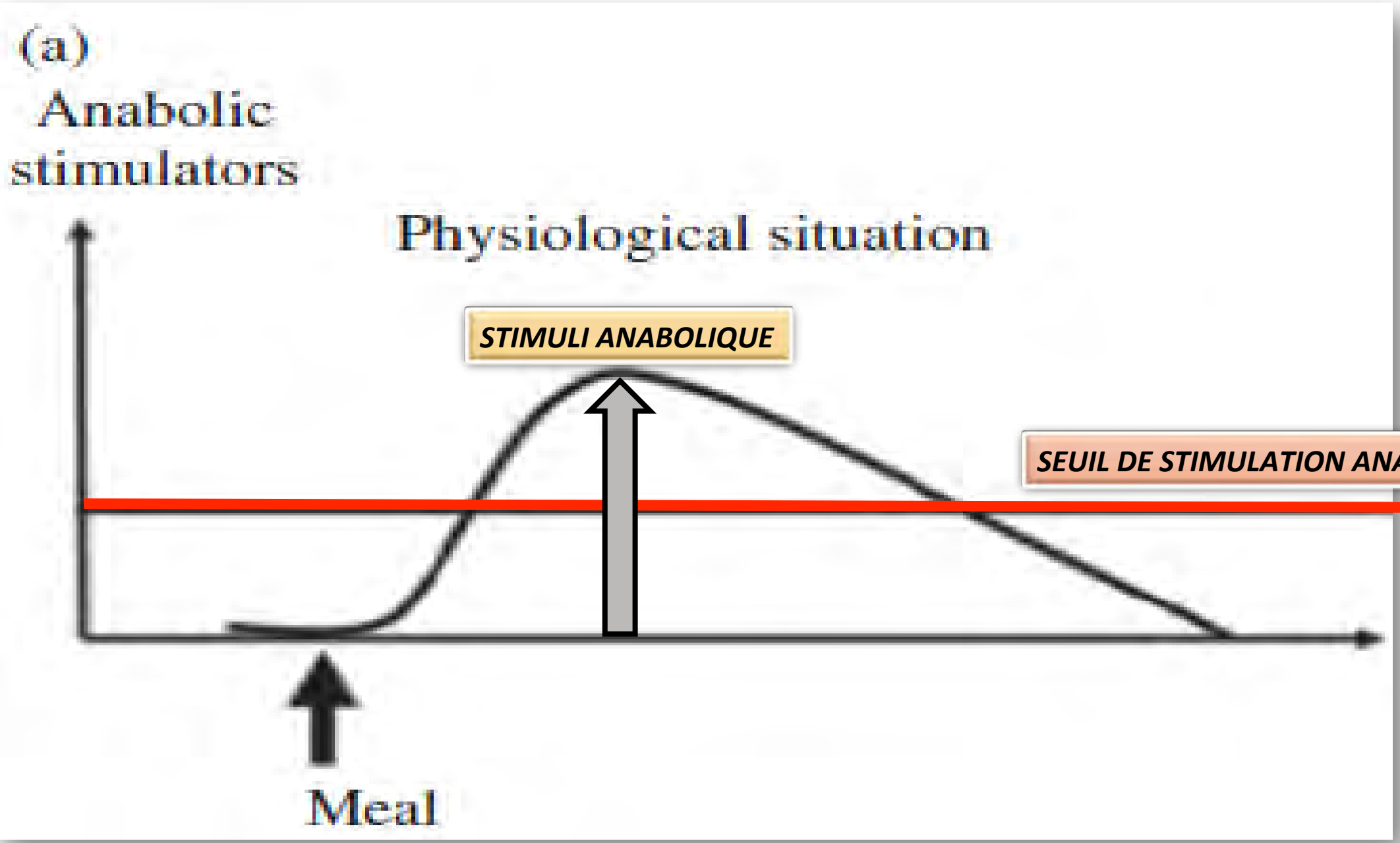
Hoppeler H Front Physio

METABOLISME / NUTRITION

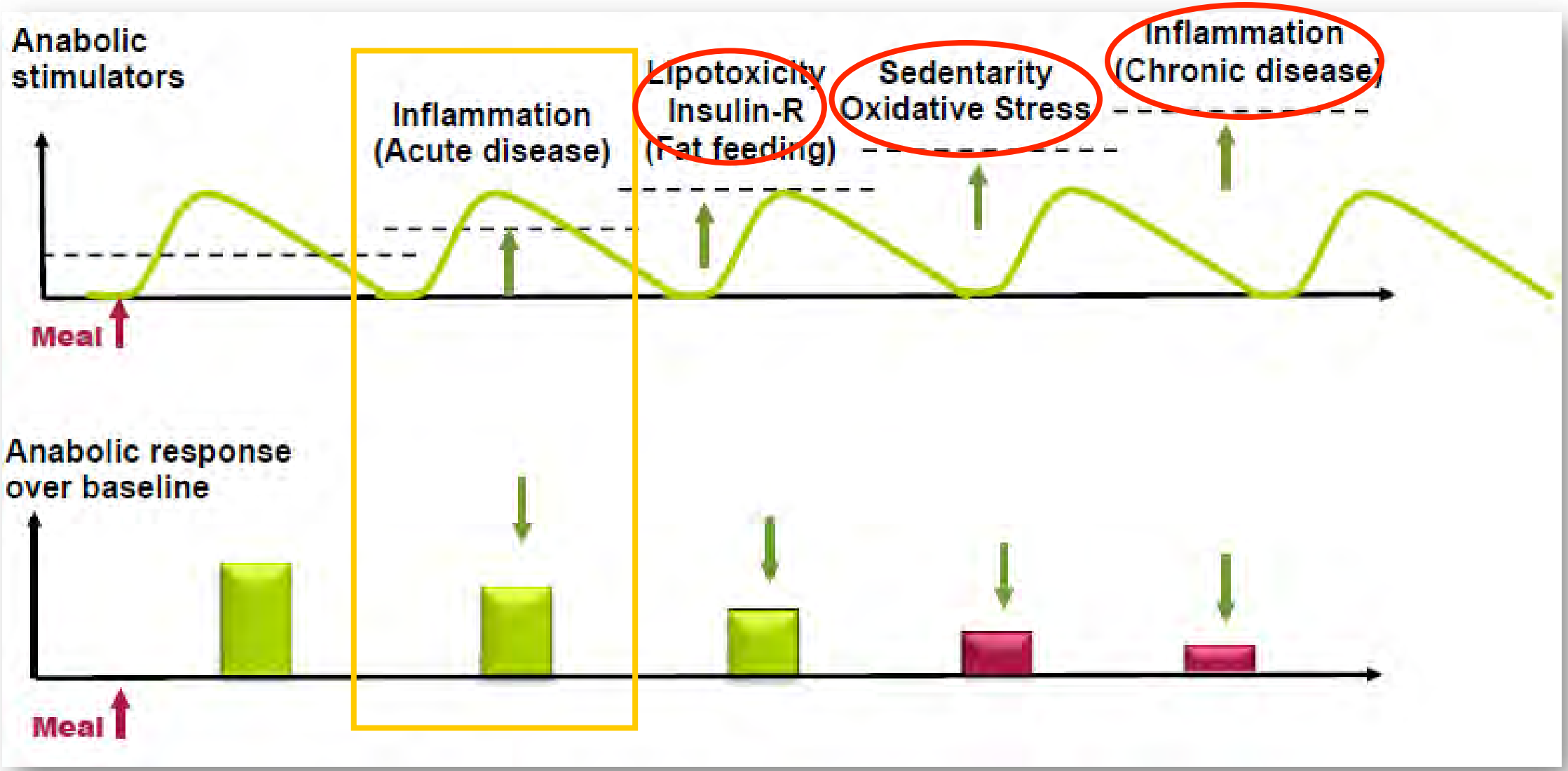
	Patients	*Intervention*	*Résultats*	*Etat nutritionnel*	*Stratégie nutritionn*
Zanotti E. et col. CHEST 2003	12/12 (BPCO, trachéotomisés, ventilés, sarcopeniques)	Mobilisation active + Electrostimulation (5/7 jours pendant 4 semaines)	Augmentation de la force musculaire Diminution du temps lit fauteuil	**BMI**	**Calories: ?** **Protéines: ?**
Porta R et col. CHEST 2005	32/34 (BPCO post réanimation)	Post-réanimation, exercices actif et passifs + cycloergomètre (20 min/j pendant 15 jours)	Augmentation de l'endurance, de la pression d'inspiration maximale et diminution de la dyspnée.	**BMI**	**Calories: ?** **Protéines: ?**
Chiang L et col. Phys Ther 2006	15/17 (Patients ventilés > 14 jours)	Exercice physique (5/7 jours pendant 6 semaines)	Augmentation de la force musculaire, amélioration fonctionnelle et diminution du temps de IOT	**Albumine** **Créatinine**	**Calories: ?** **Protéines: ?**
Burtin C et col. CCM 2009	36/31 (hospitalisation en réanimation au moins 7 jours)	Cycloergomètre 20/min/j , 5/7 jours	Augmentation de la distance du test de marche de 6 min et de la force du quadriceps, amélioration de la qualité de vie	**BMI** **Créatinine**	**Calories: ?** **Protéines: ?**
nweickert W et col. Lancet 2009	49/49 (patients ventilés > 72 heures)	Arrêt précoce de la sédation, mobilisation précoce active et passive	Amélioration du pronostique fonctionnel, diminution confusion/ delire et jours de VM	**BMI**	**Calories: 37% / 34%** **Protéines: ?**
Routsi C et col. CC 2010	24/28 (traitement à l'admission en réa)	Electrostimulation (55 min/j)	Amélioration MRC, sevrage respiratoire, prévention de la PNM de réanimation	-	**Calories: ?** **Protéines: ?**
Chao P et col. AJRCCM 2014	15535/15535 (post réanimation, avec sepsis)	Rehabilitation physique (30-60 min x 6 sur 1 mois dans les 90 j post réanimation)	Diminution de la mortalité à 10 ans (20,6% vs 22%)	-	**Calories: ?** **Protéines: ?**

Muscle deposition occurs in response to a complex interplay of stimuli such as physical activity and hormonal signaling (e.g., testosterone, insulin, growth hormone, insulin-like growth factors). However, in all circumstances, the prerequisite for muscle protein synthesis and the most readily adaptable stimulus is dietary-derived amino acids. Therefore, this review will focus on

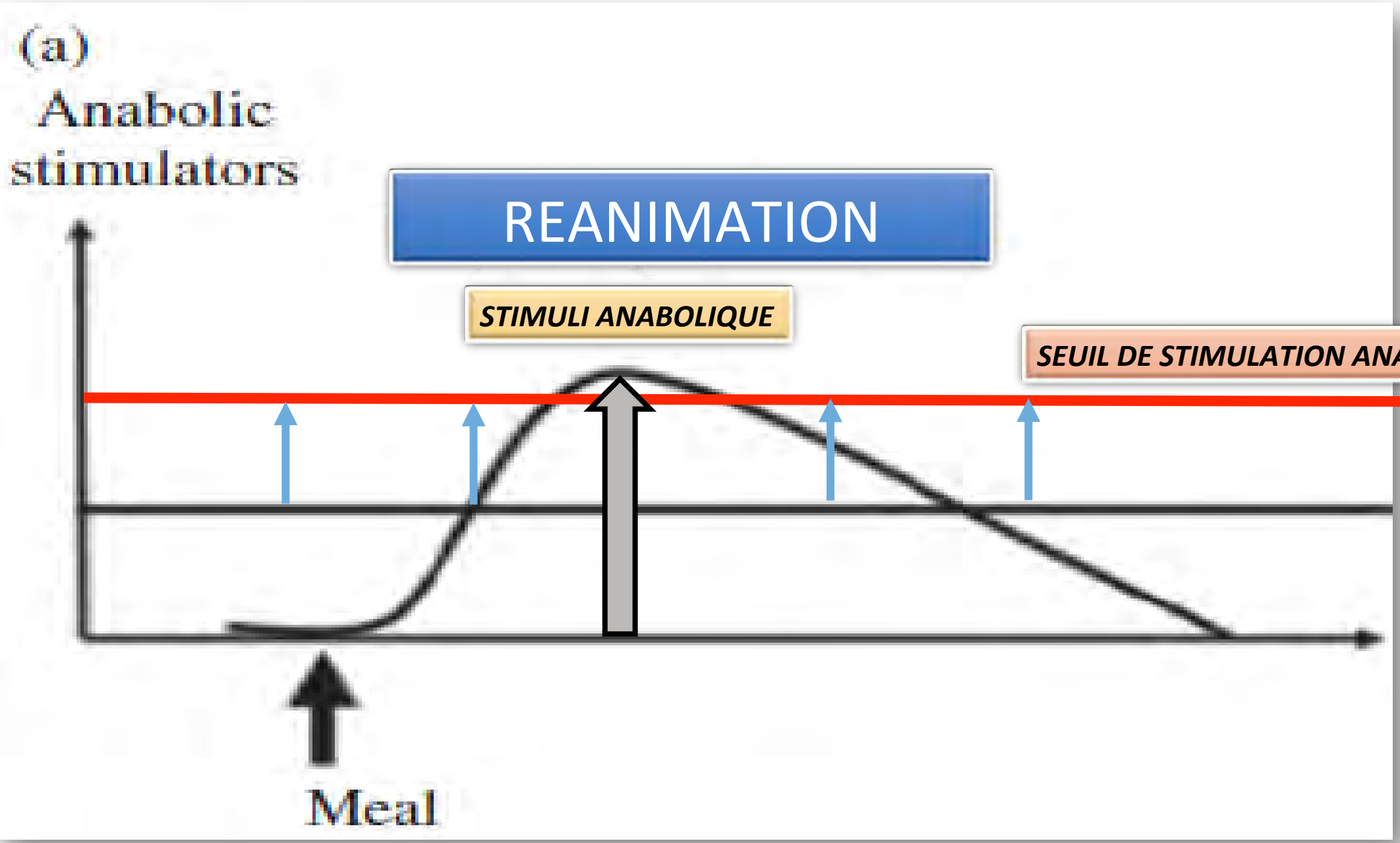
Paddon – Jones D J of Nutrit 2006



Magne H et col. Nutr Res Rev 2013

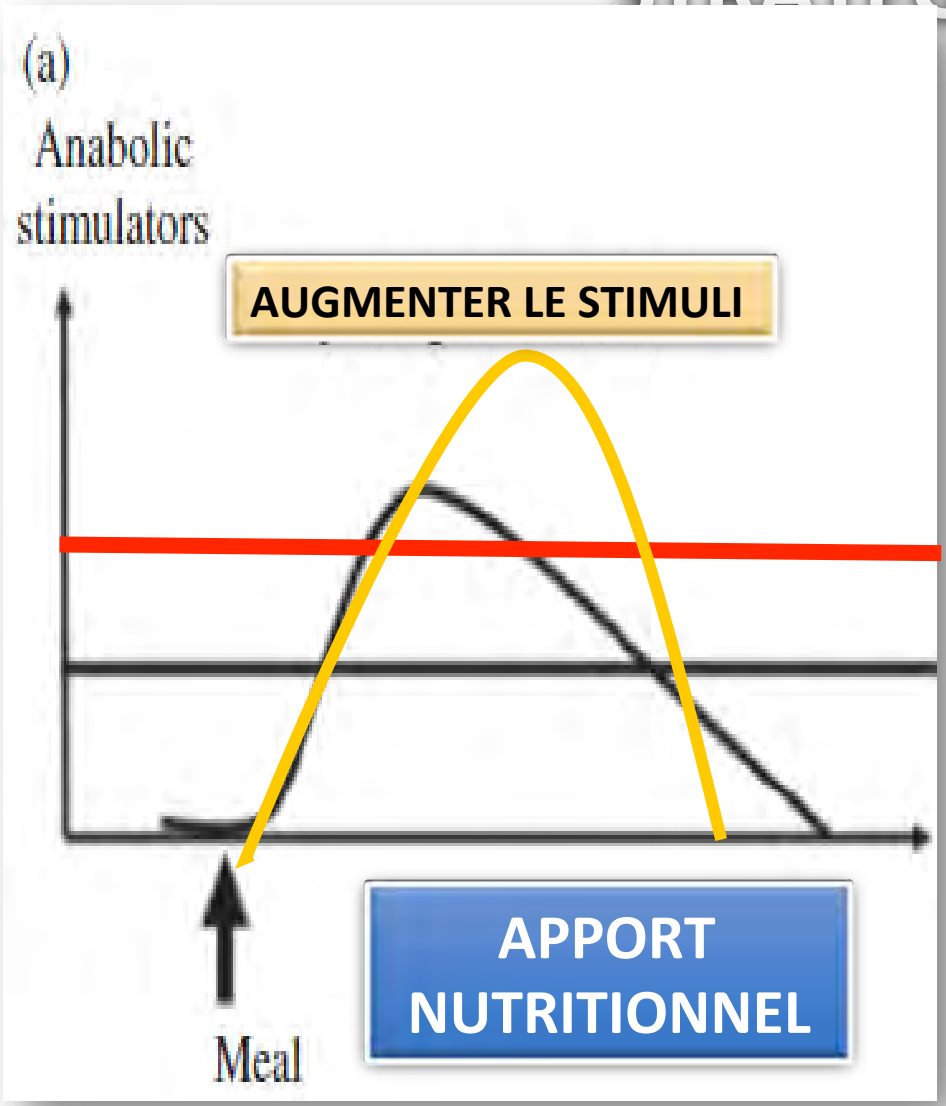


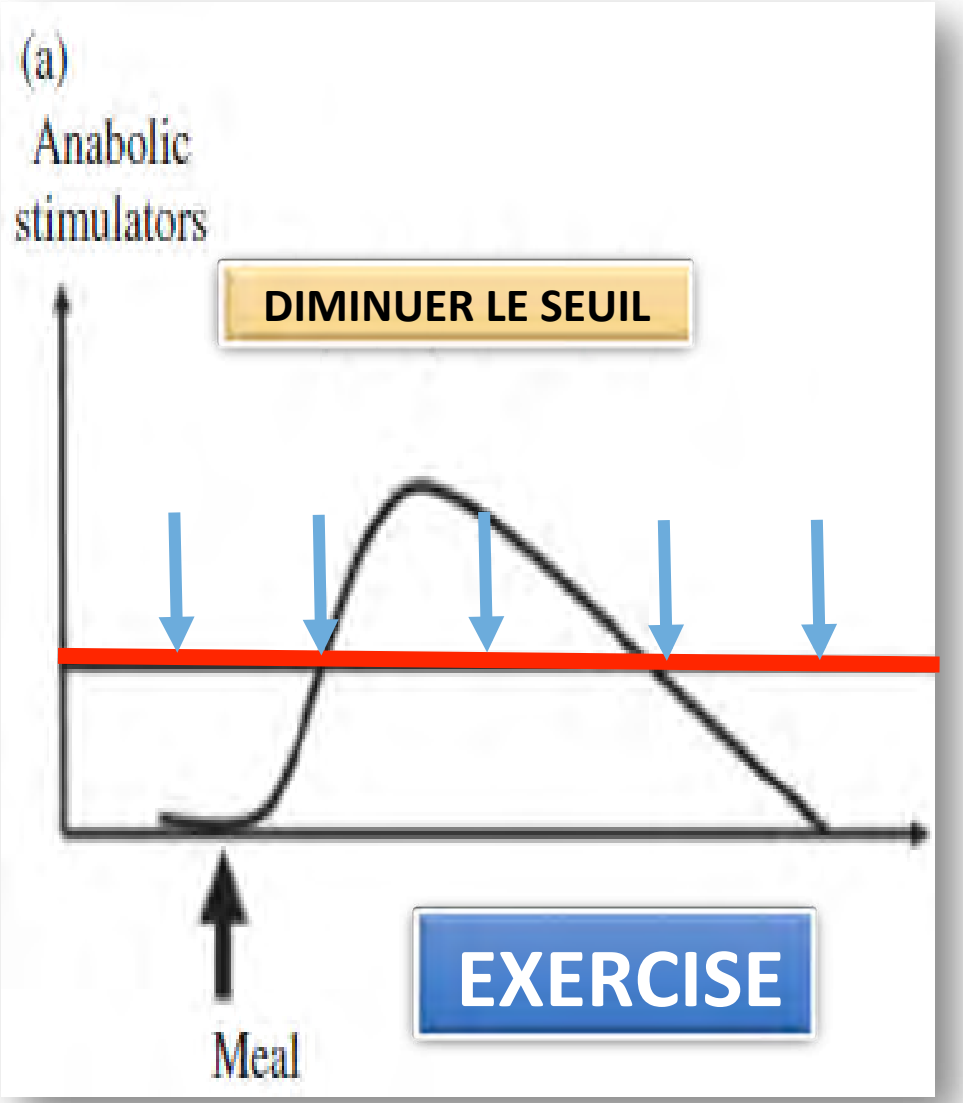
Magne H et col. Nutr Res Rev 2013

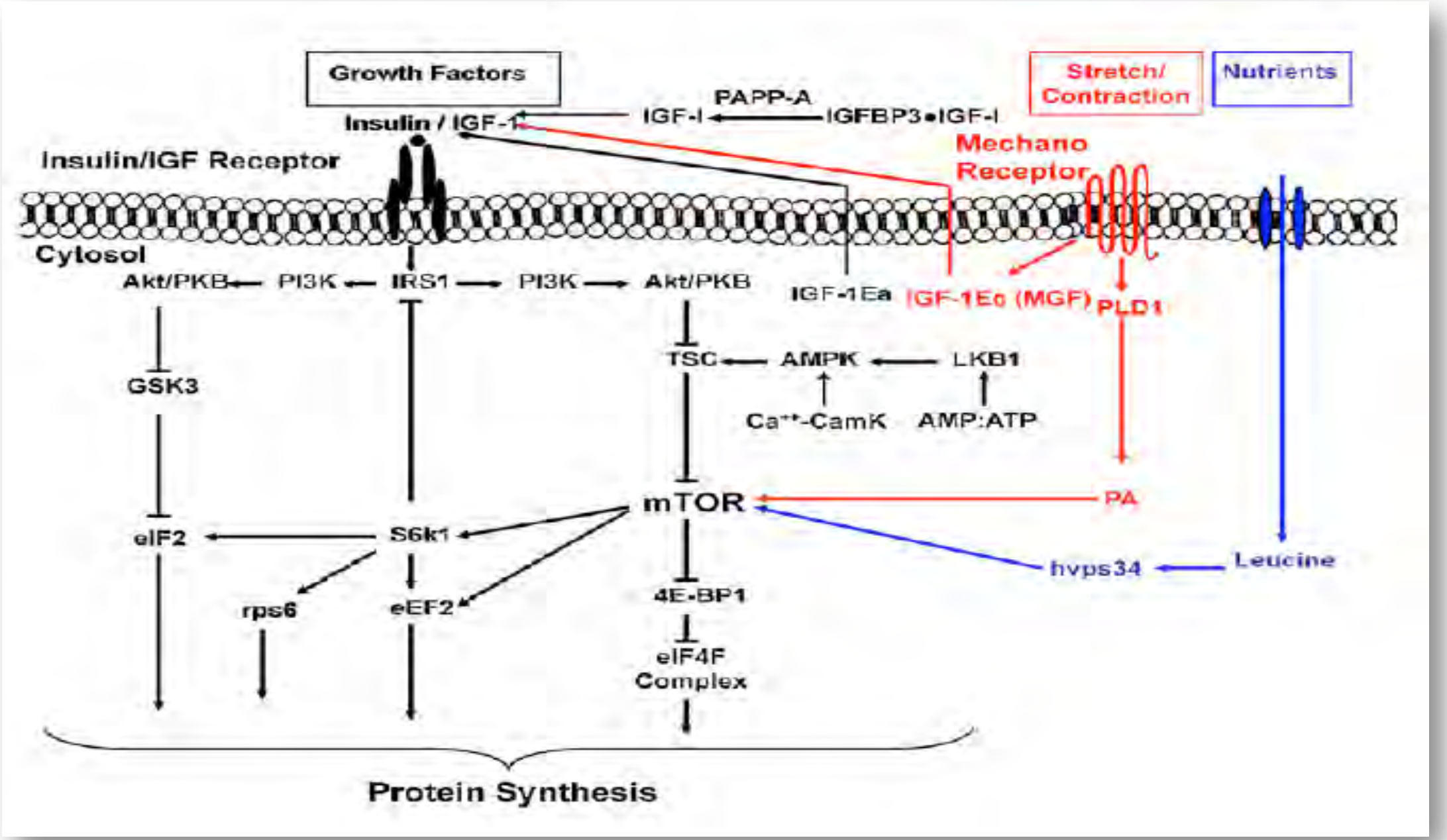


Magne H et col. Nutr Res Rev 2013

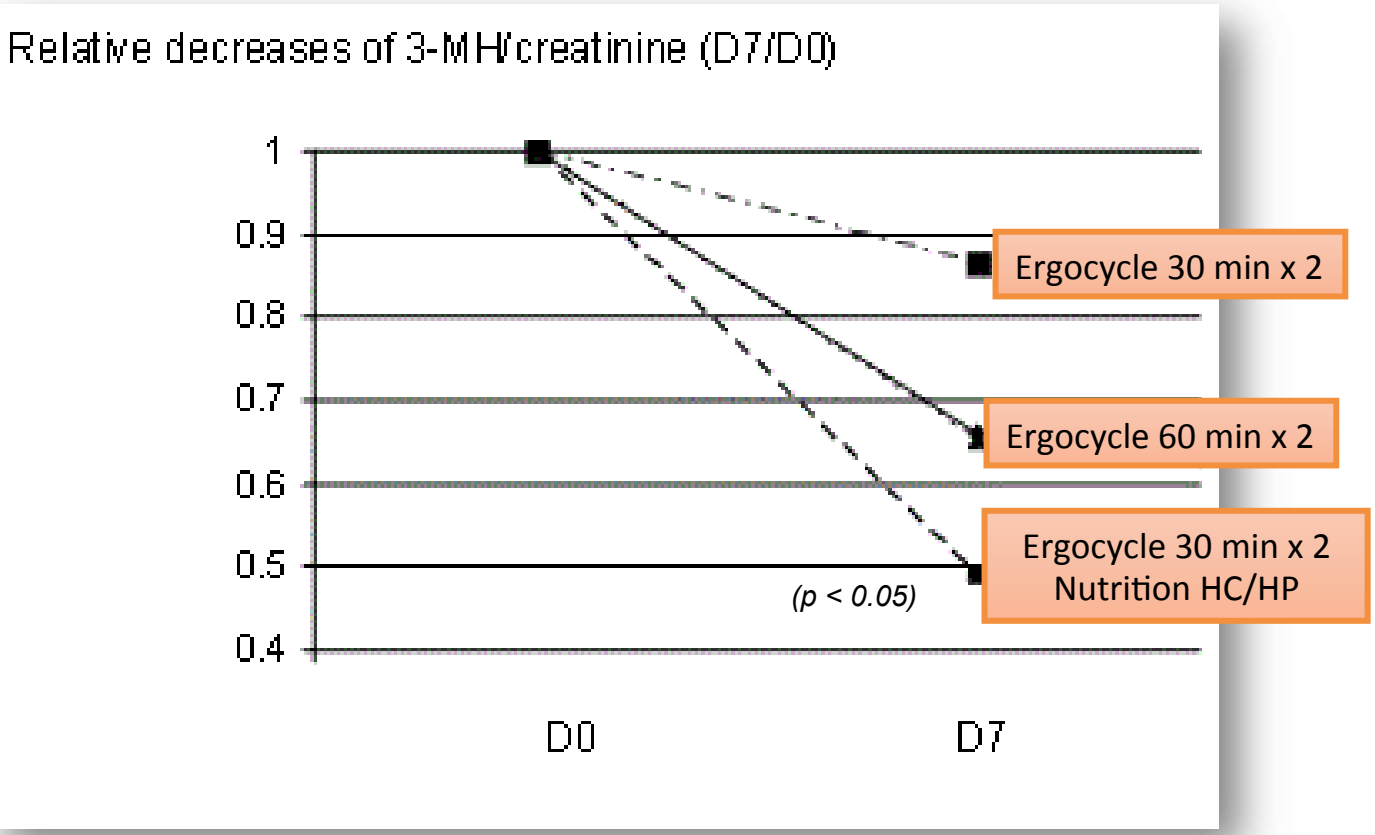
QUELLES STRATEGIES ?







Irving B et col. Aging Res Rev 2012



- Etude prospective randomisé. Patients sedatés ou inconscients, ventilés.

- **4 groupes**: Soins standard mobilisation passive, ergocycle 30 min x 2/j avec, ergocycle 60 min x 2/j (les deux groupes avec 25 cal/kg/j et 1,2 gr/kg/j de protéines) et un groupe avec ergocycle 30 min x 2/j et avec 35 cal/kg/j et 1,8 gr/kg/j de protéines).

- Dosage de la ***3 MH*** urinaire.

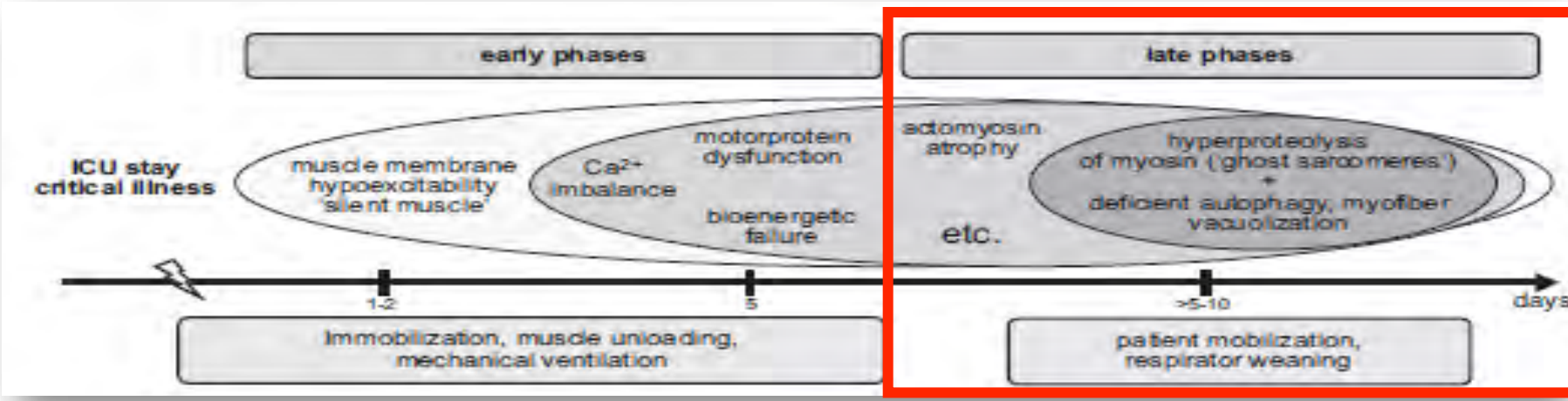
Preiser JC et col. Nov Physiother 2014

1)Moment idéal pour l'apport protidiqu

2)Apport qualitatif de protéines?

Protéine idéal en réanimation:

- Non influencée par la vidange gastriq
- Digestion simple
- Absorption rapide
- Disponibilité musculaire en quantité



Ebb phase

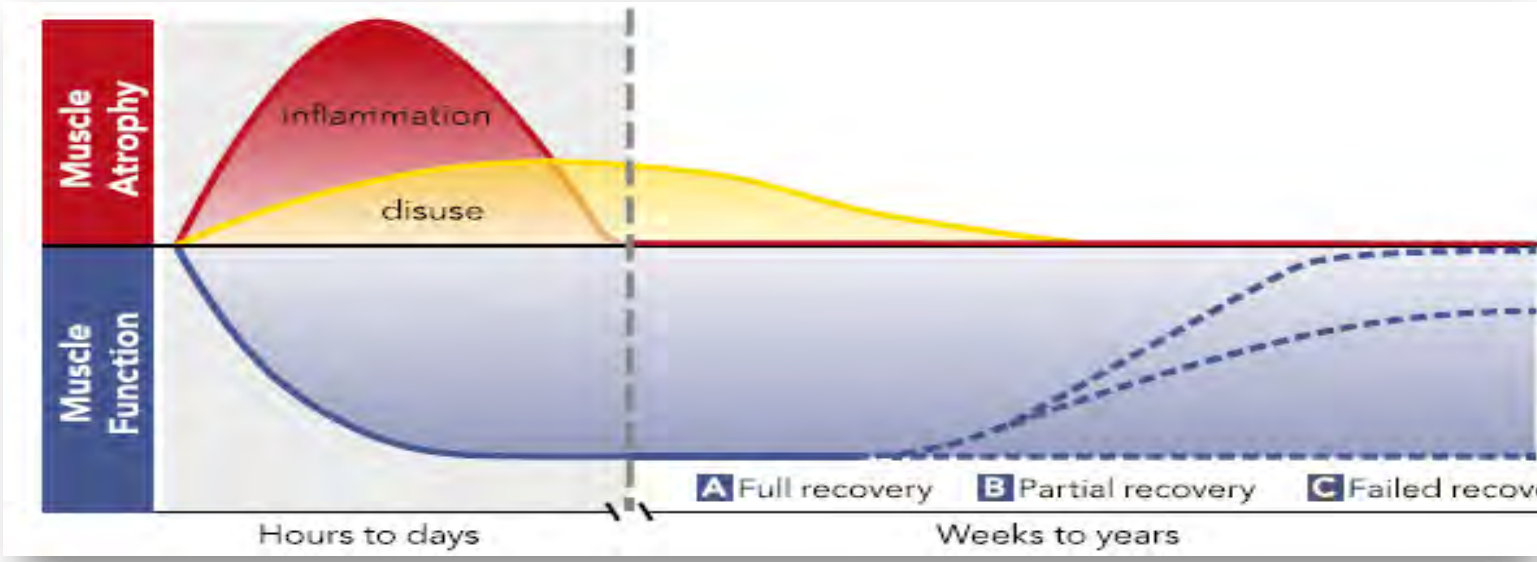
-hTA,
-Hyperglycemia,
-Reduction in metabolic rate

Flow phase

-Metabolism increased
-Protein catabolism
-Salt/water retained

Anabolic phase

-Anabolism
-Healning accelerated
-Salt/water returns normal



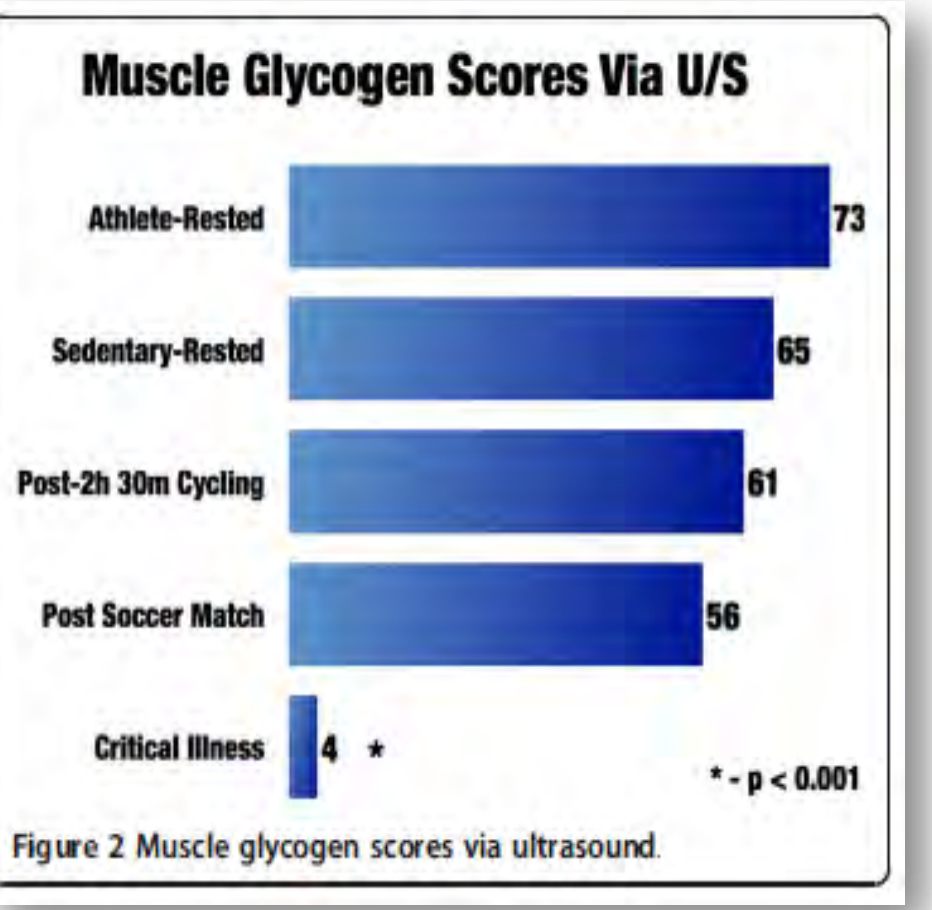


Figure 2 Muscle glycogen scores via ultrasound.

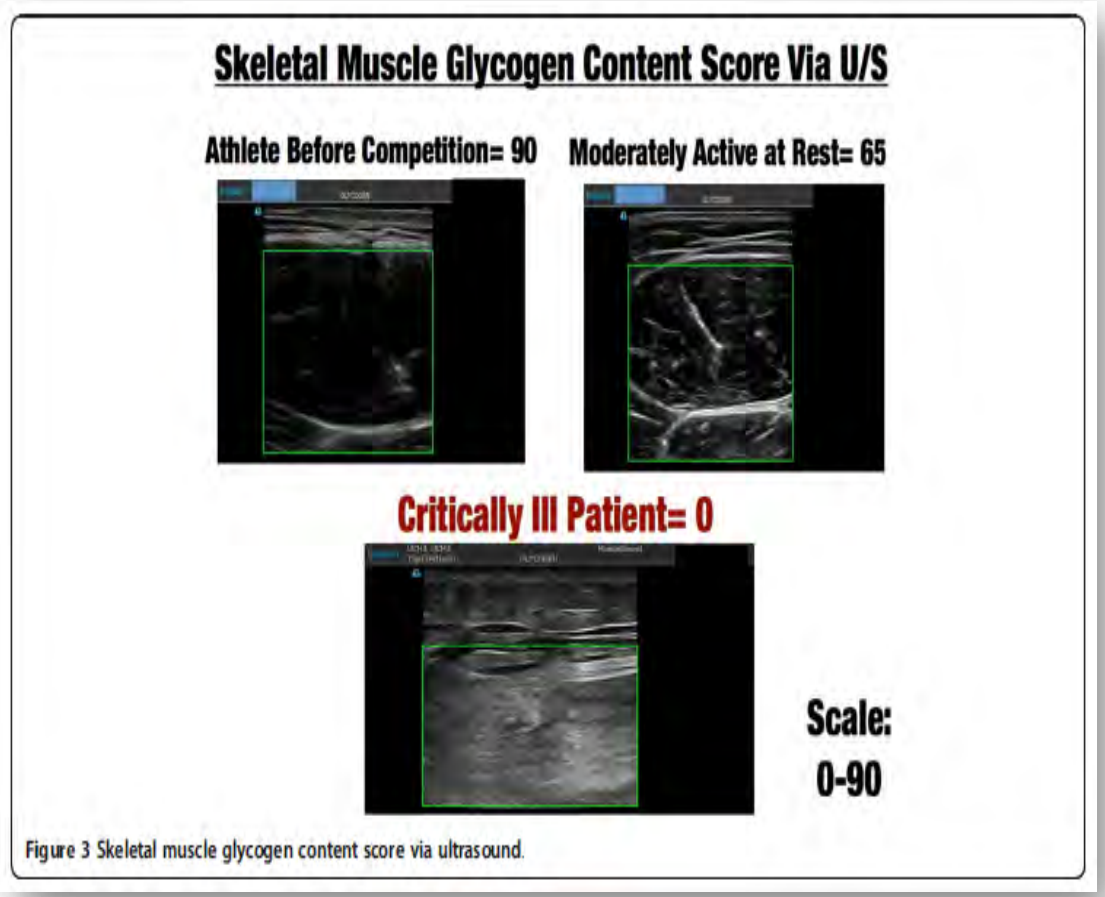
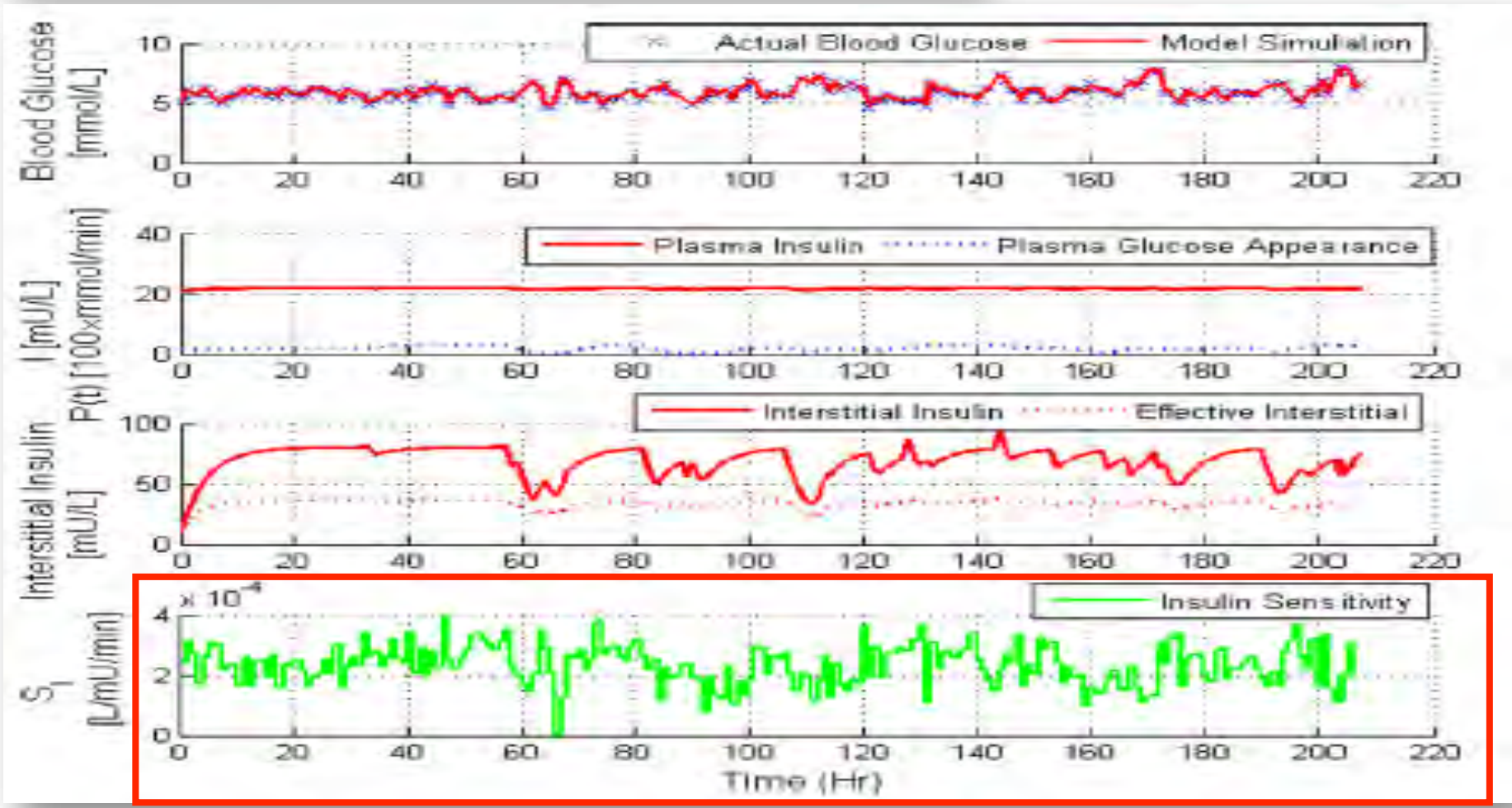


Figure 3 Skeletal muscle glycogen content score via ultrasound.

Wischmeyer P Crit Care 2015

A physiological Intensive Control Insulin-Nutrition-Glucose (ICING) model validated in critically ill patients

Jessica Lin[a,*], *Normy N. Razak*[b], *Christopher G. Pretty*[b], *Aaron Le Compte*[b], *Paul Docherty*[b], *Jacquelyn D. Parente*[b], *Geoffrey M. Shaw*[c], *Christopher E. Hann*[b], *J. Geoffrey Chase*[b]



Comp Meth Prog Biomed 2

Feeding critically ill patients the right 'whey': thinking outside of the box. A personal view

Paul E Marik

Table 1 Potential harm associated with continuous tube feed

Organ system	Potential adverse effect
Muscle	Decreased skeletal muscle synthesis
Endocrine	Decreased secretion of GIP, GLP-1, peptide YY and CCK
	Decreased insulin release
	Insulin resistance
	Hyperglycemia
Gastrointestinal	Hepatic steatosis
	Hepatic inflammation
	Enlarged non-contractile gall bladder
	Impaired lipid absorption
	Small bowel atrophy
	Impaired small bowel function
	Decreased mesenteric blood flow
Other	Multi-organ dysfunction syndrome

GIP glucose-dependent insulinotropic polypeptide, *GLP-1* glucagon-like peptide-1, *CCK* cholecystokinin

Table 2 Intermittent feeding schedule

Time (h)	Volume (ml)	Duration of infusion (min)
0	100	20
4	150	20
8	150	20
12	200	30
16	200	30
20	250	40
24	Target	

Marik P Ann Int Care 2015

AA	Indications	Contraindications
LEU	None	None
GLN	ICU patients without kidney or liver failure	ICU patients with MOF, especially kidney and liver failure
ARG	Seems good for hemodynamically stable patients	Patients with septic shock syndrome
CIT	Intestinal ischemia (based on an experimental study)	Renal failure (which increases CIT plasma concentration and decrease ARG *de novo* synthesis)
TAU	In PICU?	None

Indications and contraindications for infusing specific amino acids (leucine, glutamine, arginine, citrulline, and taurine) in critical illness

Antonin Ginguay[a], *Jean-Pascal De Bandt*[a,b], *and Luc Cynober*[a,b]

Cur Opin Clin Nutr 201

ETAT MUSCULAIRE BASAL (NUTRITIONNEL??)

DM

keletal muscle quality as assessed by T-derived skeletal muscle density is ssociated with 6-month mortality in echanically ventilated critically ill patients

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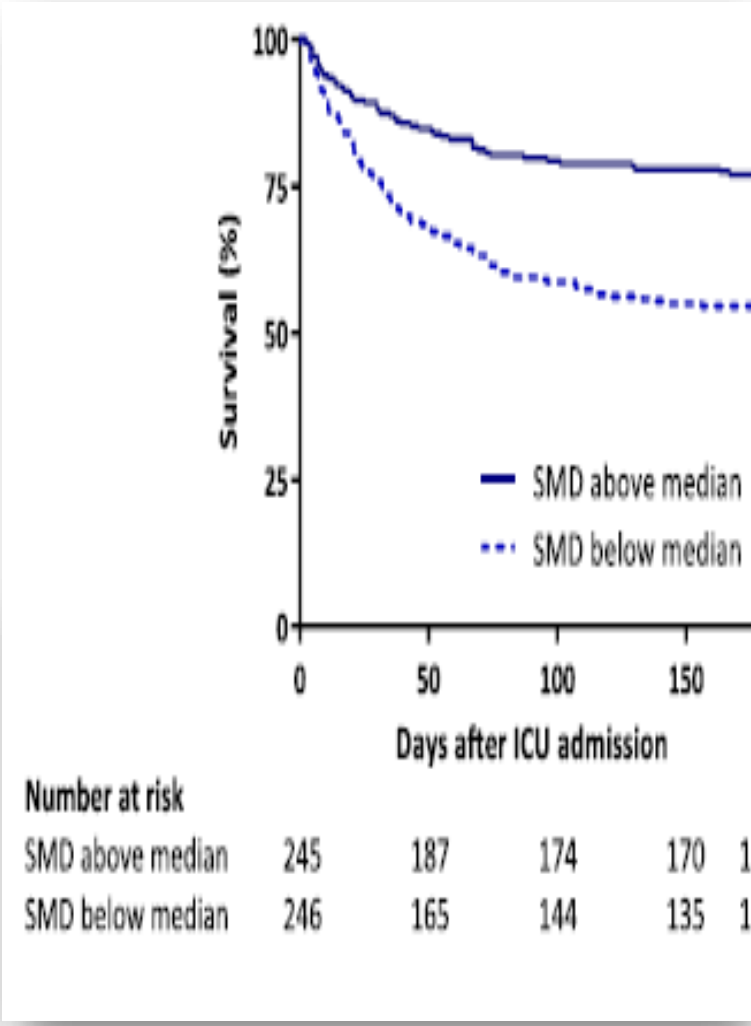
skeletal muscle density (SMD)

intermuscular adipose tissue (IMAT).

ble 3 Cox regression: association between skeletal muscle density or intermuscular adipose tissue and mortality

	Univariable N = 491			Model 2 N = 491			Model 3 N = 491			Model 4 (n = 337)		
onth mortality	HR	95% CI	*P* value	HR	95% CI	*P* value	HR	95% CI	*P* value	HR	95% CI	*P* value
D (per 10 HU)	0.640	0.552–0.742	**<0.001**	0.703	0.605–0.818	**<0.001**	0.774	0.643–0.931	**0.006**	0.728	0.571–0.928	**0.010**
T (per 10 cm^2)	1.153	1.042–1.277	**0.006**	1.092	0.980–1.217	0.110	1.092	0.966–1.236	0.159	1.244	1.048–1.476	**0.012**

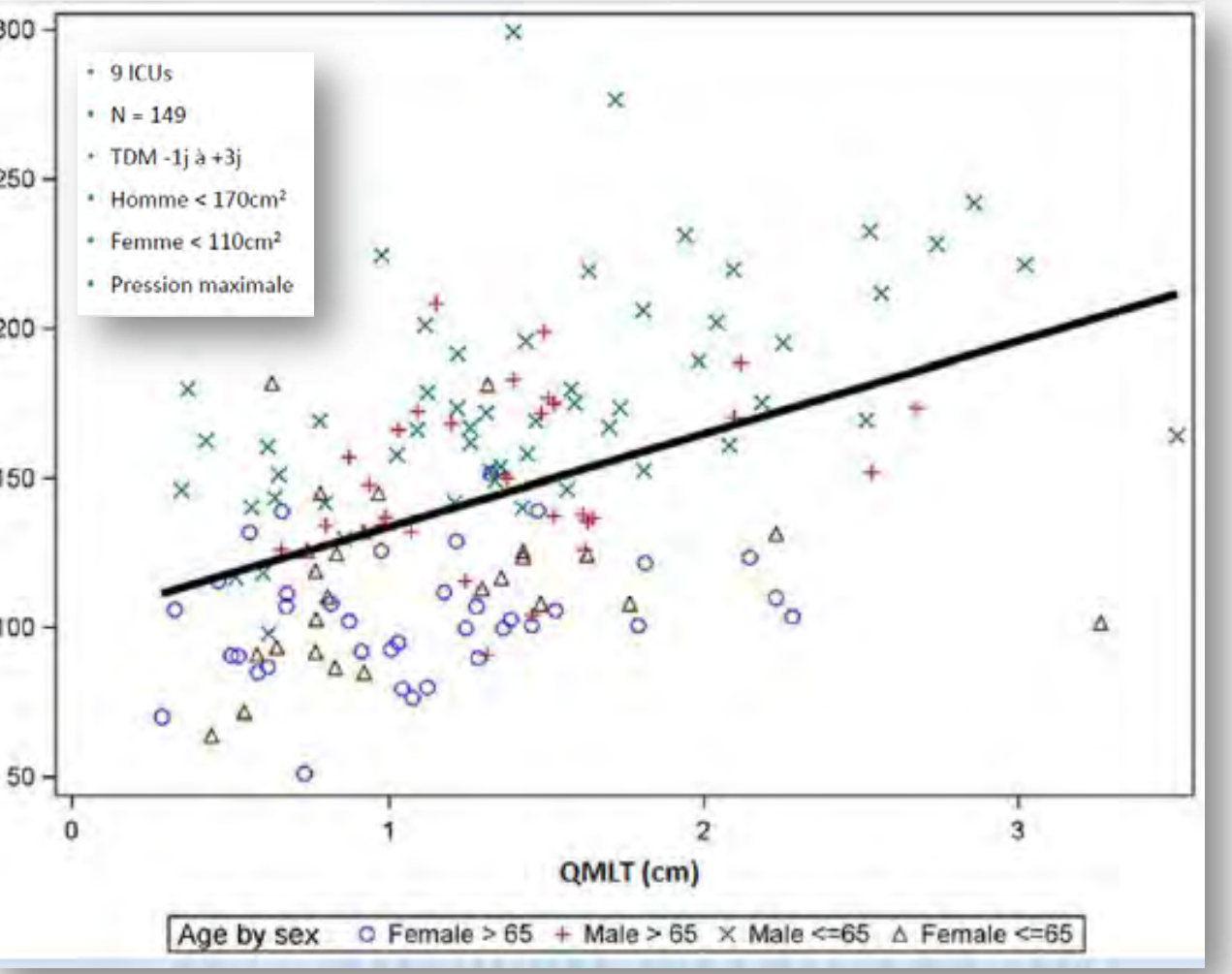
del 2: adjusted for APACHE II score
del 3: adjusted for APACHE II score, skeletal muscle area, and BMI
del 4 (subgroup analysis): adjusted for APACHE II score, skeletal muscle area, visceral adipose tissue, and subcutaneous adipose tissue
es in bold indicate statistically significant *p* values
CHE Acute Physiological, Age, and Chronic Health Evaluation, *CI* confidence interval, *HR* hazard ratio, *HU* Hounsfield Units, *IMAT* intermuscular adipose tissue, skeletal muscle density

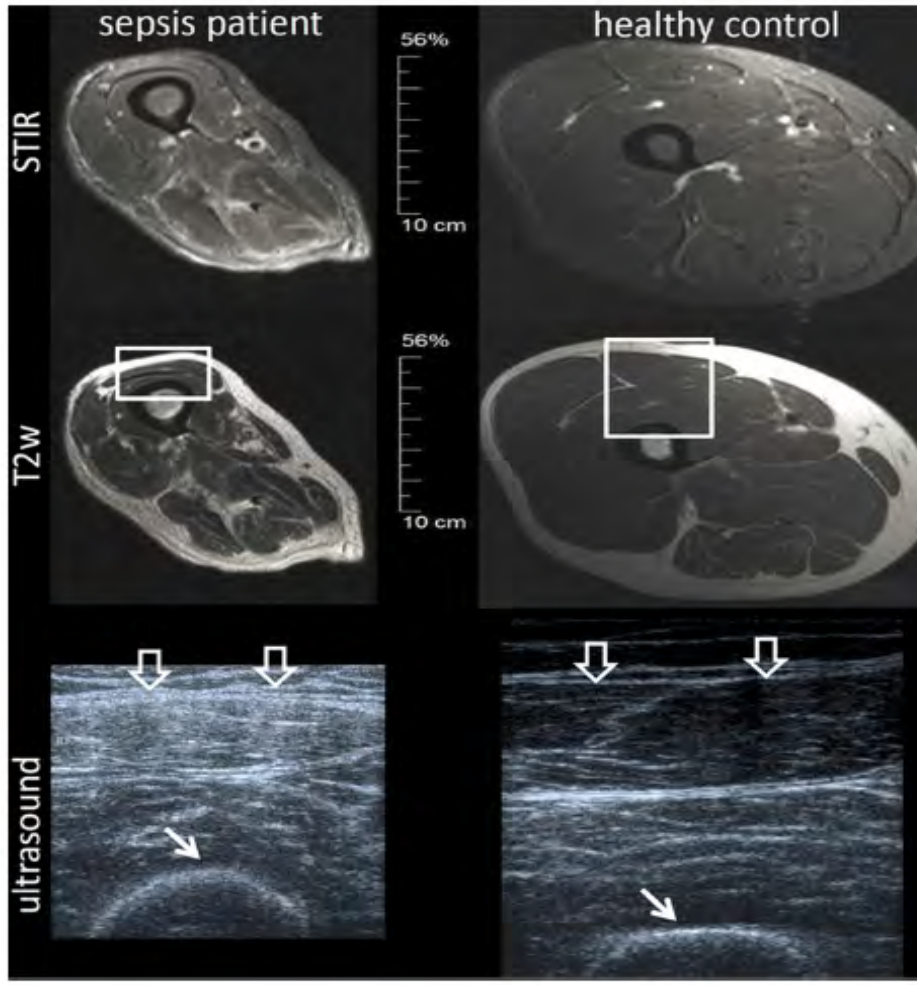


Crit Care 2016

CHO

VALIDATION OF BEDSIDE ULTRASOUND OF MUSCLE LAYER THICKNESS OF THE QUADRICEPS IN THE CRITICALLY ILL PATIENT (VALIDUM STUDY): A PROSPECTIVE MULTICENTER STUDY





Paris MT JPEN 201

Etat musculaire basal (nutritionnel??)

1)Evolution? / Pronostic?

2)Choix thérapeutique ?

Adjusted associations of decline in each physical status measure or death over each 5-year annual follow-up
nal multivariable model

[a]	Muscle strength[b] multivariable model	p value[c]	Exercise capacity[d] multivariable model	p value[c]	Physical function[e] multivariable model	p value[c]
decade	1.34 (1.18, 1.52)	<0.001	1.69 (1.39, 2.05)	<0.001	1.48 (1.23, 1.77)	<0.001
comorbidity index	1.10 (1.02, 1.18)	0.018	1.18 (1.05, 1.32)	0.006	1.08 (0.98, 1.18)	0.131
daily SOFA organ core	1.06 (1.01, 1.11)	0.022	1.01 (0.94, 1.10)	0.756	1.05 (0.98, 1.12)	0.193

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Charlson comorbidity index

Pathologies	Poids assigné
Infarctus du myocarde Insuffisance cardiaque congestive Maladie vasculaire périphérique Accident vasculaire cérébral sauf hémiplégie Démence Maladie pulmonaire chronique Connectivite Ulcère gastro-duodénal Hépatopathie légère Diabète	1
Hémiplégie Atteinte rénale modérée ou sévère Diabète avec atteinte d'organe cible Tumeurs Leucémie Lymphome	2
Hépatopathie modérée à sévère	3
Cancer métastasé Sida	6

Charlson ME J Chronic Dis 1

CONCLUSION

- Mobiliser les patients précocement.
- Limiter la durée de la sédation.
- Optimiser les apports caloriques et azotés, éviter la surnutrition à la phase précoce et la sous nutrition à la phase tardive.
- Les bénéfices spécifiques d'un apport protidique en termes quantitatif (dose) et qualitatif reste à démontrer en réanimation.
- L'effet de l'exercice et la nutrition en réanimation peuvent se potentialiser, mais un tel résultat n'est pas encore démontré.
- Evaluer pour traiter.