JDP PARIS 2014

Activité physique en réanimation

Jean-Charles Preiser et les kinés!

Service des soins intensifs

Hôpital Erasme, Bruxelles

SFNEP Société Francophone Nutrition Clinique et Métabolisme Nourrir l'Homme malade

JDP SFNEP Journées de Printemps

Au menu…

- Quel est le problème?
- Modes d'évaluation
  - Morphologique
  - Fonctionnel
- Approches préventives
- Approches thérapeutiques

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Rapid Disuse Atrophy of Diaphragm Fibers in Mechanically Ventilated Humans

N Engl J Med 2008;358:1327-35.

Sanford Levine, M.D., Taitan Nguyen, B.S.E., Nyali Taylor, M.D., M.P.H., Michael E. Friscia, M.D., Murat T. Budak, M.D., Ph.D., Pamela Rothenberg, B.A., Jianliang Zhu, M.D., Rajeev Sachdeva, M.D., Seema Sonnad, Ph.D., Larry R. Kaiser, M.D., Neal A. Rubinstein, M.D., Ph.D., Scott K. Powers, Ph.D., Ed.D., and Joseph B. Shrager, M.D.

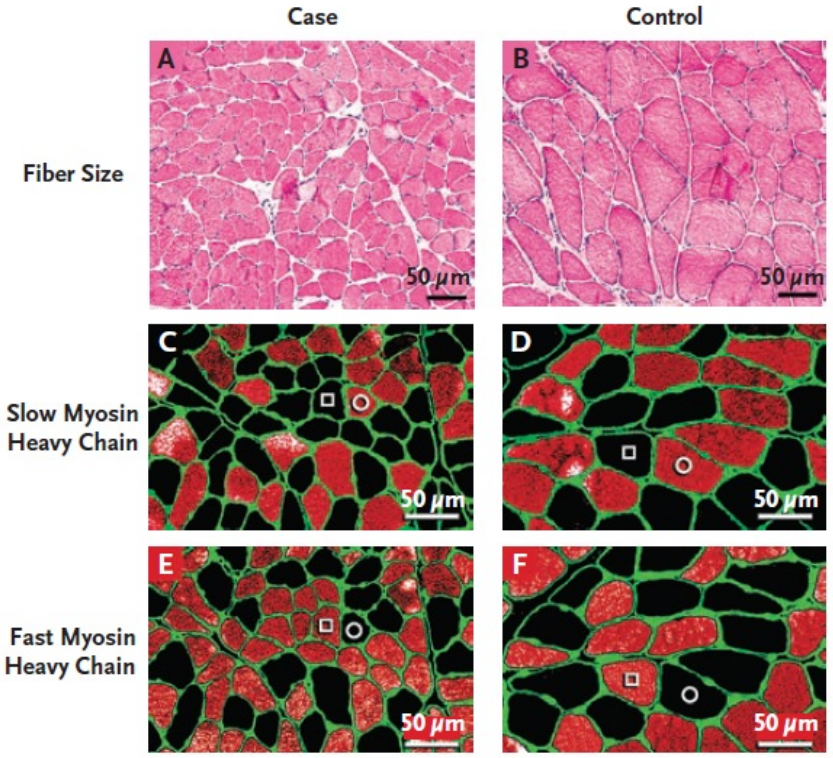
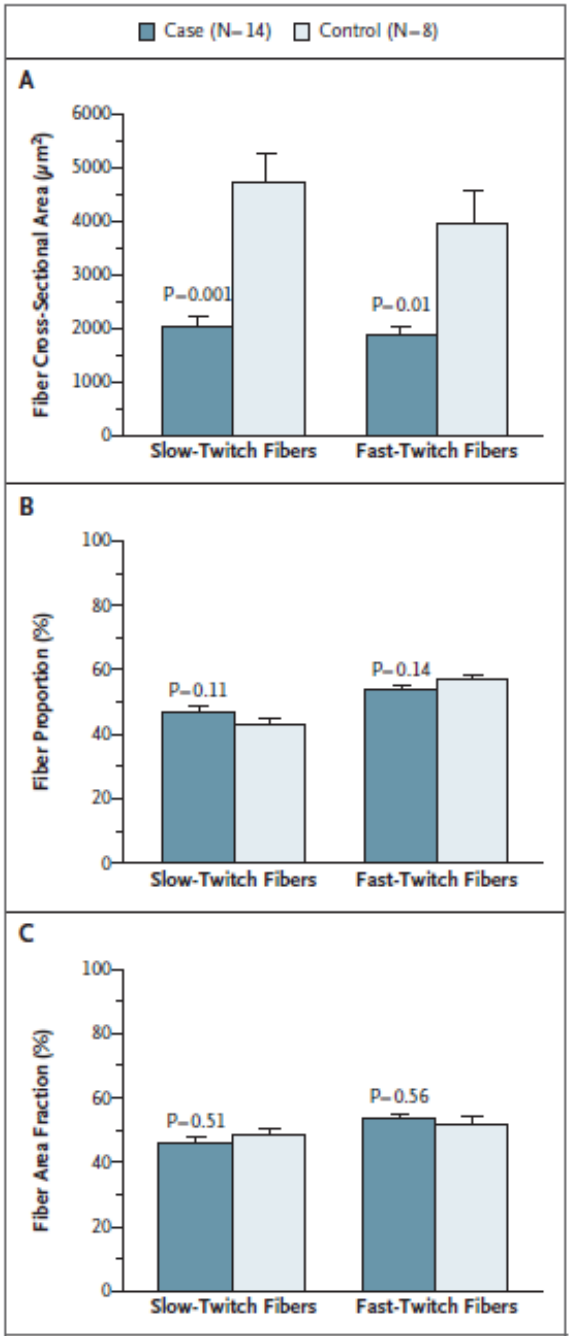


Figure 1. Comparison of Representative Case and Control Diaphragm-Biopsy Specimens with Respect to Fiber Size.

The slow-twitch and fast-twitch fibers in the case specimens (Panels A, C, and E) are smaller than those in the control diaphragms (Panels B, D, and F). Panels A and B (hematoxylin and eosin) show that neither inflammatory infiltrate nor necrosis is present in case or control specimens. The sections in Panels C and D were preincubated with NOQ7.5.4D antibody,[10,13] which is specific for the slow myosin heavy chain, whereas sections in Panels E and F were preincubated with the MY-32 antibody,[10,14] which reacts with all fast myosin heavy chains. In addition, in each section, all fibers are outlined by an antibody reactive to laminin.[10,15] In each of the sections, fibers reacting with the antibody appear orange-red, whereas fibers not reacting with the antibody appear black. In Panels C, D, E, and F, a representative slow-twitch fiber is indicated by an open circle and a fast-twitch fiber by an open square.



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

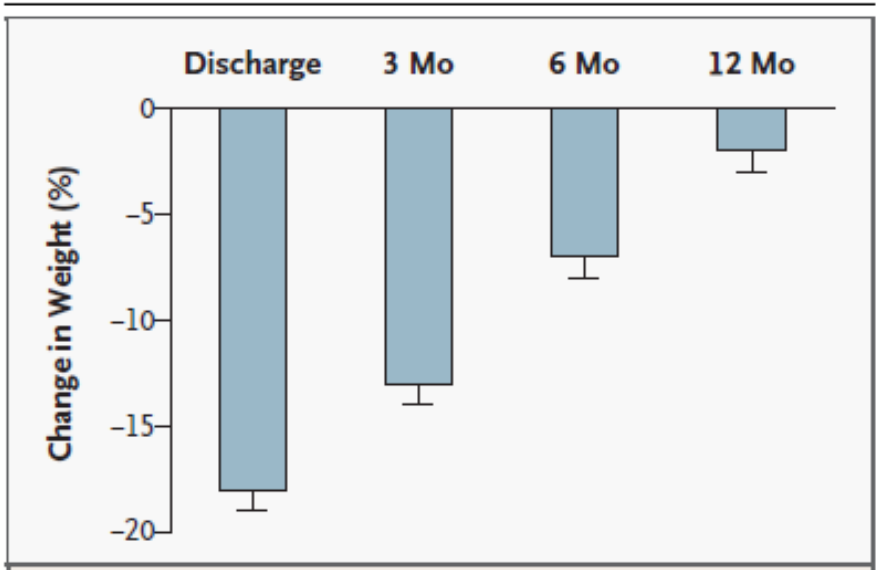


Figure 2. Mean (+SE) Change in Weight from Base Line among Patients with the Acute Respiratory Distress Syndrome at the Time of Discharge from the ICU and at 3, 6, and 12 Months.

Functional Disability 5 Years after Acute Respiratory Distress Syndrome

Margaret S. Herridge, M.D., M.P.H., Catherine M. Tansey, M.Sc., Andrea Matté, B.Sc., George Tomlinson, Ph.D., Natalia Diaz-Granados, M.Sc., Andrew Cooper, M.D., Cameron B. Guest, M.D., C. David Mazer, M.D., Sangeeta Mehta, M.D., Thomas E. Stewart, M.D., Paul Kudlow, B.Sc., Deborah Cook, M.D., Arthur S. Slutsky, M.D., and Angela M. Cheung, M.D., Ph.D., for the Canadian Critical Care Trials Group

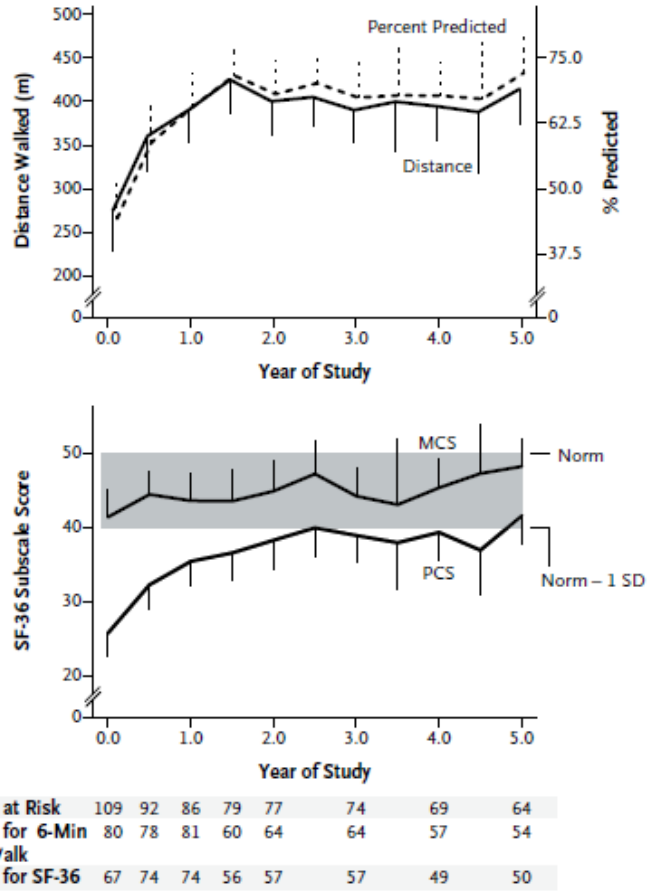
N Engl J Med 2011;364:1293-304.

METHODS

We evaluated 109 survivors of ARDS at 3, 6, and 12 months and at 2, 3, 4, and 5 years after discharge from the intensive care unit. At each visit, patients were interviewed and examined; underwent pulmonary-function tests, the 6-minute walk test, resting and exercise oximetry, chest imaging, and a quality-of-life evaluation; and reported their use of health care services.

Functional Disability 5 Years after Acute Respiratory Distress Syndrome

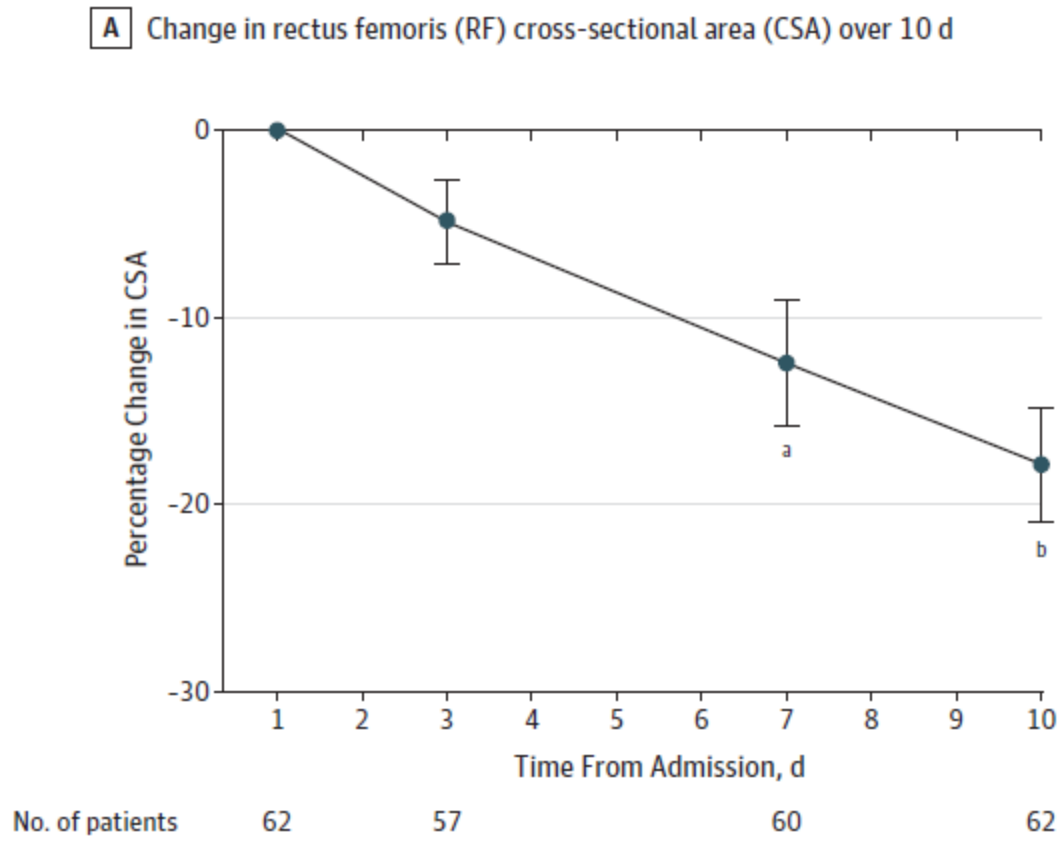
Margaret S. Herridge, M.D., M.P.H., Catherine M. Tansey, M.Sc., Andrea Matté, B.Sc., George Tomlinson, Ph.D., Natalia Diaz-Granados, M.Sc., Andrew Cooper, M.D., Cameron B. Guest, M.D., C. David Mazer, M.D., Sangeeta Mehta, M.D., Thomas E. Stewart, M.D., Paul Kudlow, B.Sc., Deborah Cook, M.D., Arthur S. Slutsky, M.D., and Angela M. Cheung, M.D., Ph.D., for the Canadian Critical Care Trials Group



walked in 6 minutes in meters (solid line) and the percent of the predicted distance (dashed line). The bottom graph shows the physical-component score (PCS) and the mental-component score (MCS) on the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36); scores range from 0 to 100, with higher scores indicating better health status. Vertical bars in the middle and bottom graphs represent half 95% confidence intervals.

No. at Risk	109	92	86	79	77	74	69	64
No. for 6-Min Walk	80	78	81	60	64	64	57	54
No. for SF-36	67	74	74	56	57	57	49	50

Muscle wasting during critical illness



JAMA. doi:10.1001/jama.2013.278481
Published online October 9, 2013.

Acute Skeletal Muscle Wasting in Critical Illness

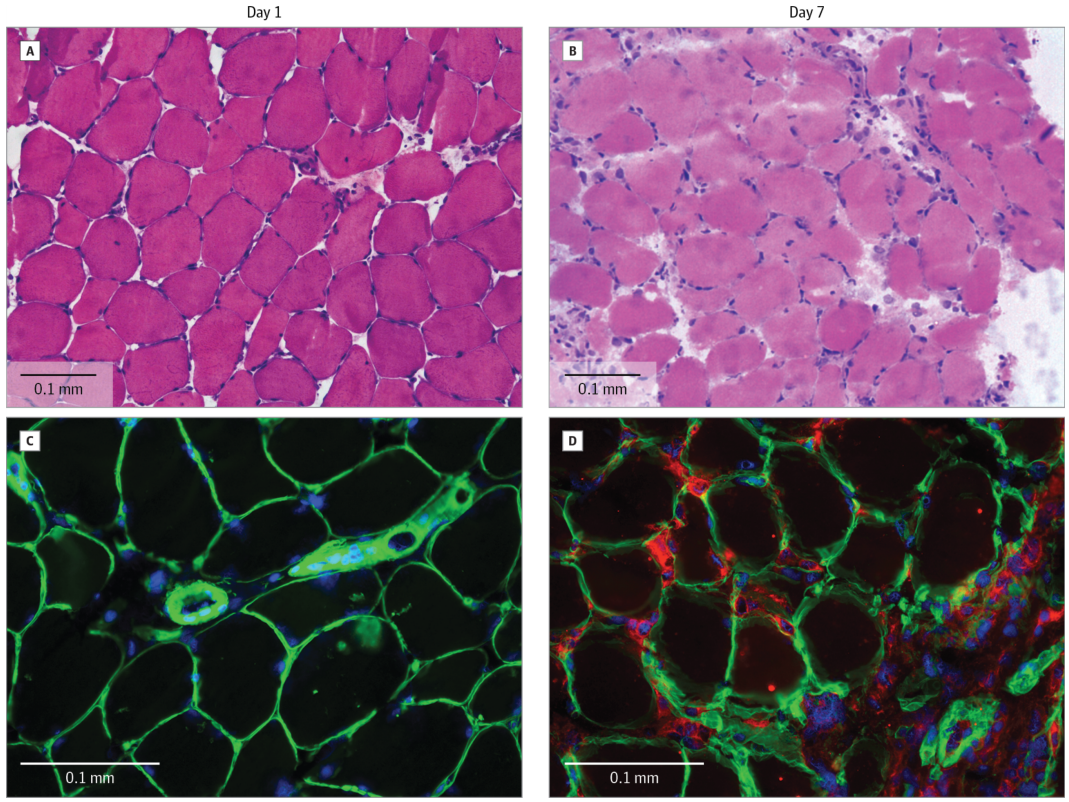
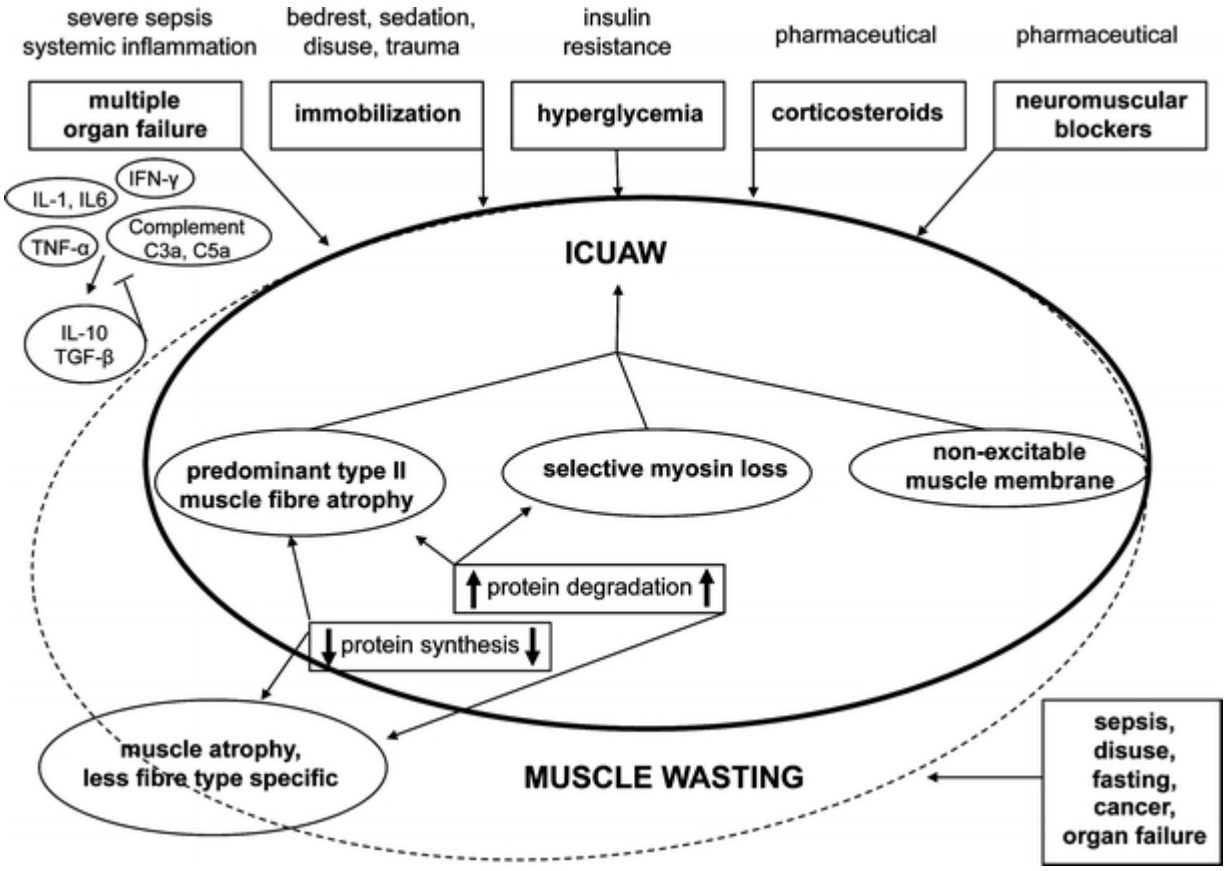


Figure Legend:

Muscle Biopsy Specimens From a Representative Patient on Day 1 and Day 7Healthy muscle is seen on day 1 (A, C) with necrosis and a cellular infiltrate on day 7 (B, D).This infiltrate was CD68 positive on immunostaining, indicating macrophage origin (red). A, B are hematoxylin and eosin stain, and C, D was immunostaining, with CD68 for red, laminin (myofiber outline) for green, and 4',6-diamidion-2-pheylidole (a nuclear marker) for blue.

Potential mechanisms of ICUAW

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



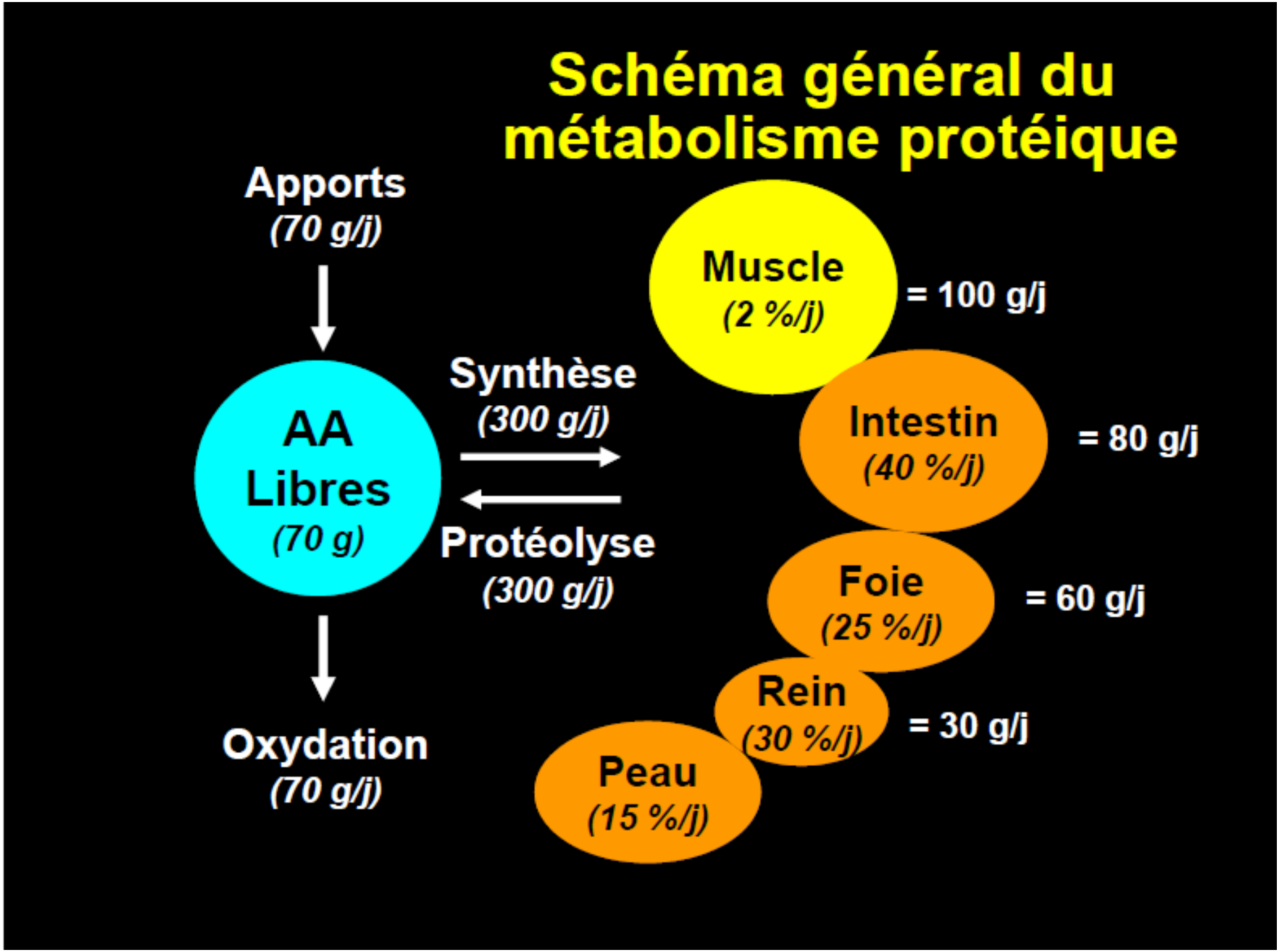
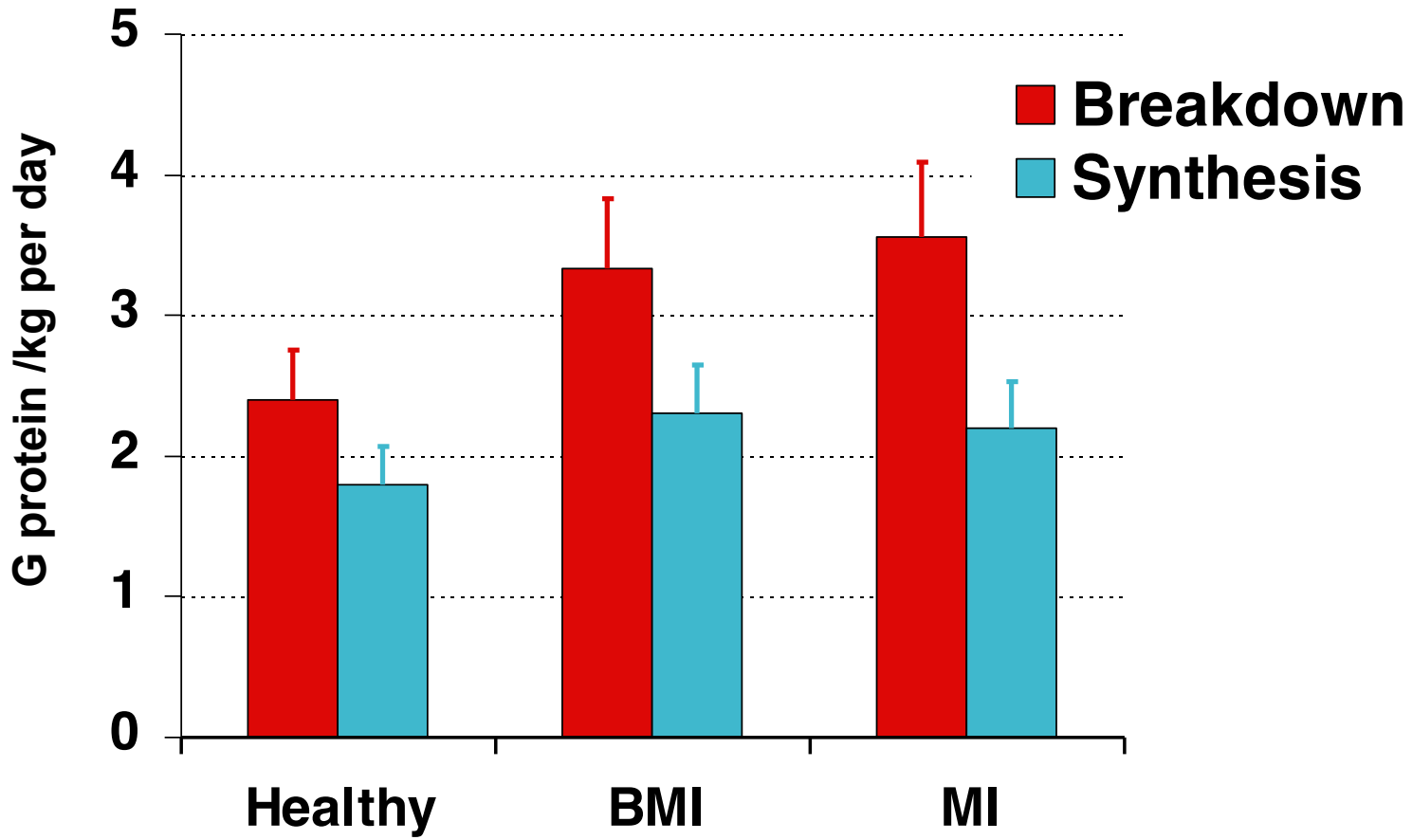


Schéma général du métabolisme protéique
Apports
(70 g/j)
AA Libres
(70 g)
Oxydation
(70 g/j)
Synthèse
(300 g/j)
Protéolyse
(300 g/j)
Muscle
(2 %/j)
= 100 g/j
Intestin
(40 %/j)
= 80 g/j
Foie
(25 %/j)
= 60 g/j
Rein
(30 %/j)
= 30 g/j
Peau
(15 %/j)

Protein metabolism in trauma patients with or without brain injury

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



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

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Muscle ultrasound for early assessment of critical illness neuromyopathy in severe sepsis

Ultrasonic echogenicity was graded semiquantitatively according to Heckmatt et al. [23]. Figure 1 shows some examples of different grades of echotexture in the tibialis anterior muscle. Interimage measurements demonstrated an intraclass correlation coefficient (ICC) of 0.915 between raters, while intrarater ICC was 0.972.

Grimm et al Crit Care 2013

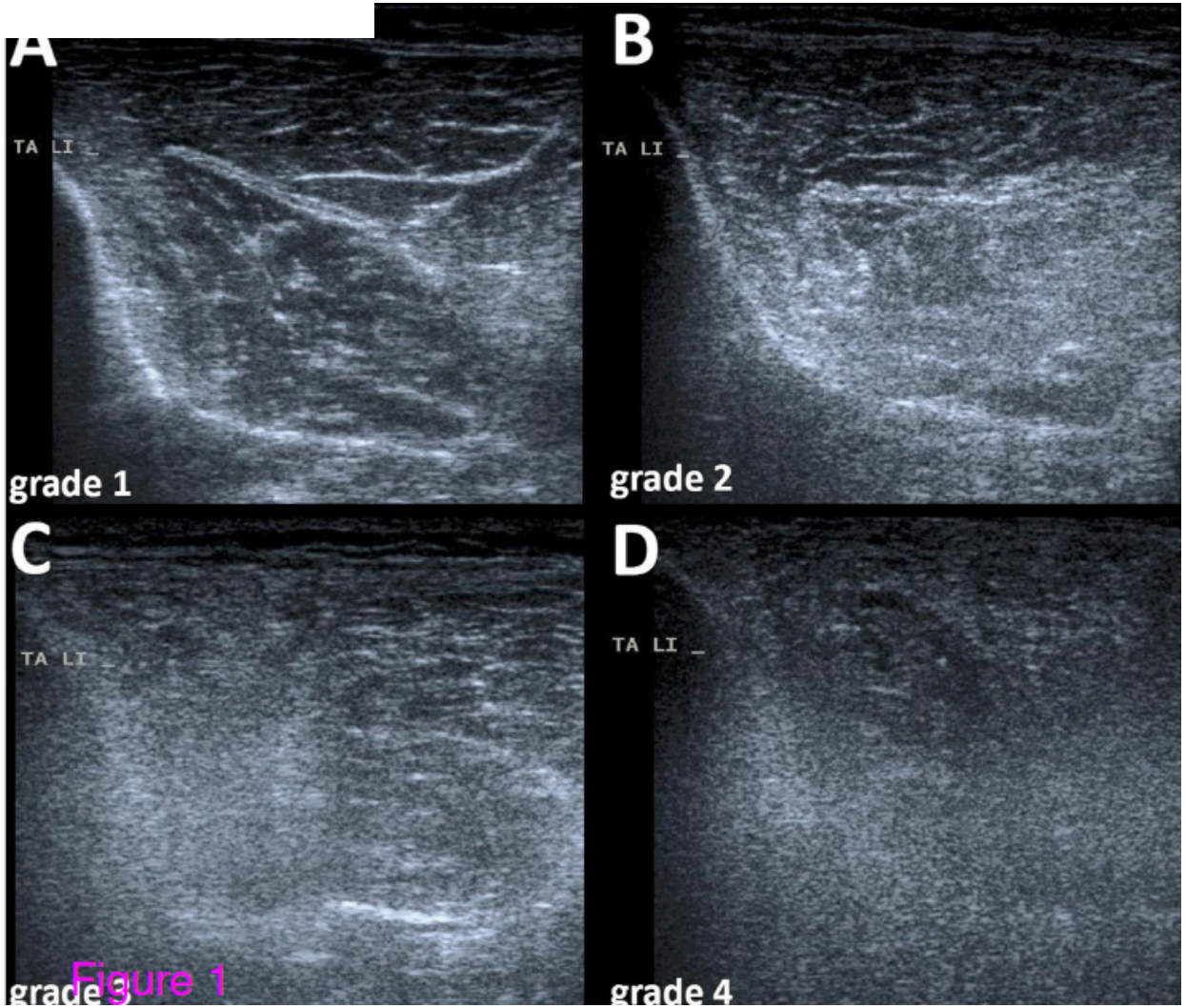
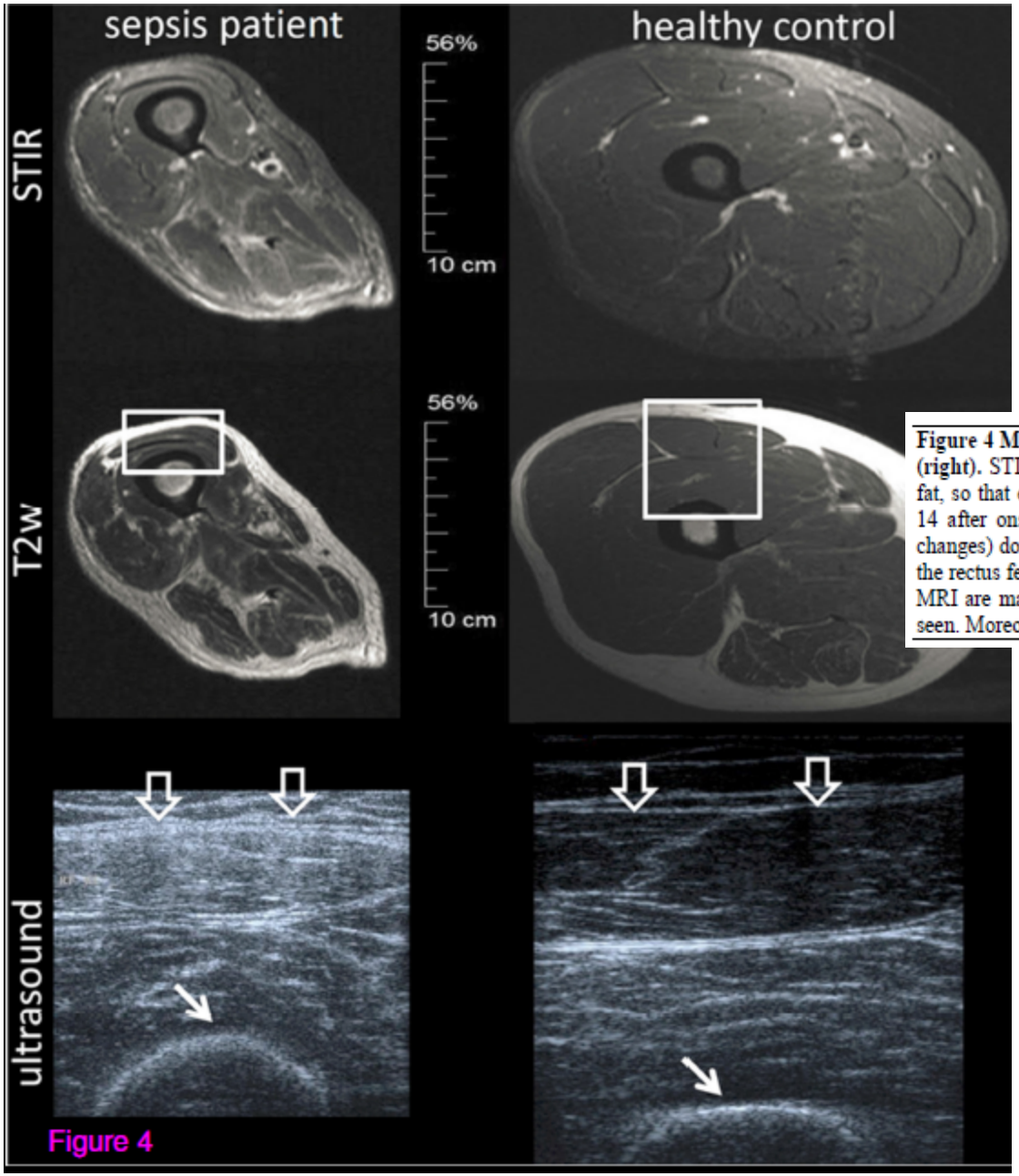


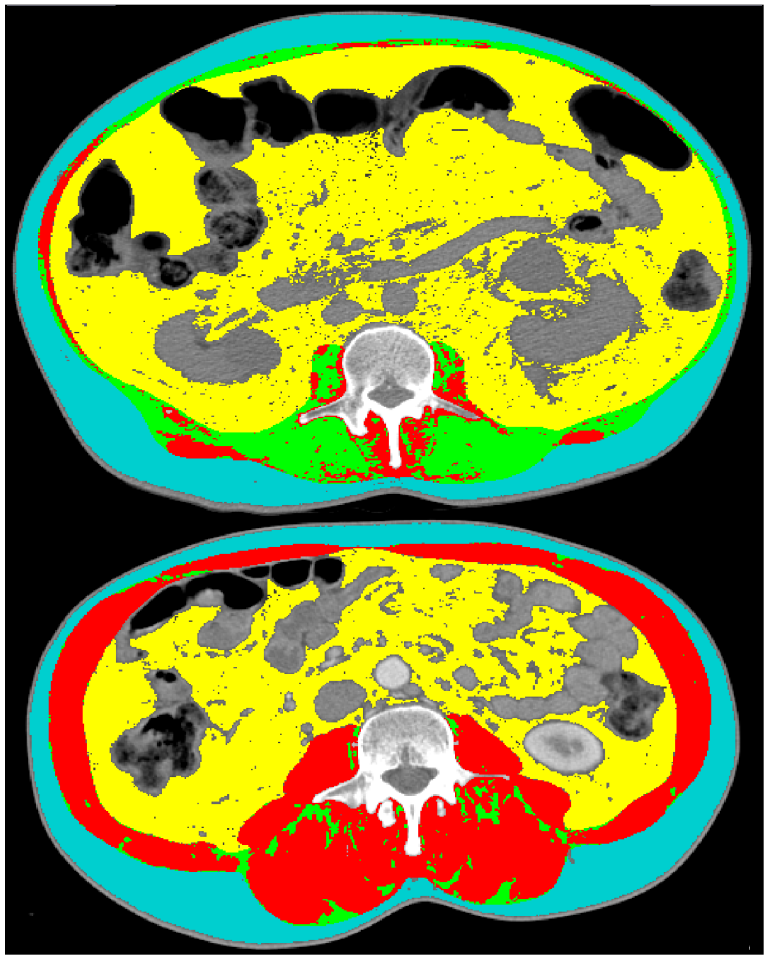
Figure 1



Grimm et al Crit Care 2013

Figure 4 Muscle MRI (1.5 Tesla) of a sepsis patient at day 14 (left) and a healthy control (right). STIR (Short TI Inversion Recovery) is a MRI sequence to suppress the signal from fat, so that especially edema can be seen in the muscle. The images demonstrate that at day 14 after onset of severe sepsis the structural changes in the muscle (atrophic and fibrous changes) dominate over edematous changes. Ultrasonic sections of the same subjects through the rectus femoris muscle (large arrows) are shown at the bottom. The corresponding areas in MRI are marked as rectangles. The difference in echogenicity of the muscle can clearly be seen. Moreover, the bone signal in the patient begins to blur (small arrows).

Muscle atrophy



Muscle atrophy is predictive of

- poor survival (independently of BMI)
-prolonged ventilation
-long-term functional disability
-risk of infection
-….

Low skeletal muscle area is a risk factor for mortality in mechanically ventilated critically ill patients

Critical Care 2014, **18**:R12

Peter JM Weijs[1,2,3*], Wilhelmus GPM Looijaard[2], Ingeborg M Dekker[1], Sandra N Stapel[2], Armand R Girbes[2,5],

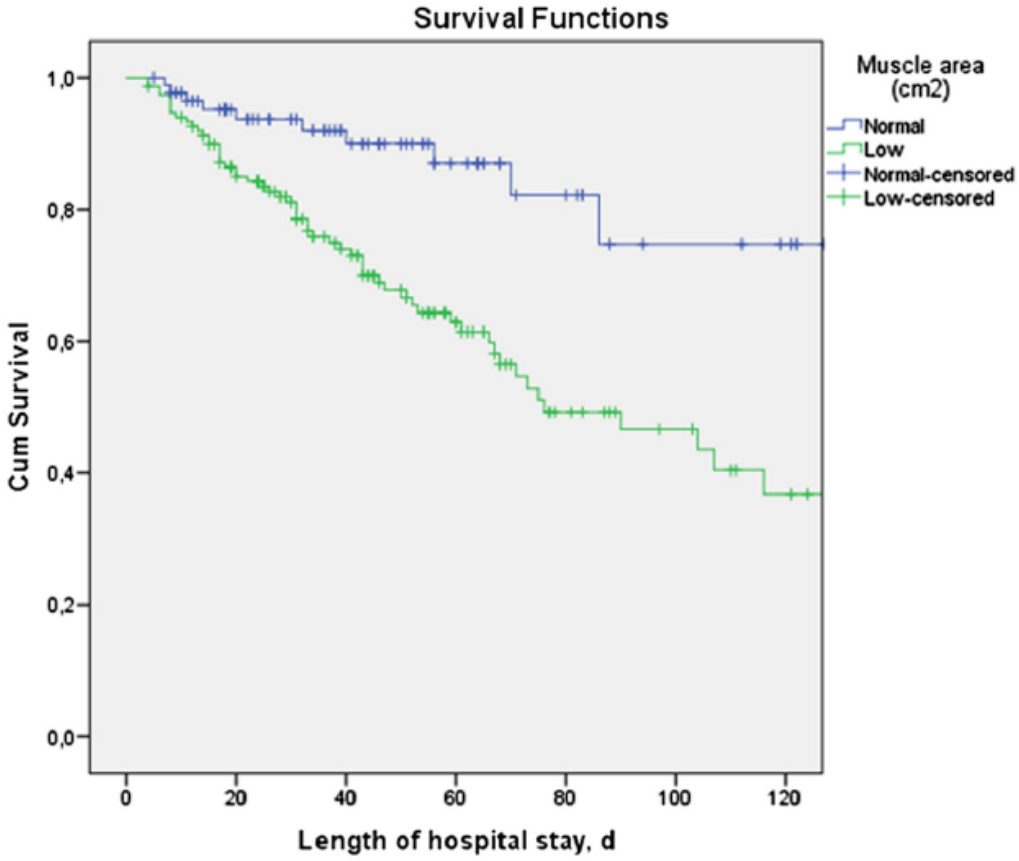
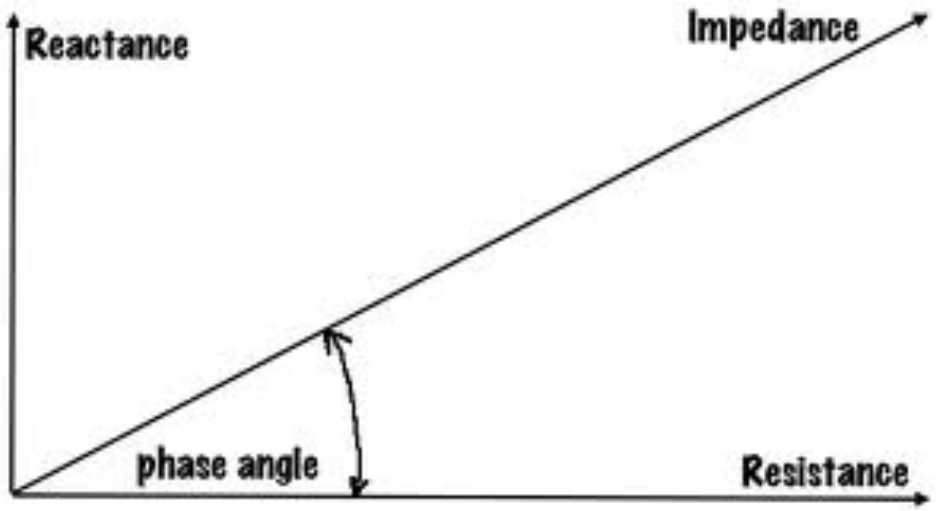


Figure 2 Kaplan-Meier survival plot for low- and normal-muscle area group (log rank test, $P < 0.001$).

BIA PHASE ANGLE

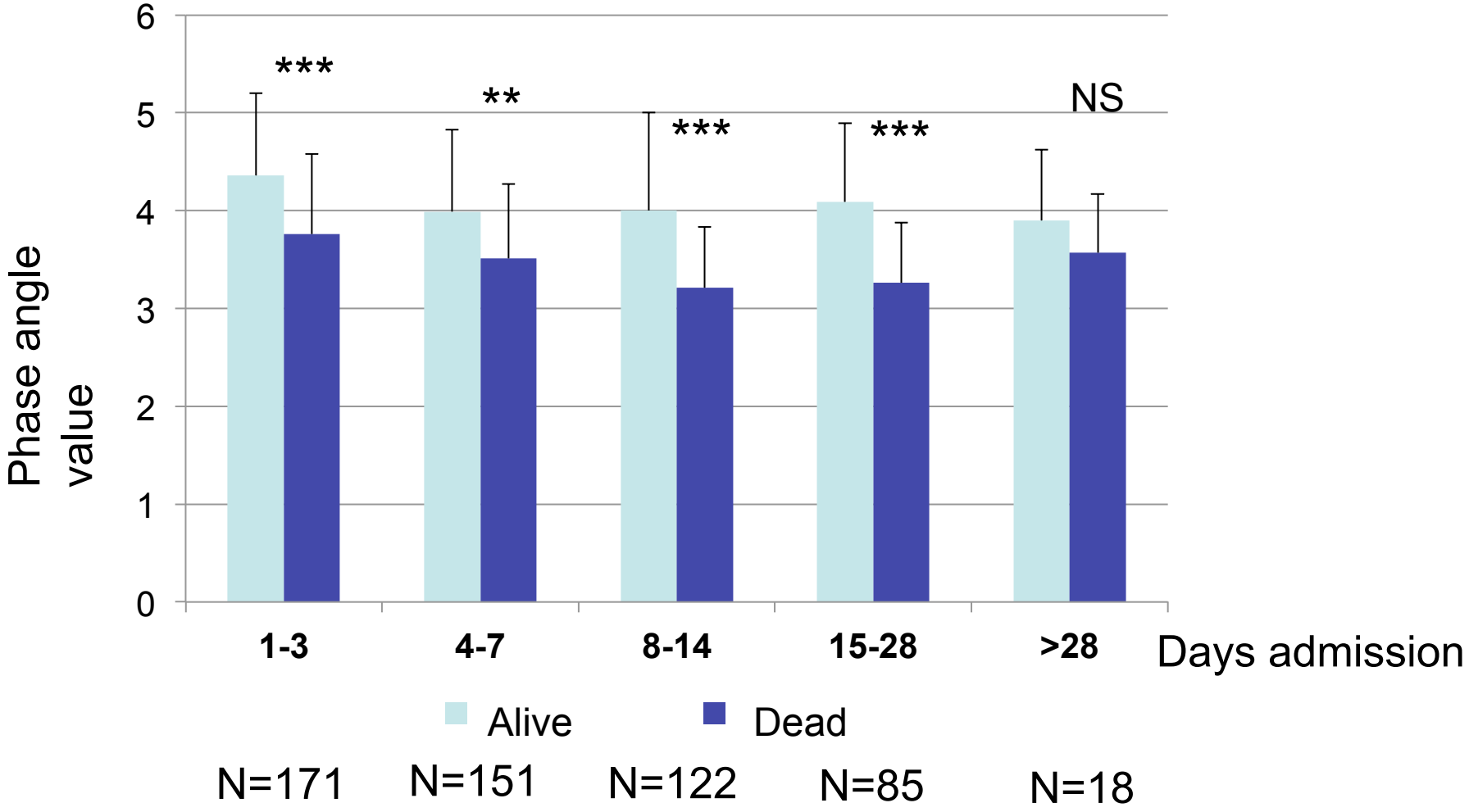
Increased by cell membranes
Proportional to body cell mass



Inversely proportional to total body water
Low in FFM – high in fat tissues

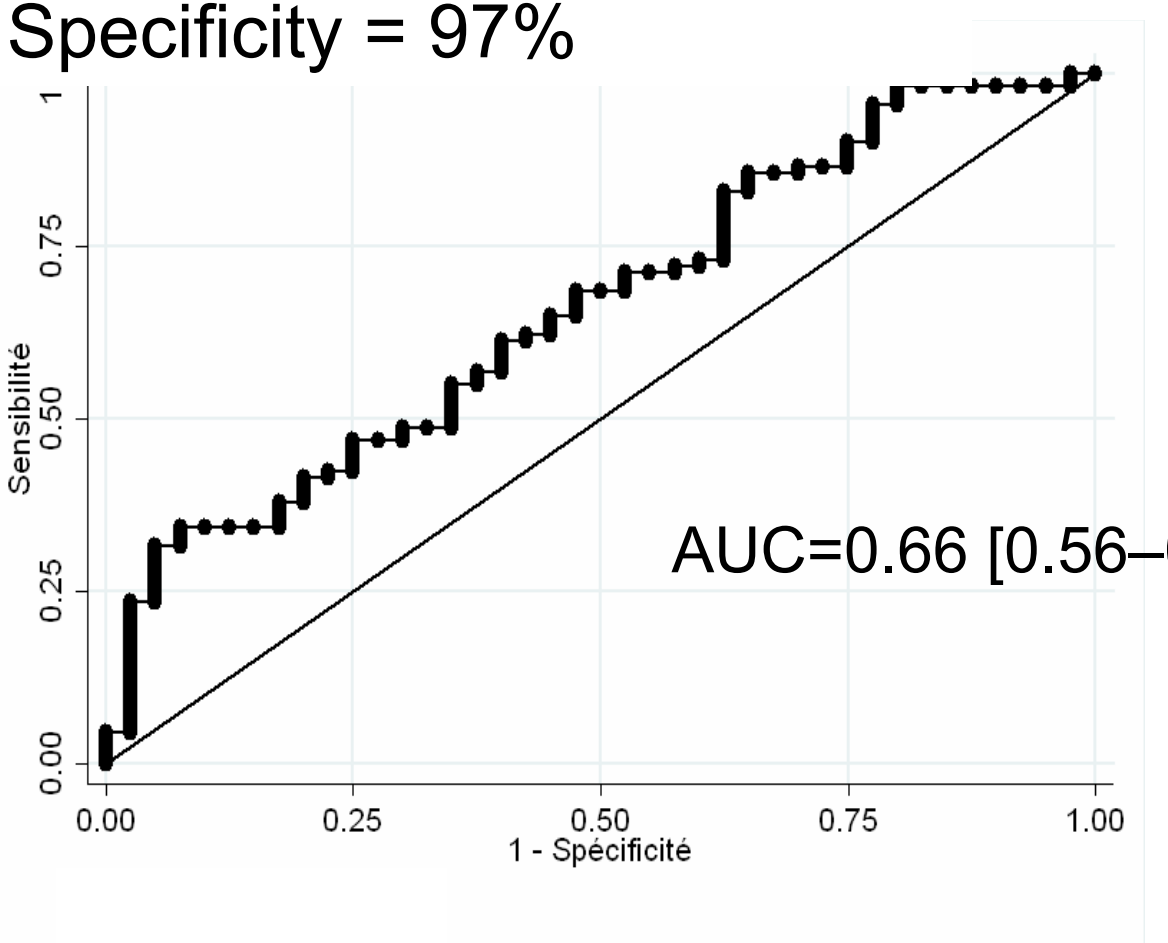
Using the 3 parameters, resistance, reactance and phase angle, in addition to further information about the patient (ie. weight, height, sex, age) a detailed analysis of body composition and nutritional status can be calculated. Published formulae and special software which contain the appropriate statistical data are used to achieve this diagnosis.

Phase angle and prognosis – recent preliminary data in 197 patients



D4-d7 Phase angle 50 kHz and mortality (n=151)

PhA 50 kHz <4.52 : Sensibility = 30%
Specificity = 97%



AUC=0.66 [0.56–0.75]

Fonctionnel : MRC

- Permet d'évaluer de manière détaillée et répétée la force musculaire d'un patient conscient et collaborant.
- Il varie de 0 à 5 points et teste six groupes musculaires sur les hémicorps droit et gauche du patient.
- Le score total varie de 0 (tétraplégie flasque) à 60 points (force musculaire normale).
- La présence d'une faiblesse musculaire acquise en réanimation est établie lorsque ce score est inférieur ou égal à 48.

Hand grip test

Réanimation (2014) 23:109-115
DOI 10.1007/s13546-013-0827-z

PARAMÉDICAL / *HEALTHCARE PROFESSIONALS*

Comment, en pratique clinique, évaluer la force musculaire du patient de réanimation ?

How to assess muscle strength in clinical practice in the intensive care unit?

N. Dousse · F. Vermeulen · L. Brochard

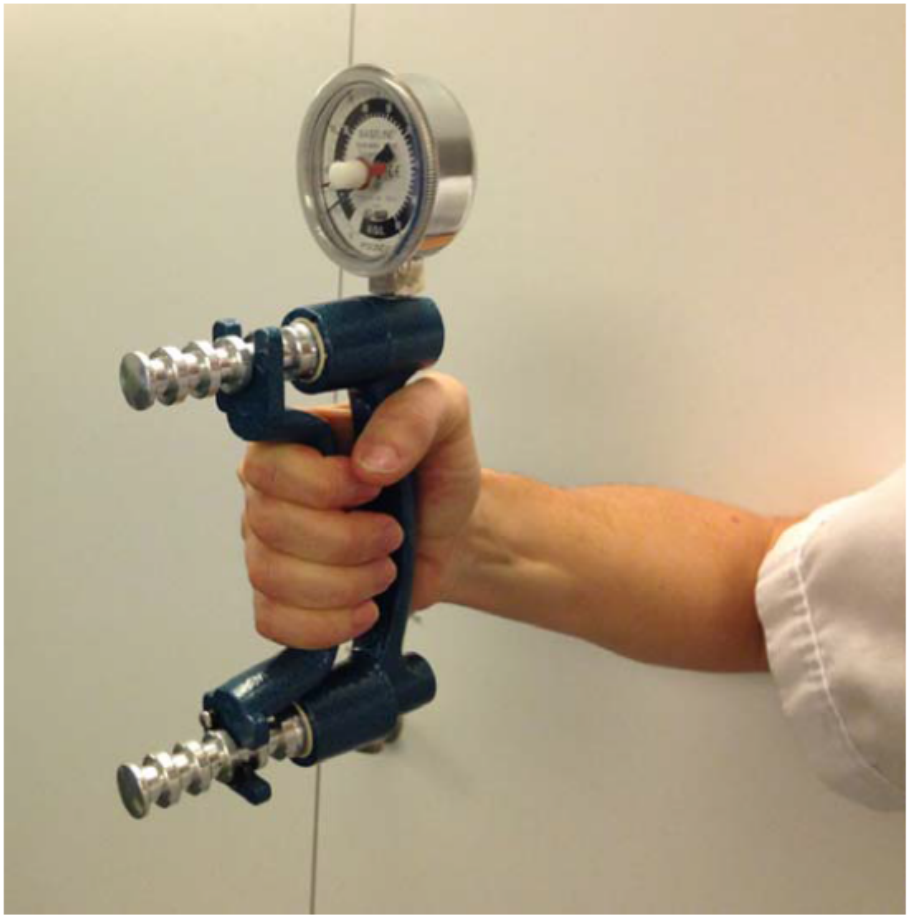


Fig. 1 Dynamomètre à poignée de type "handgrip"

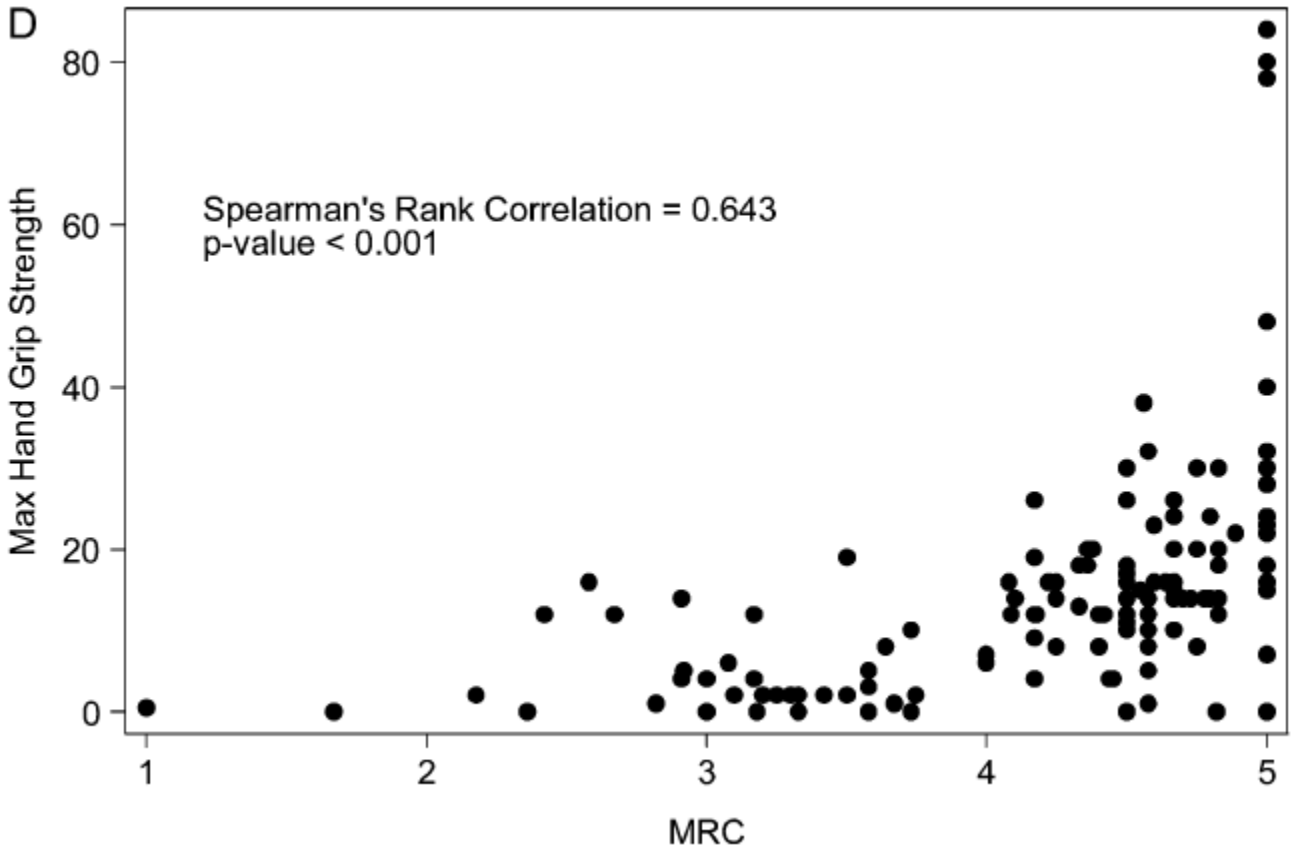
Hand grip test

Fig. 2 Dynamomètre portable de type "handheld". Exemple de positionnement en vue de la mesure de la force du quadriceps

Acquired Weakness, Handgrip Strength, and Mortality in Critically Ill Patients

Naeem A. Ali[1], James M. O'Brien, Jr.[1], Stephen P. Hoffmann[1], Gary Phillips[2], Allan Garland[3], James C. W. Finley[4], Khalid Almoosa[5], Rana Hejal[6], Karen M. Wolf[7], Stanley Lemeshow[8], Alfred F. Connors, Jr.[9], and Clay B. Marsh[1], for The Midwest Critical Care Consortium

Am J Respir Crit Care Med Vol 178. pp 261–268, 2008



Acquired Weakness, Handgrip Strength, and Mortality in Critically Ill Patients

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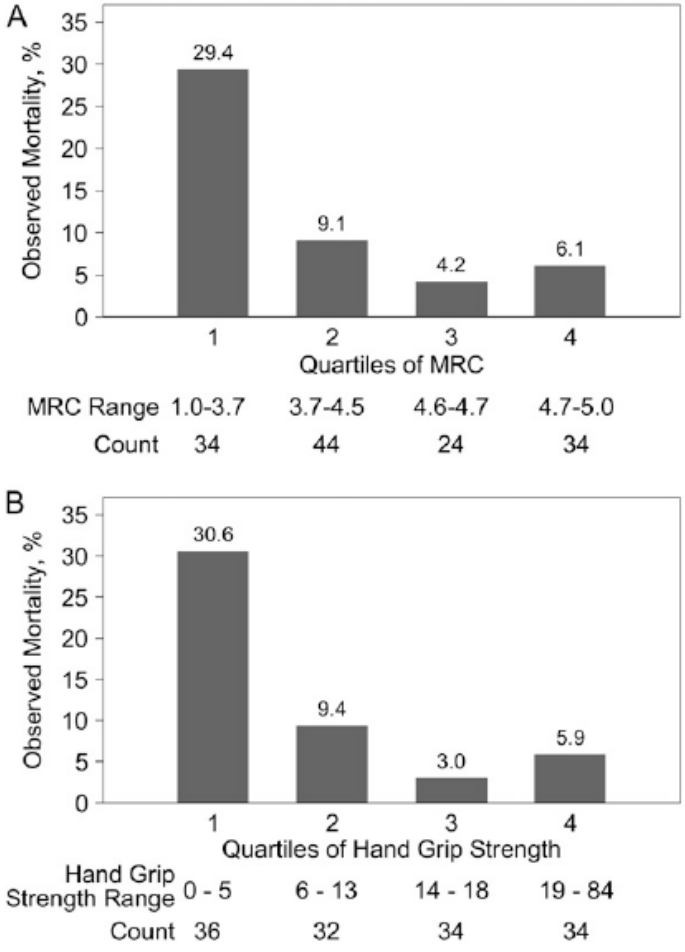
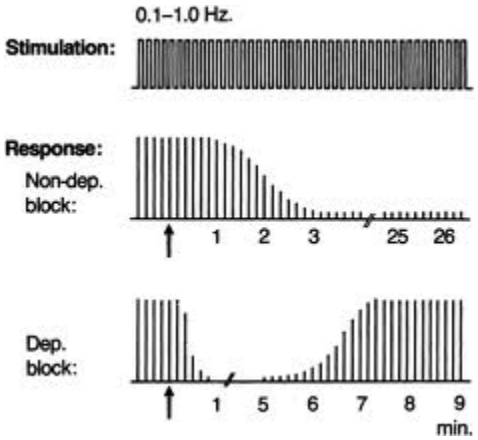


Evaluation biochimique : 3-methylhistidine/ creat urinaire

- Le 3-méthyl-histidinurie est un reflet de la production musculaire, validé par des études isotopiques. La 3-MH est l'un des rares index du catabolisme des protéines myofibrillaires
- L'excrétion de la 3-MH doit être rapportée à la créatininurie des 24 heures pour être indépendante de la masse musculaire. Ainsi, le rapport 3-MH/ créatininurie évalue le pourcentage de la masse musculaire catabolisée par jour : un adulte détruit quotidiennement environ 1% de son capital protéique musculaire.
- La valeur normale de la 3-MH urinaire diffère selon l'âge et le sexe ; cependant, en considérant le rapport 3-MH/créatininurie, on constate un catabolisme identique chez la femme et chez l'homme. De même, ce rapport est identique chez le sujet âgé et chez l'adulte jeune malgré la différence de masse musculaire.
- La mesure de l'excrétion de 3-MH urinaire est donc un index de la protéolyse musculaire globale.

Cynober L, Aussel C. Exploration biologique du statut nutritionnel. Nutrition Clinique et Métabolisme. Volume 18, Issue 1, March 2004, Pages 49-56

Electrophysiology



- Electrical and magnetic neuromuscular twitch stimulation are both nonvolitional muscle strength assessment tools.
- Magnetic or electric stimulation, when applied on maximal output, causes a discharge of a peripheral nerve, eliciting a supramaximal twitch contraction in the muscle it supplies [57,58].
- However, the application of this assessment of limb muscles was limited to hand muscles in ICU patients [58]

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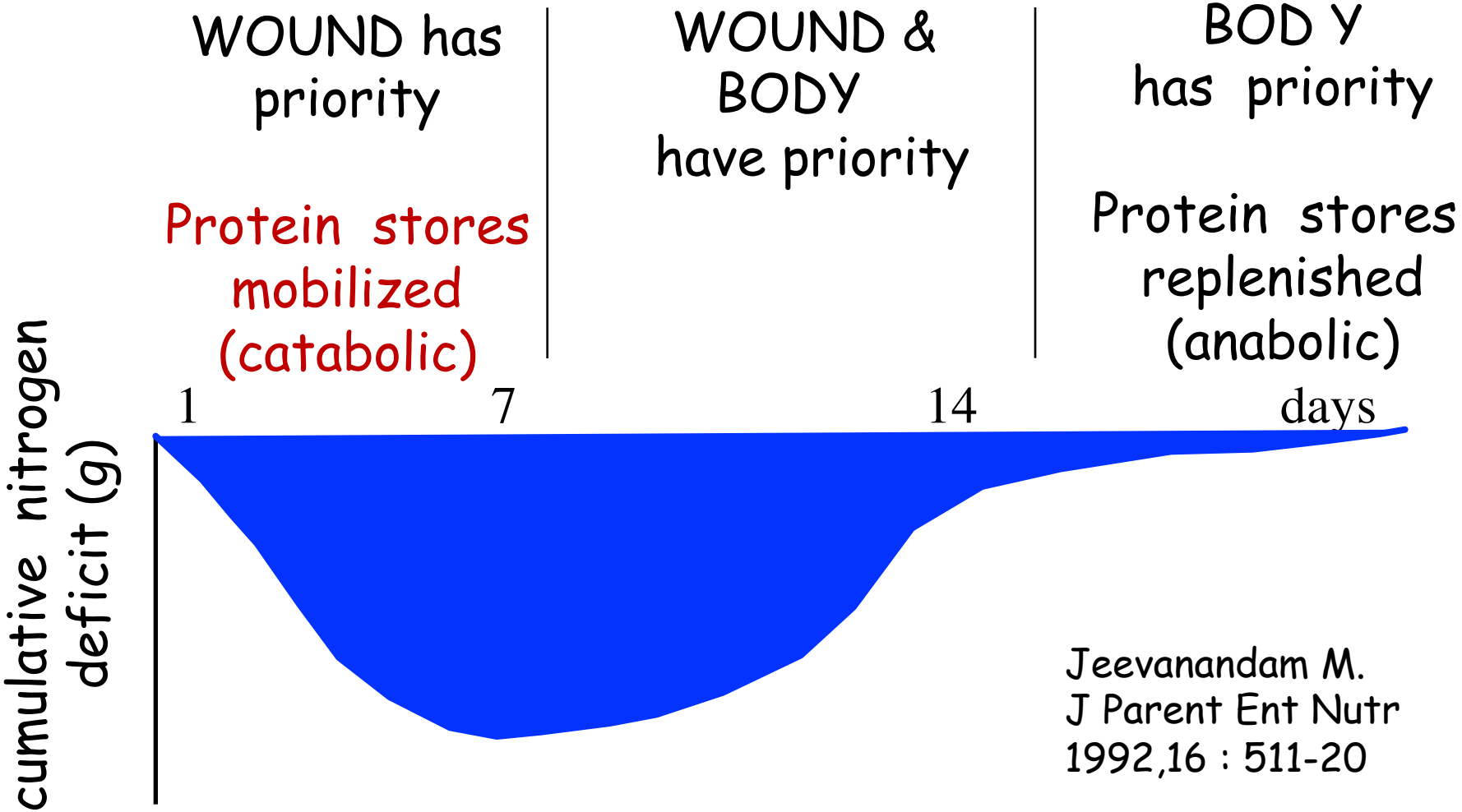
A éviter…

- Sédation prolongée
- Immobilisation
- Hyperglycémie sévère
- Drogues : paralysants musculaires, stéroïdes, aminoglycosides
- Apports calorico-azotés excessifs à la phase aigüe, insuffisants à la phase tardive

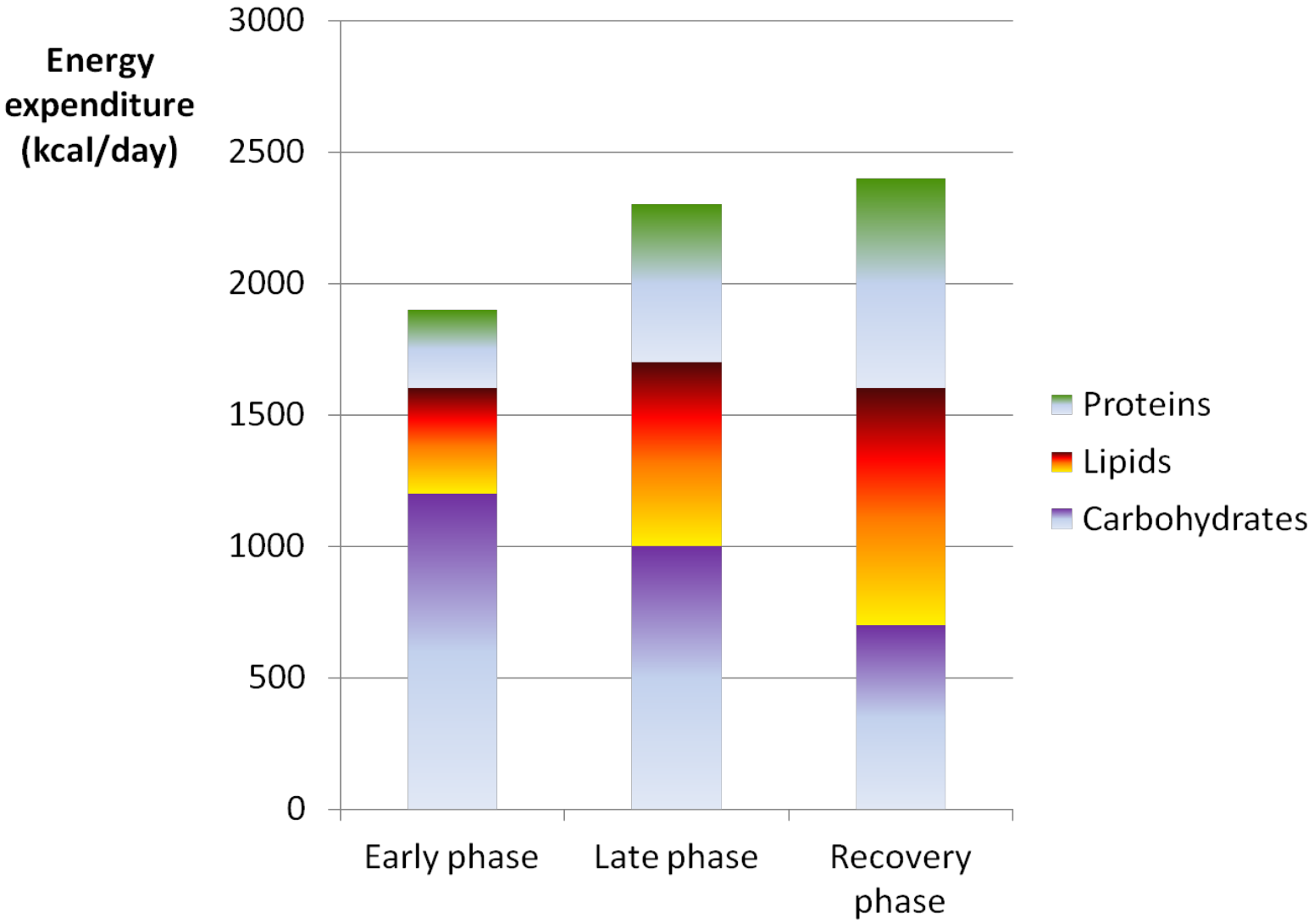
Metabolic response in ICU patients



Jeevanandam M.
J Parent Ent Nutr
1992,16 : 511-20

Energy Estimation and Measurement in Critically Ill Patients

Fraipont V, Preiser JC JPEN 2013;37:705



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.

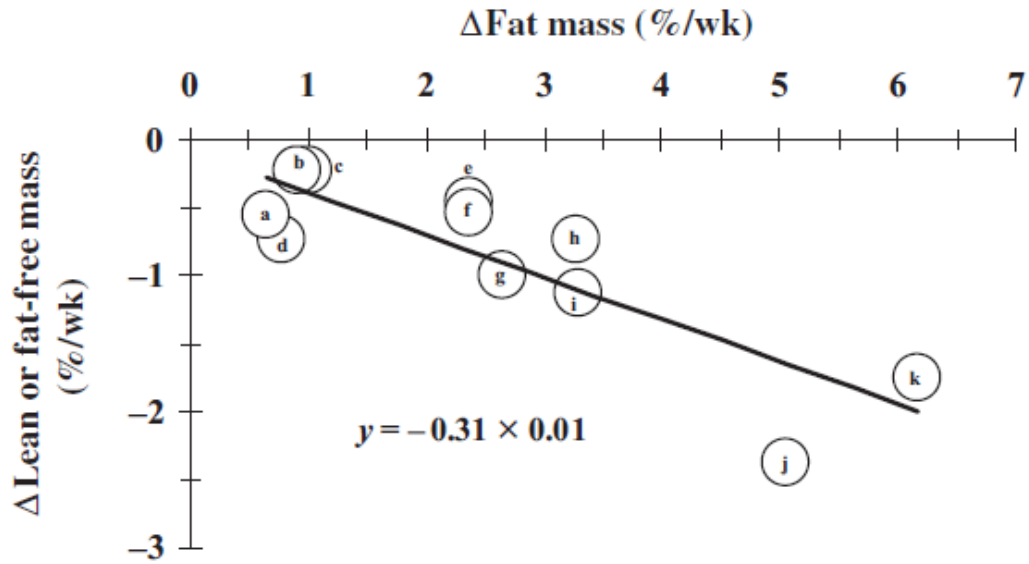


FIGURE 2. Relation between average values of absolute changes in fat mass and lean mass (by dual-energy X-ray absorptiometry) or fat-free mass (by bioelectrical impedance analysis) in previous studies and in the present study. Letters inside (or just outside of) circles represent values from these studies: 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). $r = -0.85$, $P = 0.001$; $n = 11$.

Effect of tolerating macronutrient deficit on the development of intensive-care unit acquired weakness: a subanalysis of the EPaNIC trial

www.thelancet.com/respiratory **Published online September 10, 2013**

Greet Hermans, Michael P Casaer*, Beatrix Clerckx, Fabian Güiza, Tine Vanhullebusch, Sarah Derde, Philippe Meersseman, Inge Derese, Dieter Mesotten, Pieter J Wouters, Sophie Van Gromphaut, Yves Debaveye, Rik Gosselink, Jan Gunst, Alexander Wilmer, Greet Van den Berghe*, Ilse Vanhorebeek**

Incidence of ICU-AW :
Late PN : 105/305 (34%)
Early PN : 127/295 (43%)
p< .05

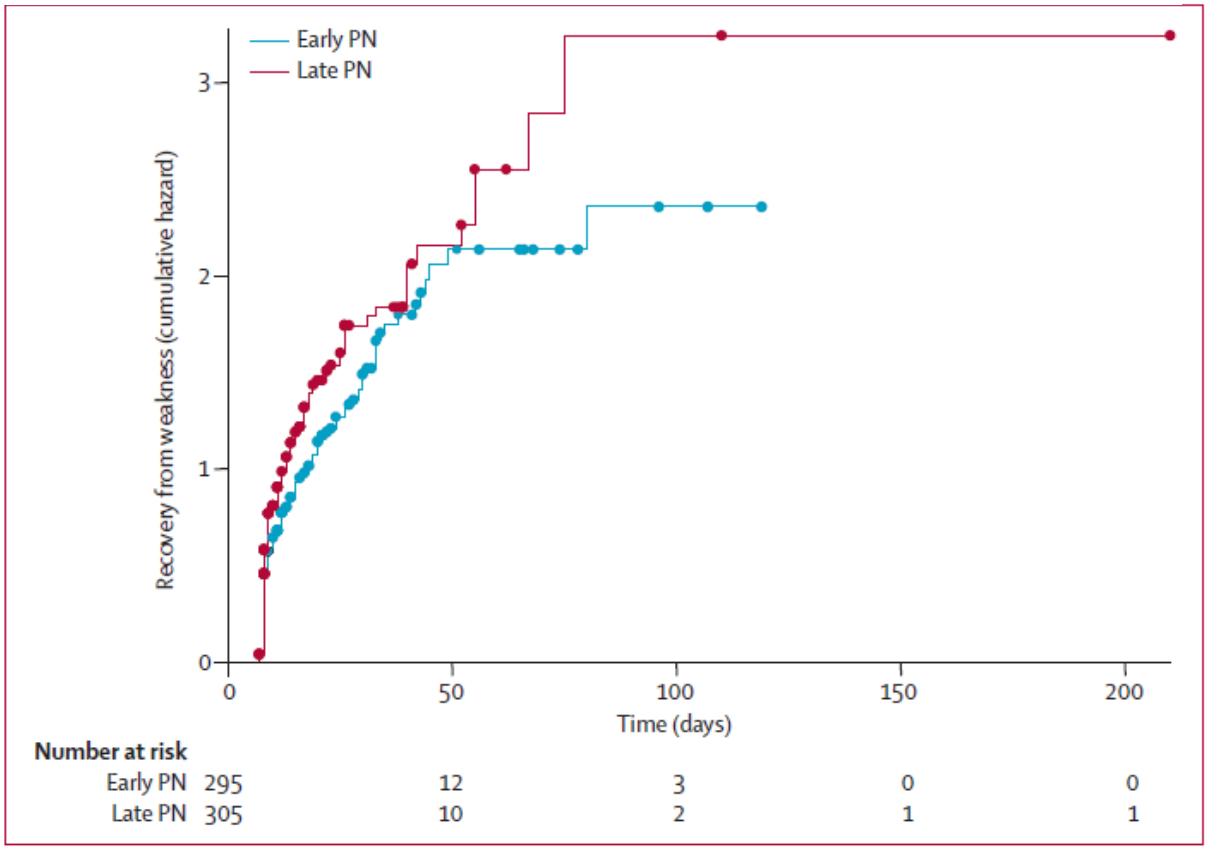


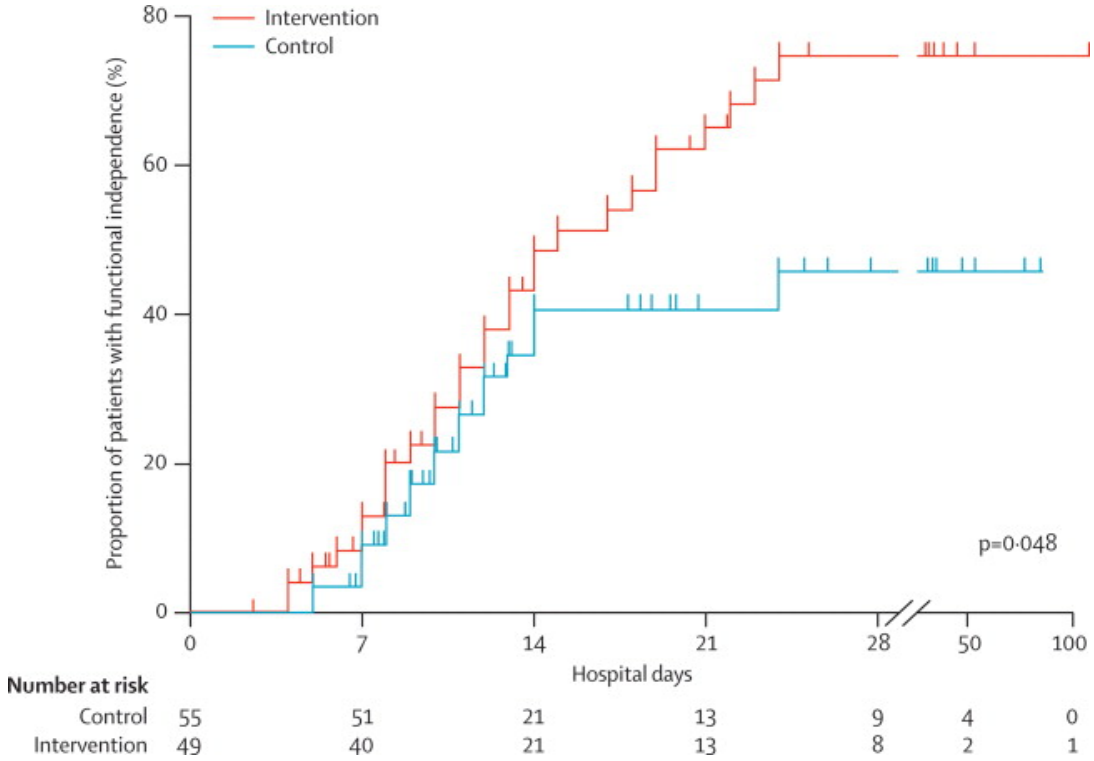
Figure 2: **Kaplan-Meier plot for time to recovery from intensive-care unit acquired weakness**
Cumulative hazard is equal to the negative logarithm of the survival probability. Dots represent patients who never recovered from weakness and were censored at the time of last measurement. Numbers at risk at any timepoint represent patients not yet recovered from weakness and not yet censored for death or discharge before recovery from weakness. PN=parenteral nutrition.

Mobilisation précoce….

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.



Hodgson *et al. Critical Care* 2013, 17:207
http://ccforum.com/content/17/1/207

CRITICAL CARE

REVIEW

Clinical review: Early patient mobilization in the ICU

Carol L Hodgson*[1,2], Sue Berney[3,4], Megan Harrold[5,6], Manoj Saxena[7,8,9] and Rinaldo Bellomo[1]

preliminary low-level evidence suggests that EM in the ICU is safe, feasible and may yield clinical benefits, EM is also labor-intensive and requires appropriate staffing models and equipment. More research is thus required to identify current standard practice, optimal EM techniques and appropriate outcome measures before EM can be introduced into the routine care of critically ill patients.

Case report

Needham JAMA 2008;300:1685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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 ($p < .05$).**

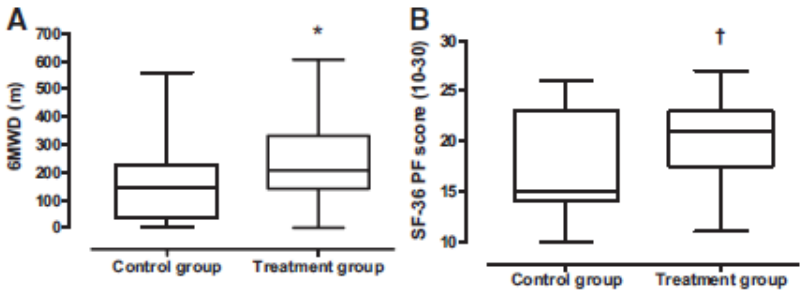


Figure 3. *A*, *Boxplot* of 6MWD at hospital discharge. *6MWD*, 6-min walking distance. *$p < .05$ compared with control group. *B*, *Boxplot* of SF-36 PF score at hospital discharge. *SF-36 PF*, "Physical Function" item of Short Form 36 Health Survey Questionnaire. †$p < .01$ compared with control group.

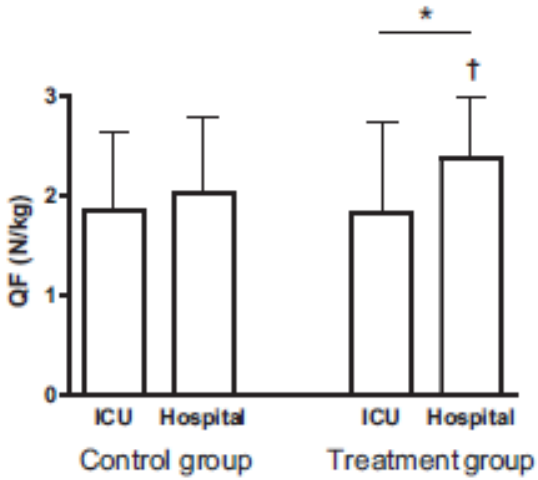


Figure 4. Isometric quadriceps force at intensive care unit (*ICU*) discharge and at hospital discharge. Data are presented as mean and standard deviation. *QF*, quadriceps force; *hospital*, day of hospital discharge. *$p < .01$ between ICU and hospital discharge; †$p < .05$ compared with control group.

HYPOTHESES DE TRAVAIL

Preiser De Prato Harvengt Peters Bastin (soumis)

Etude 1- La mobilisation passive peut-elle

- influencer la masse musculaire (anthropometrique/US)?
- Réduire la protéolyse musculaire (3-MH/creatinine)?

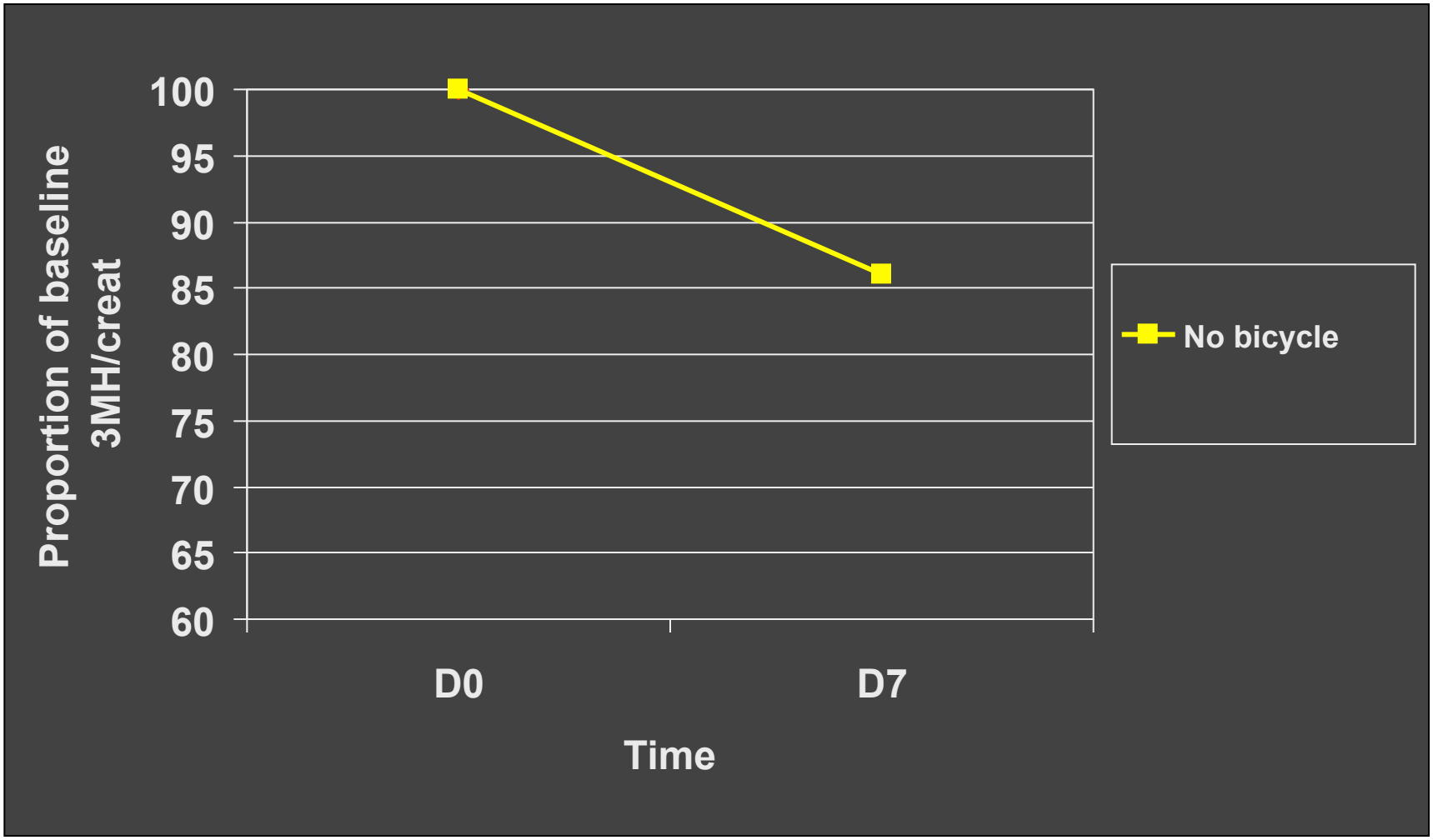
Etude 2- Existe-t-il une relation dose-effet?

Etude 3- Les effets de la mobilisation passive sont-ils majorés par une augmentation des apports calorico-azotés?

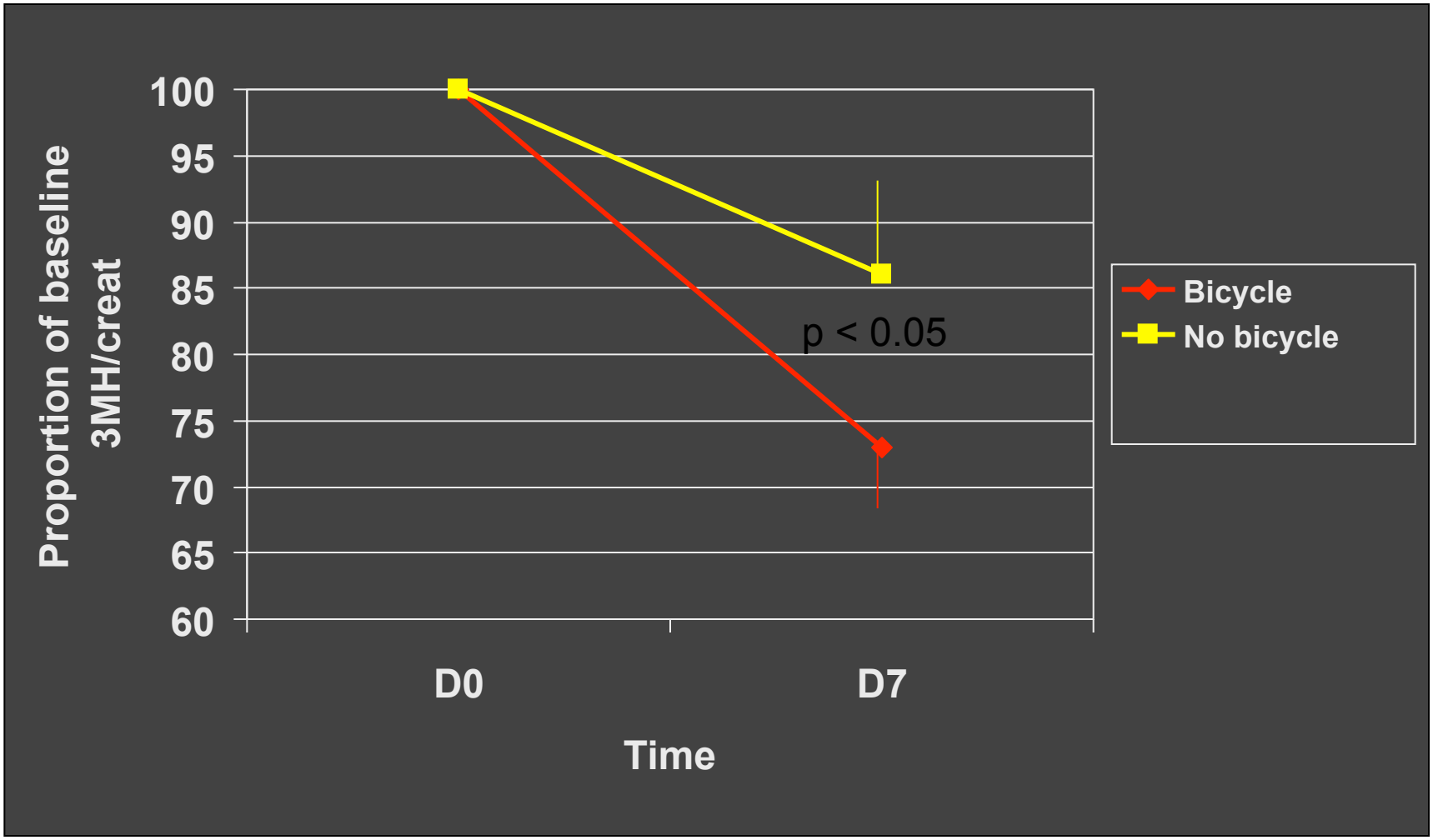
CRITERES D'INCLUSION

- Coma ou sedation anticipée > 10 jours
- Stabilité hémodynamique
- Pas de paralysants musculaire ni contre-indication à la mobilisation passive

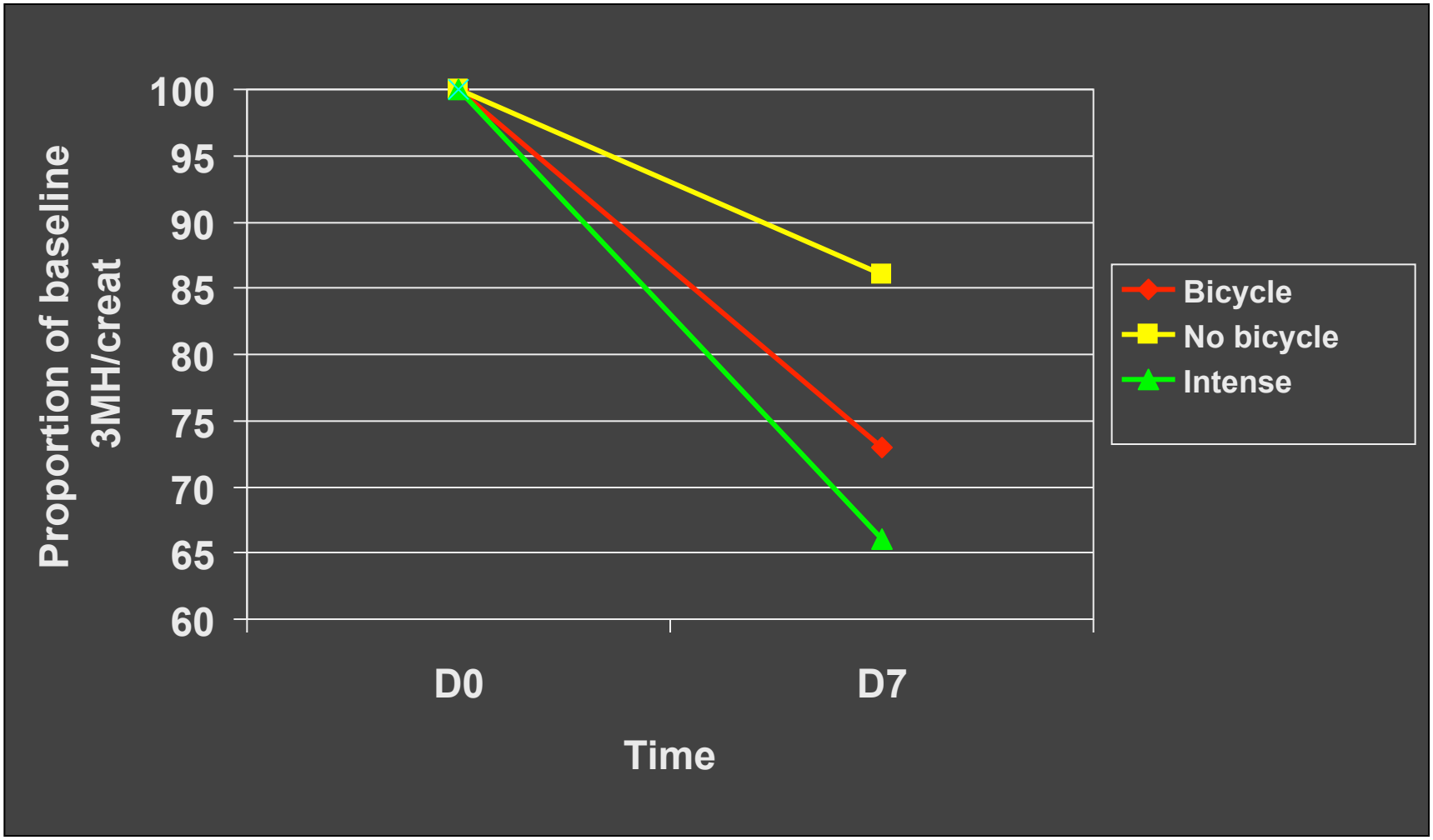
Effects of exercise on muscle protein catabolism



Effects of exercise on muscle protein catabolism



Effects of exercise on muscle protein catabolism

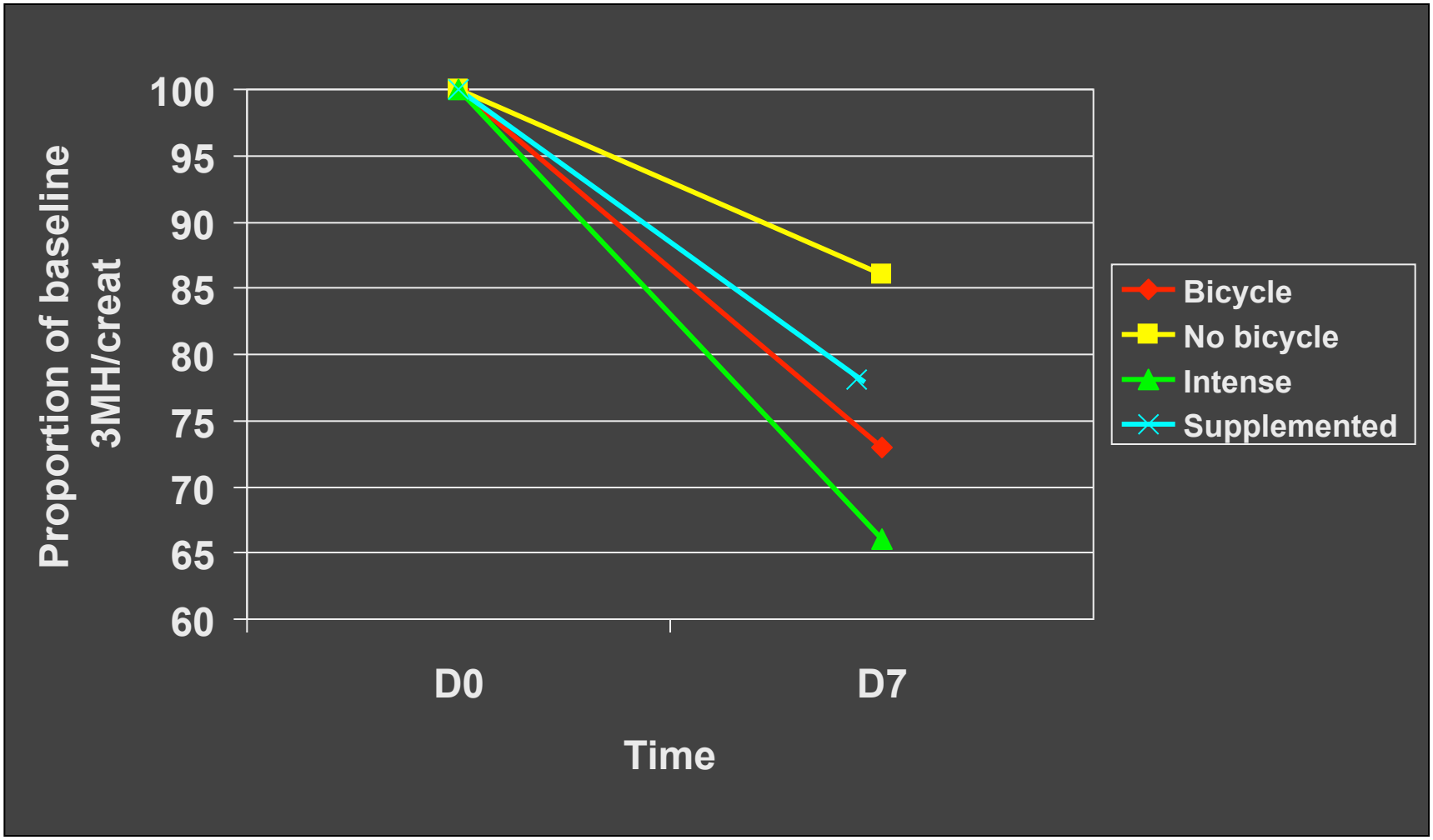


Effet d'un entrainement sur cyclo-ergomètre combiné à un accroissement de l'apport protéo-calorique sur la fonte musculaire
A Harvengt et al

	Calories au total (en kcal)	Protéines au total (en g)	Cal/jour (en kcal)	Prot/jour (en g)
Moyenne pour le groupe contrôle	9680 ± 3845	387 ± 154	1210 ± 481	48 ± 19
Moyenne pour le groupe test	16218 ± 3390	811 ± 169	2027 ± 424	101 ± 21
T-test (p)	0,005	0,0005	0,005	0,0005

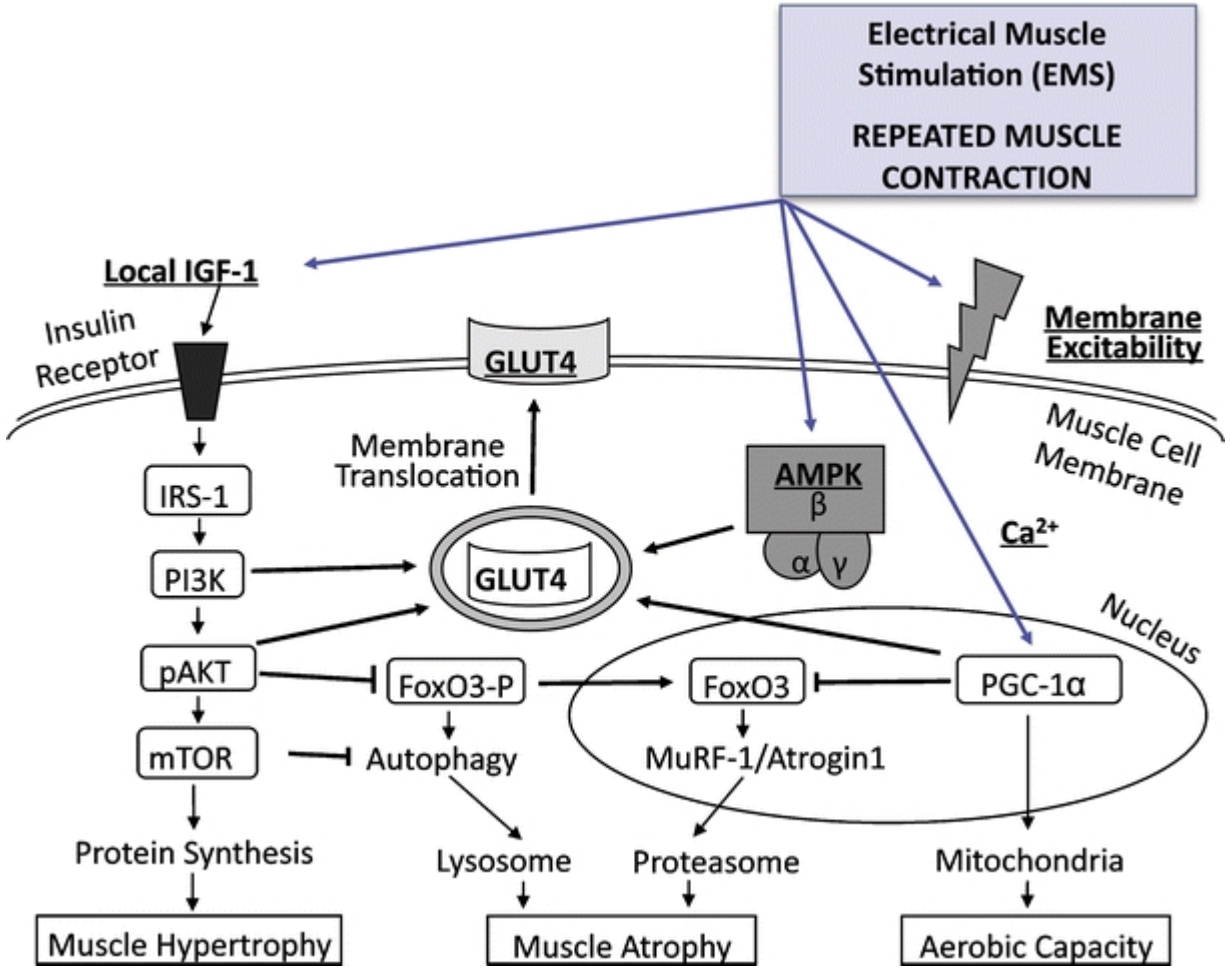
- Groupe test par rapport au groupe contrôle: - x 1,7 pour les calories - x 2,1 pour les protéines

Effects of exercise on muscle protein catabolism



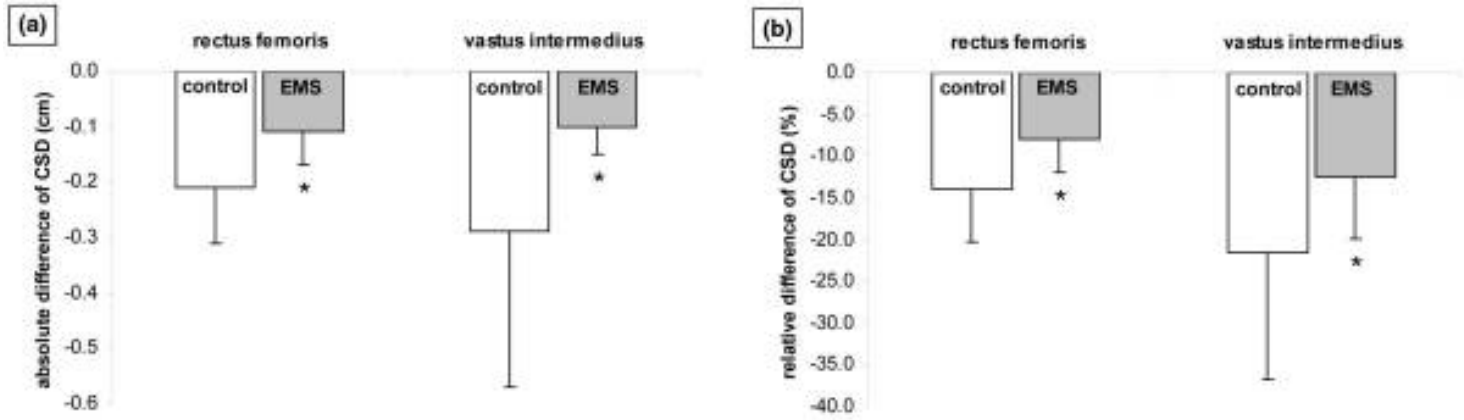
Effects of electrical muscle stimulation

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



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.

Au menu…

- Quel est le problème?
- Modes d'évaluation
  - Morphologique
  - Fonctionnel
- Approches préventives
- Approches thérapeutiques

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 ?

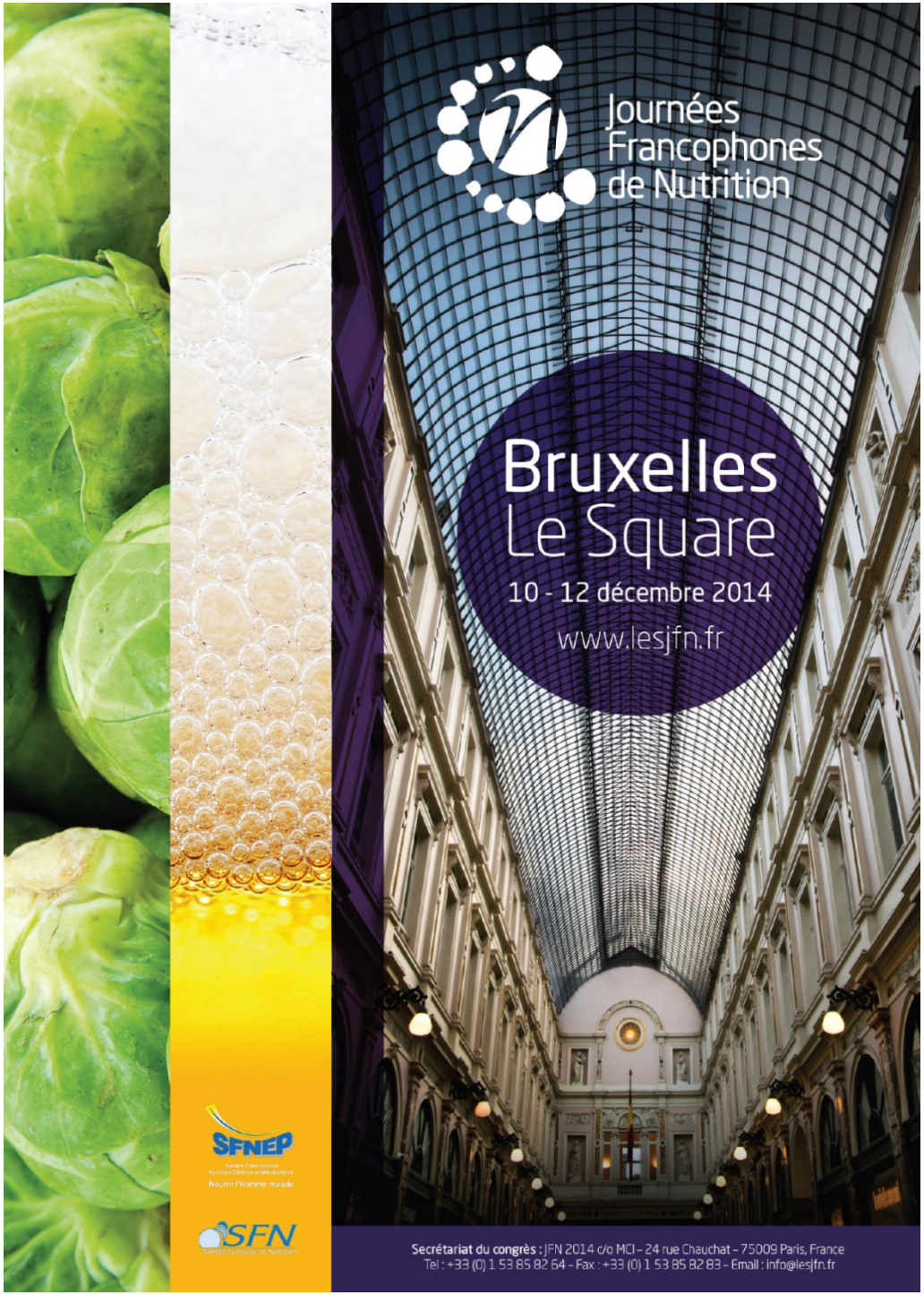
Bricks = proteins

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

Conclusion

Exercise

Nutrition



Programme détaillé en ligne
juin 2014

Ouverture des inscriptions et de la soumission des abstracts
juin 2014

Date limite de soumission des abstracts
12 septembre 2014

WWW.LESJFN.FR