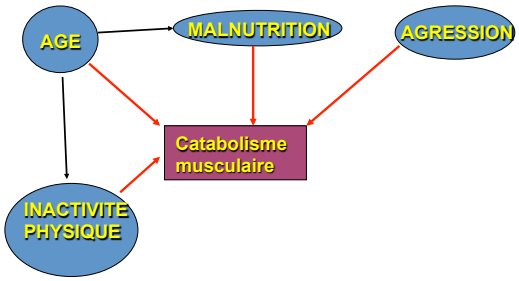
Aspects musculaire et nutritionnel

Prof Jean-Charles Preiser

SRLF/SKR – Paris - janvier 2016

LE PROBLEME



LA SOLUTION?

Mangerbouger.fr, le site de la nutrition santé et plaisir

Take-home messages

- Le muscle est un organe métaboliquement actif, qui participe à la réponse à l'agression.
- Le métabolisme des fibres musculaires varie selon le type de fibres.
- La faiblesse musculaire acquise en soins intensifs est reconnue comme problème majeur!
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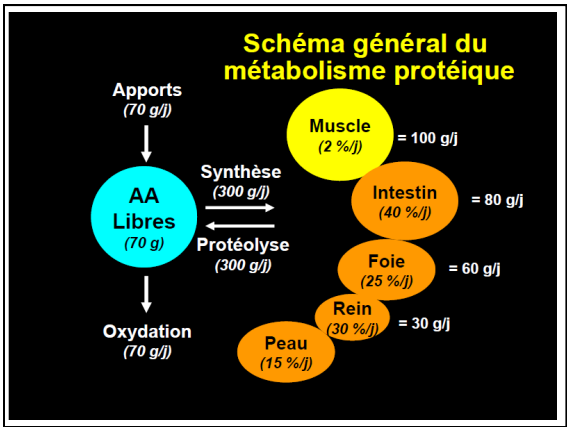
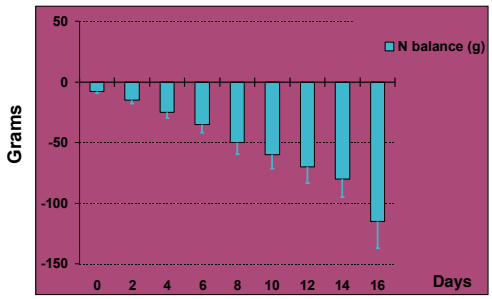
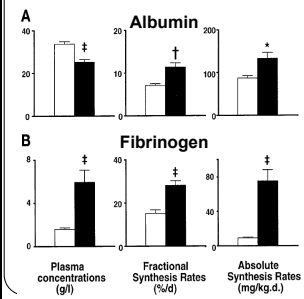


Cumulative N balance in mechanically ventilated patients receiving full enteral feeding



Albumin and fibrinogen syntheses increase while muscle protein synthesis decreases in head-injured patients

ODILE MANSOOR,[1,3] MARC CAYOL,[2] PIERRE GACHON,[3] YVES BOIRIE,[3] PIERRE SCHOEFFLER,[1] CHRISTIANE OBLED,[2] AND BERNARD BEAUFRÈRE[3]

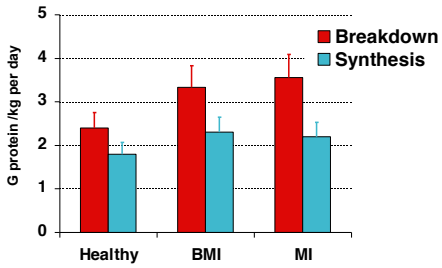


Plasma levels, fractional and absolute synthesis rate of albumin and fibrinogen in brain-injured patients

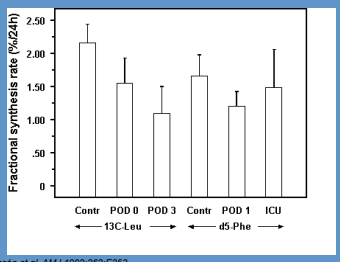
Am J Physiol 1997; 273: E898

Protein metabolism in trauma patients with or without brain injury

Petersen SR et al, J. Trauma 1993; 34: 653



Muscle protein synthesis in postoperative and ICU patients



Essén et al. AMJ 1992;262:E253
Essén et al. Eur.J Surg 1993;159:195
Tjäder et al. JPEN 1996;20:135
Essén et al. CCM 1998;26:92

jw09

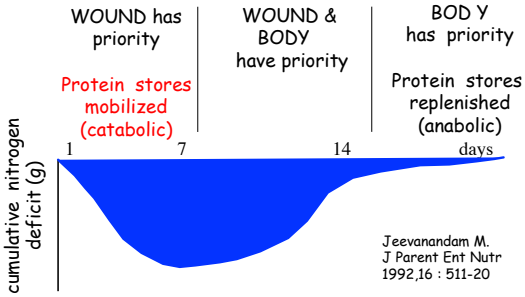
Weight loss (%)	Protein loss * (%)
5	11.2 - 16.8
10	15.2 - 20.8
15	19.2 - 24.8
20	23.0 - 29.0
25	26.8 - 33.2

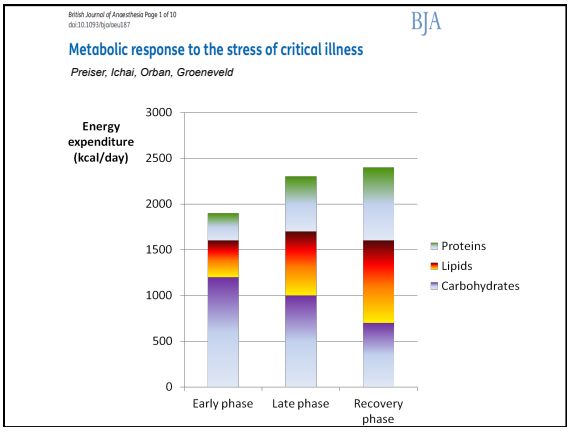
* in vivo neutron analysis. Hill G.L. J Parent Enteral Nutr 16, 197-218, 1992

Protein losses during critical illness

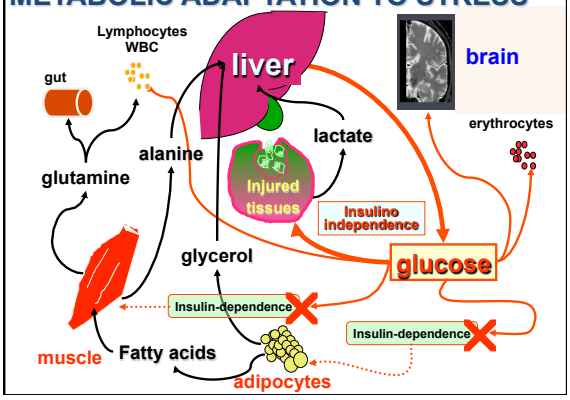
- ≥ 7 - 14 g nitrogen / d.
- ≥ 220 - 440 g lean tissue / d
- › 80-200 g/d muscular proteins

Metabolic response in ICU patients

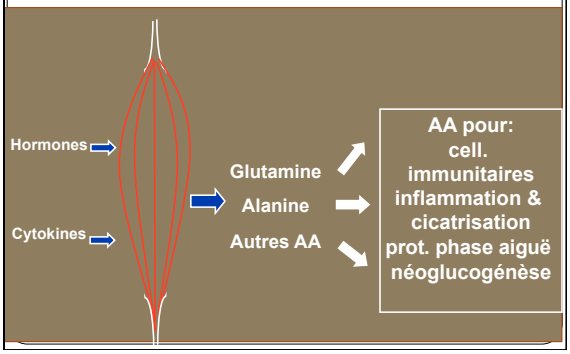




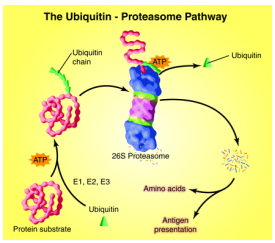
METABOLIC ADAPTATION TO STRESS

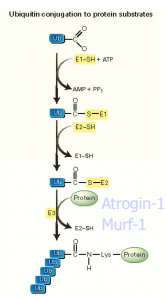


Catabolisme protéique: la libération d'AA est un phémomène adaptatif



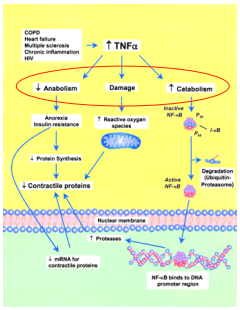
The ubiquitin-proteasome system





Role of TNF in muscle wasting

Laghi American J Respir Crit Care Med 2003; 168 :10-48



Take-home messages

- Le muscle est un organe métaboliquement actif, qui participe à la réponse à l'agression.
- Le métabolisme des fibres musculaires varie selon le type de fibres.
- La faiblesse musculaire acquise en soins intensifs est reconnue comme problème majeur!
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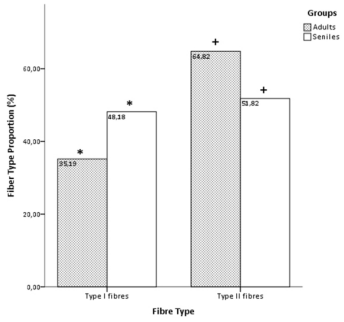
CHARACTERISTICS OF MUSCLE FIBERS

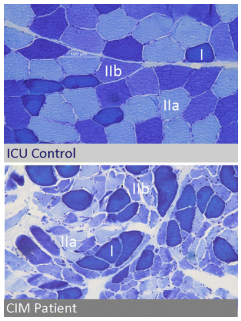
- Type I
  - Slow-twitch
  - More active oxidative metabolism
  - More susceptible to hypoxia
  - More resistant to fatigue
  - Maintenance of posture (back)
  - Poorly innervated
- Type II
  - Fast-twitch
  - Glycogen-rich
  - Less active oxidative metabolism
  - Less susceptible to hypoxia
  - Less resistant to fatigue
  - Highly innervated
  - Rapid movements (legs)

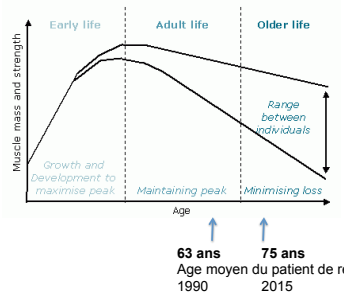
Atrophie des fibres de type II au cours du vieillissement



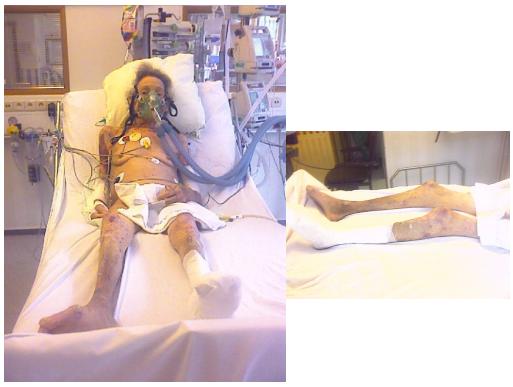
Histological features of CI myopathy

Schefold *J Cachex Sarcopenia Muscle.* 2010; 1: 147–157.





63 ans **75 ans**
Age moyen du patient de réa:
1990 2015



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Acquired Muscle Weakness in the Surgical Intensive Care Unit

Nosology, Epidemiology, Diagnosis, and Prevention

Hassan Farhan, M.D., Ingrid Moreno-Duarte, M.D., Nicola Latronico, M.D., Ross Zafonte, D.O., Matthias Eikermann, M.D., Ph.D.

Anesthesiology 2016; 124:207-34

Quelques termes…

English	Français
Sarcopenia	Sarcopénie
Tetraparesia	Tétraparésie / plégie
Polyneuropathy	Polyneuropathie
Myopathy	Myopathie
Wasting syndrome	Cachexie
ICU-acquired weakness	Faiblesse musculaire acquise en réanimation / soins intensifs

One-Year Outcomes in Survivors of the Acute Respiratory Distress Syndrome

Margaret S. Herridge, M.D., M.P.H., Angela M. Cheung, M.D., Ph.D., Catherine M. Tansey, M.Sc., Andrea Matte-Martyn, B.Sc., Natalia Diaz-Granados, B.Sc., Fatma Al-Saidi, M.D., Andrew B. Cooper, M.D., Cameron B. Guest, M.D., C. David Mazer, M.D., Sangeeta Mehta, M.D., Thomas E. Stewart, M.D., Aiala Barr, Ph.D., Deborah Cook, M.D., and Arthur S. Slutsky, M.D., for the Canadian Critical Care Trials Group

N Engl J Med 2003;348:683-93.

GLOBAL ASSESSMENT

At the time of discharge from the ICU, patients who survived the acute respiratory distress syndrome were severely wasted and had lost 18 percent of their base-line body weight (Fig. 2). Seventy-one percent of patients (59 of 83) returned to their base-line weight by one year. All patients reported poor function and attributed this to the loss of muscle bulk, proximal weakness, and fatigue. Most patients had

DISTANCE WALKED IN SIX MINUTES

The distance walked in six minutes improved over the 12 months after discharge from the ICU but still remained lower than the predicted value[38] (Table 3). The patients attributed exercise limitation to global muscle wasting and weakness, foot drop (as a result of nerve-entrapment syndromes that began in the ICU), immobility of large joints (heterotopic ossification[40,41]), and dyspnea. The proportion of

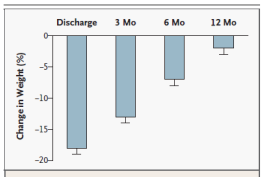
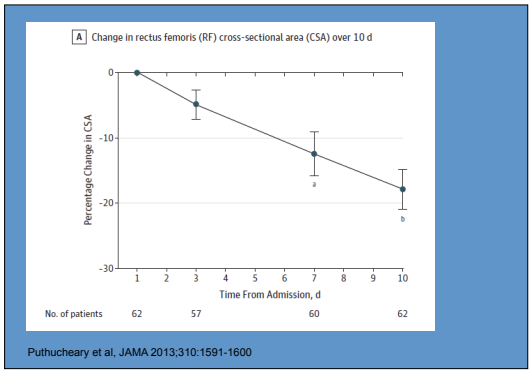
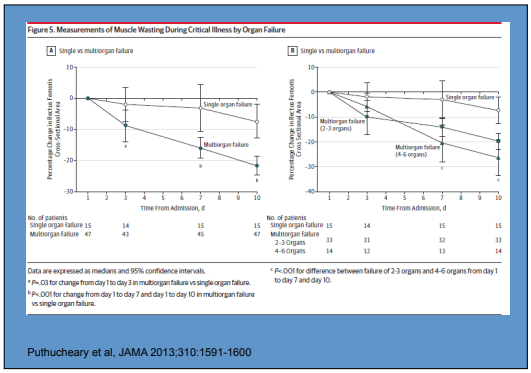


Figure 2. Mean (+SE) Change in Weight from Base Line among Patients with the Acute Respiratory Distress Syndrome at the Time of Discharge from the ICU and at 3, 6, and 12 Months.



Puthucheary et al, JAMA 2013;310:1591-1600

jw14

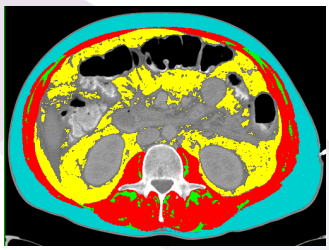


Puthucheary et al, JAMA 2013;310:1591-1600

jw14

Hogeschool van Amsterdam
Amsterdam University of Applied Sciences

Muscle mass from CT scan abdomen L3



Low muscle:
F < 110 cm²
M < 170 cm²

Weijs et al. Crit Care 2014

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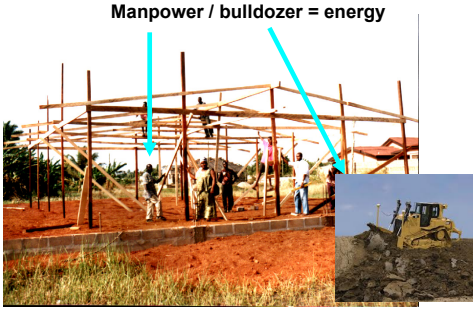
After the acute phase….

A huge task of re-building in front of us !

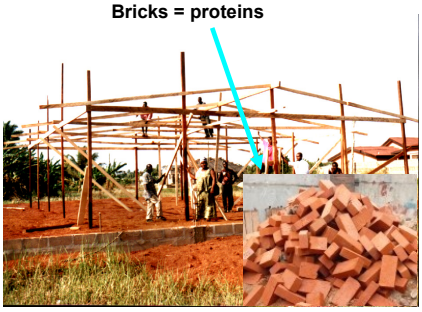
What do we need ?

Manpower / bulldozer = energy



What do we need ?

Bricks = proteins



Common concern and goal

- How to preserve muscular mass and function?

Exercise

Nutrition

- **Energy**
- **Proteins**
- *Water-electrolytes*
- *Micronutriments*

Positive energy balance is associated with accelerated muscle atrophy and increased erythrocyte glutathione turnover during 5 wk of bed rest[1–3]

Gianni Biolo, Francesco Agostini, Bostjan Simunic, Mariella Sturma, Lucio Torelli, Jean Charles Preiser, Ginette Deby-Dupont, Paolo Magni, Felice Strollo, Pietro di Prampero, Gianfranco Guarnieri, Igor B Mekjavic, Rado Pišot, and Marco V Narici

Am J Clin Nutr 2008;88:950–8.

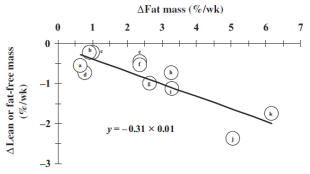
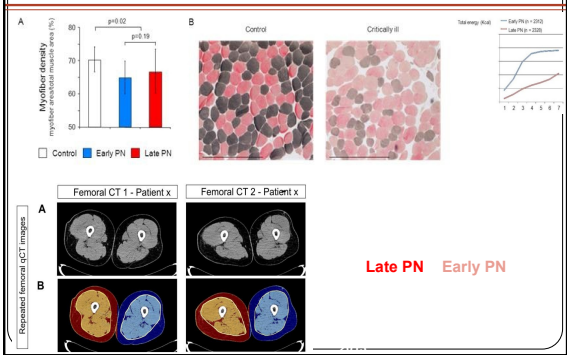


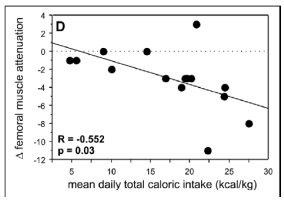
FIGURE 2. Relation between average values of absolute changes in fat mass and lean mass (by dual-energy X-ray absorptiometry) or fat-free mass (by bioelectrical impedance analysis) in previous studies and in the present study. Letters inside (or just outside of) circles represent values from these studies: a, Barbe et al (10); b, Scheld et al (13); c, Stein et al (12); d, present study, lower-energy-balance group; e, Blanc et al (6); f, Krebs et al (7); g, Lovejoy et al (11); h, Gretebeck et al (8); i, present study, higher-energy-balance group; j, Ferrando et al (9); and k, Olsen et al (5). $r = -0.85$, $P = 0.001$; $n = 11$.

Impact of Early Parenteral Nutrition on Muscle and Adipose Tissue Compartments During Critical Illness*

Objective: The goal of enhanced nutrition in critically ill patients is to improve outcome by reducing lean tissue wasting. However, such effect has not been proven. This study aimed to assess the effect of early administration of parenteral nutrition on muscle volume and composition by repeated quantitative CT.

(*Crit Care Med* 2013; 41:2298–2309)





In conclusion, direct quantification of muscle and AT volume in critically ill patients showed important muscle wasting early during the course of illness, which occurred irrespective of the nutritional management. Early PN did not prevent this muscle wasting and instead increased muscular lipid/water content and IMAT volume. In contrast, in the late PN and the control group, significant changes in lipid/water content or IMAT volume were absent.

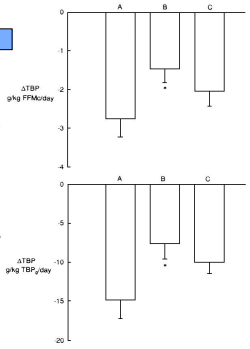
HOW MUCH PROTEINS?

HOW MUCH PROTEINS?

Ishibashi N, et al. Crit Care Med 1998; 26: 1529-35.

Patient Group	Protein (g/kg/day)	Dextrose (kcal/kg/day)	Lipid (kcal/kg/day)	Nonprotein Calorie Intake (kcal/kg/day)
A (n = 7)	1.14 ± 0.13[a,c]	18.3 ± 2.1	8.9 ± 7.9	27.3 ± 8.2
B (n = 8)	1.47 ± 0.11[c]	20.4 ± 1.4	7.0 ± 5.4	27.4 ± 5.4
C (n = 8)	1.86 ± 0.14[b]	24.7 ± 2.9	6.6 ± 3.4	31.3 ± 2.5
p^d	<.001	<.001	NS	NS

[a]Mean ± SD; [b]$p < .001$ for all pairwise comparisons; [c]$p < .001$ for comparison with group A; [d]analysis of variance.



ΔTBP : loss of Total body protein (in vivo neutron Activation)

4.9 Il faut apporter 1,2 à 1,5 g.kg/j de protéines (Accord Fort).

Les besoins protéiques du patient de réanimation sont majorés de par son hyper catabolisme azoté qui dépasse les capacités anaboliques. Les données actuelles montrent qu'une synthèse protéique optimale et une dégradation minimale sont obtenues avec ce niveau d'apports. Lors d'apports excessifs, les substrats protéiques sont oxydés et majorent l'uréogenèse et la thermogenèse sans contribuer à la synthèse protéique.

Protein needs

- FAO/WHO/UNU 1985, EFSA 2012: 0.8 g/kg
- ESPEN guidelines: 1.2 g/kg
- Recent literature: 2.0-2.5 g/kg
  (Dickerson et al 2012; Hoffer & Bistrian 2012)

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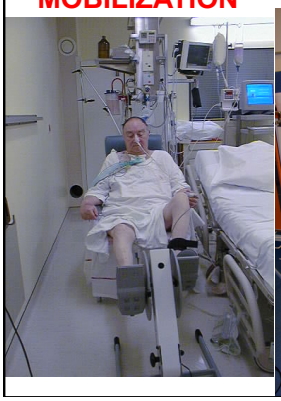
MOBILIZATION



Early exercise in critically ill patients enhances short-term functional recovery*

Chris Burtin, PT, MSc; Beatrix Clerckx, PT; Christophe Robbeets, PT; Patrick Ferdinande, MD, PhD; Daniel Langer, PT, MSc; Thierry Troosters, PT, PhD; Greet Hermans, MD; Marc Decramer, MD, PhD; Rik Gosselink, PT, PhD

Crit Care Med 2009; 37:2499

Measurements and Main Results: **All outcome data are reflective for survivors. Quadriceps force and functional status were assessed at intensive care unit discharge and hospital discharge. Six-minute walking distance was measured at hospital discharge. No adverse events were identified during and immediately after the exercise training. At intensive care unit discharge, quadriceps force and functional status were not different between groups. At hospital discharge, 6-min walking distance, isometric quadriceps force, and the subjective feeling of functional well-being (as measured with "Physical Functioning" item of the Short Form 36 Health Survey questionnaire) were significantly higher in the treatment group ($p < .05$).**

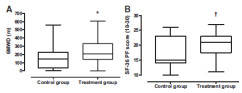


Figure 3. *A, Boxplot* of 6MWD at hospital discharge. *6MWD*, 6-min walking distance. *$p < .05$ compared with control group. *B, Boxplot* of SF-36 PF score at hospital discharge. *SF-36 PF*, "Physical Function" item of Short Form 36 Health Survey Questionnaire. †$p < .01$ compared with control group.

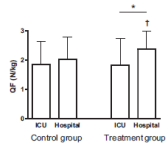
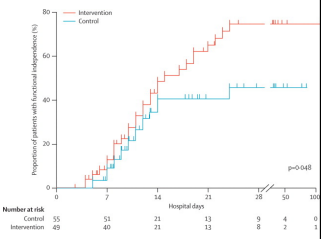


Figure 4. Isometric quadriceps force at intensive care unit (*ICU*) discharge and at hospital discharge. Data are presented as mean and standard deviation. *QF*, quadriceps force; *hospital*, day of hospital discharge. *$p < .01$ between ICU and hospital discharge; †$p < .05$ compared with control group.

Early physical and occupational therapy in mechanically ventilated, critically ill patients.

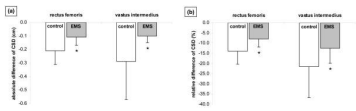
Schweickert WD Lancet 2009;373:1874

Sedated adults (>/=18 years of age) in the ICU who had been on mechanical ventilation for less than 72 h, were eligible for enrolment in this randomised controlled trial We randomly assigned 104 patients to early exercise and mobilisation (physical and occupational therapy) during periods of daily interruption of sedation (intervention; n=49) or to daily interruption of sedation with therapy as ordered by the primary care team (control; n=55). The primary endpoint was the number of patients returning to independent functional status at hospital discharge-was defined as the ability to perform six activities of daily living and the ability to walk independently.



Electrical muscle stimulation preserves the muscle mass of critically ill patients

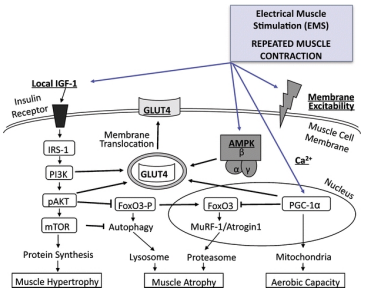
Gerovasili Crit Care 2009;13:R161



Forty-nine critically ill patients (age: 59 +/- 21 years) with an APACHE II admission score >or=13 were randomly assigned after stratification upon admission to receive daily EMS sessions of both lower extremities (EMS-group) or to the control group (control group). Muscle mass was evaluated with US, by measuring the cross sectional diameter (CSD) of the vastus intermedius and the rectus femoris of the quadriceps muscle.

Effects of electrical muscle stimulation

Schefold *J Cachex Sarcopenia Muscle.* 2010; 1: 147–157.



Study 1 : Passive mobilisation

Preiser De Prato et al J Novel Physioth 2014

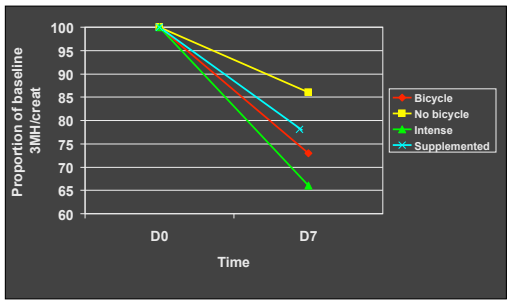
Thirty minutes of Passive mobilisation - cycling (20 rpm) 2x/day

Research Article Open Access

Passive Cycling Limits Myofibrillar Protein Catabolism in Unconscious Patients: A Pilot Study

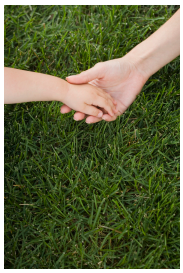
Jean-Charles Preiser[1*], Christophe De Prato[1], Amélie Harvengt[1], Lauriane Peters[1], Marie-Hélène Bastin[1], Vincent Fraipont[2], Pierre Damas[1], Jean-Michel Crielaard[3] and Gianni Biolo[4]

Preiser JC, et al., J Nov Physiother 2014, 4:4
http://dx.doi.org/10.4172/2165-7025.1000225



Conclusion

Exercise



Nutrition