Terapia nutricional obesidade e doente em estado crítico

Não há conflitos de interesse

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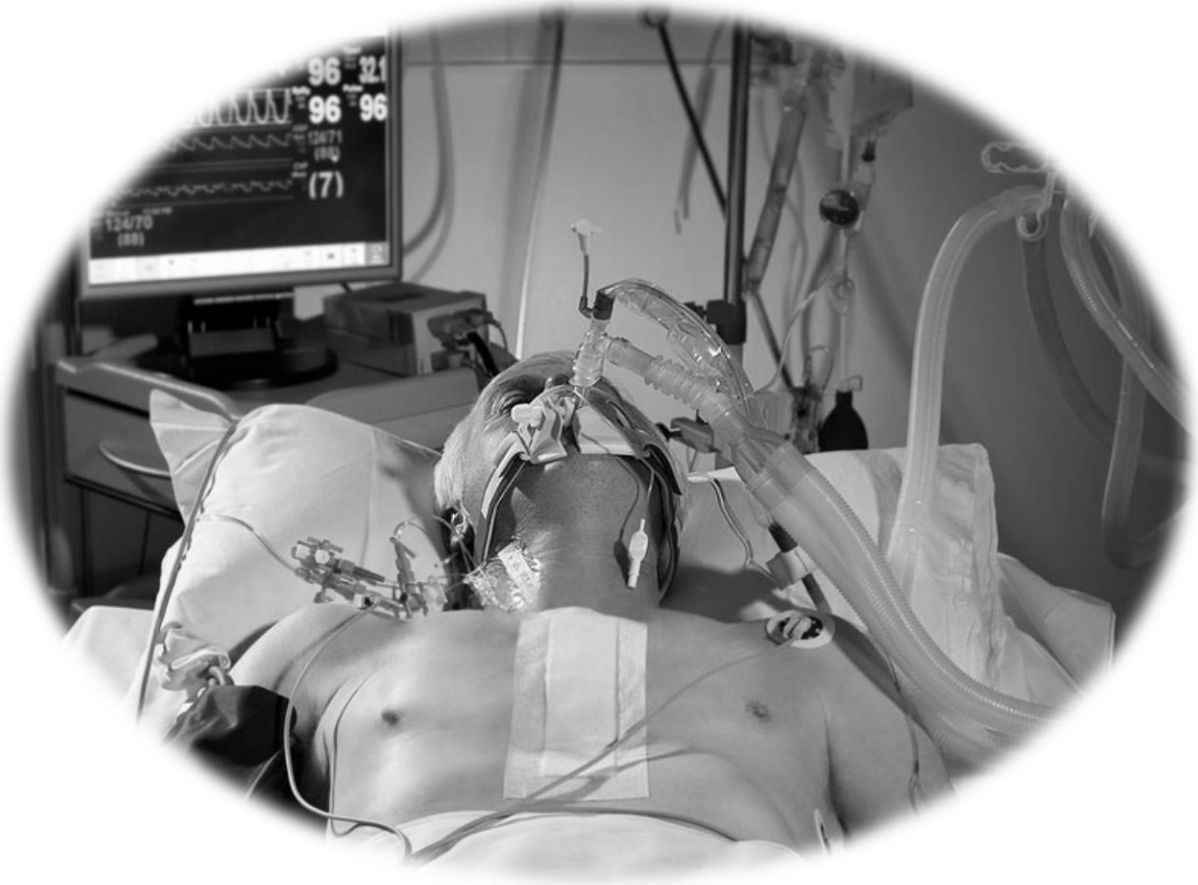
Paciente Crítico



Citocinas

Produção excessiva de Fator Necrose Tumoral alfa e Interleucina 1

↓

Comprometimento da imunidade e disfunção neuroendócrina: alterações metabólicas e aumento gasto energético

↓

Subnutrição proteico-calórica em 7 a 10 dias após admissão

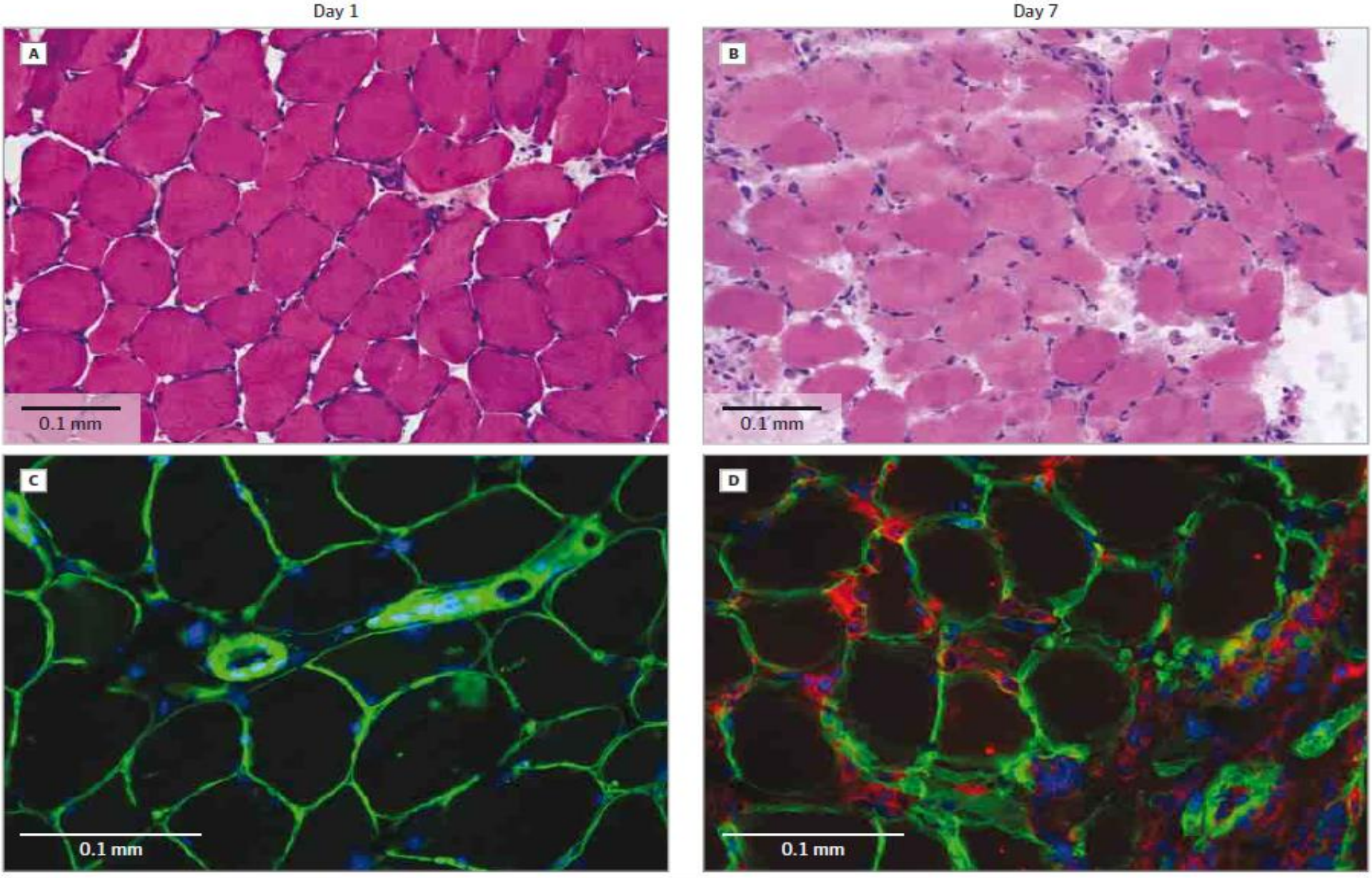
Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Acute Skeletal Muscle Wasting in Critical Illness

Zudin A. Puthucheary, MRCP; Jaikitry Rawal, MRCS; Mark McPhail, PhD; Bronwen Connolly, BSc; Gamunu Ratnayake, MRCP; Pearl Chan, MBBS; Nicholas S. Hopkinson, PhD; Rahul Phadke, FRCPath; Tracy Dew, MSc; Paul S. Sidhu, PhD; Cristiana Velloso, PhD; John Seymour, PhD; Chibeza C. Agley, MSc; Anna Selby, PhD; Marie Limb, PhD; Lindsay M. Edwards, PhD; Kenneth Smith, PhD; Anthea Rowlerson, PhD; Michael John Rennie, PhD; John Moxham, PhD; Stephen D. R. Harridge, PhD; Nicholas Hart, PhD; Hugh E. Montgomery, MD

JAMA. 2013;310(15):1591-1600. doi:10.1001/jama.2013.278481
Published online October 9, 2013.

Figure 4. Muscle Biopsy Specimens From a Representative Patient on Day 1 and Day 7



Healthy 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.

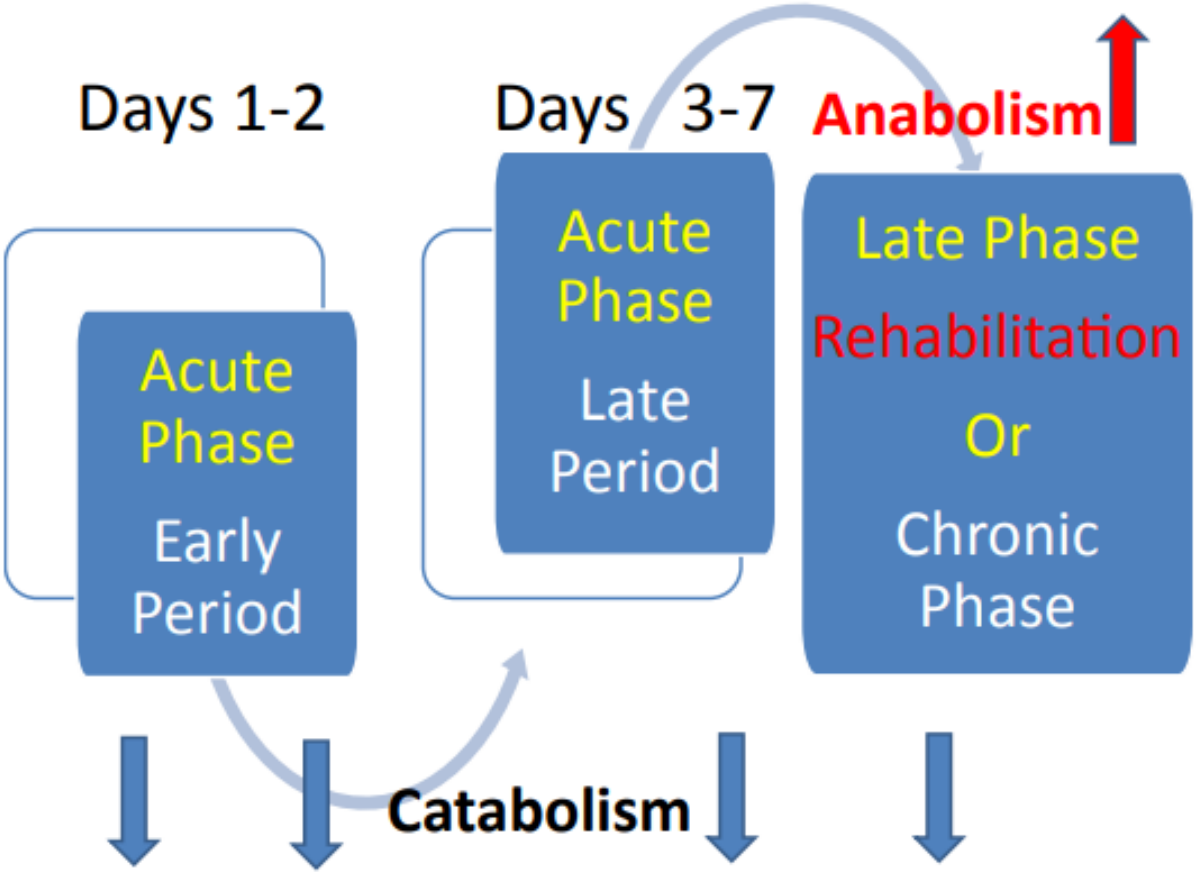
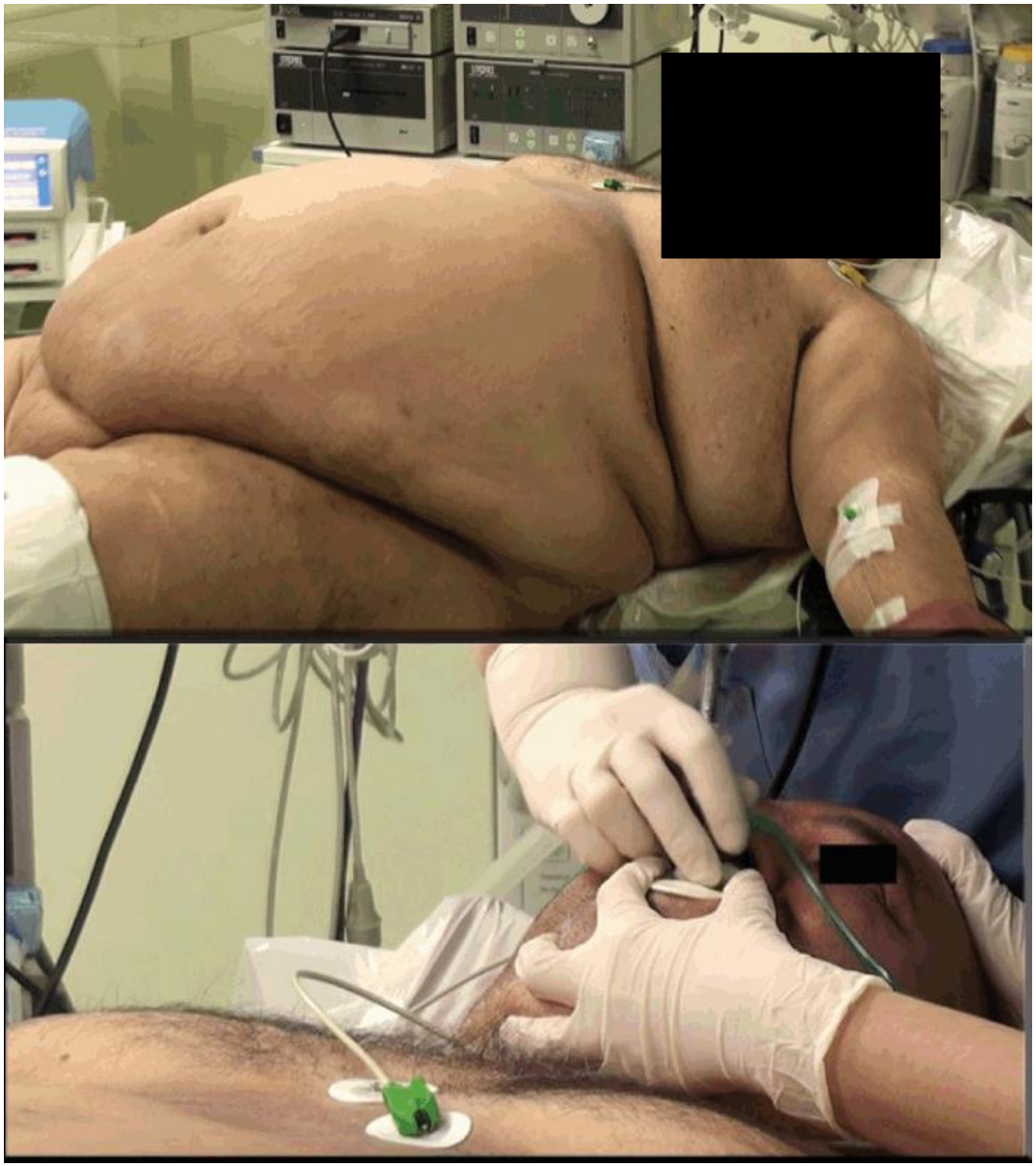


Fig. 2. Description of the acute and late phases following infection/stress/injury. After injury, the acute phase is composed of an early and a late period. Then the post-acute phase can be progressing to convalescence and rehabilitation or chronicity and Prolonged Inflammatory and Catabolic Syndrome (PICS).

Obesidade



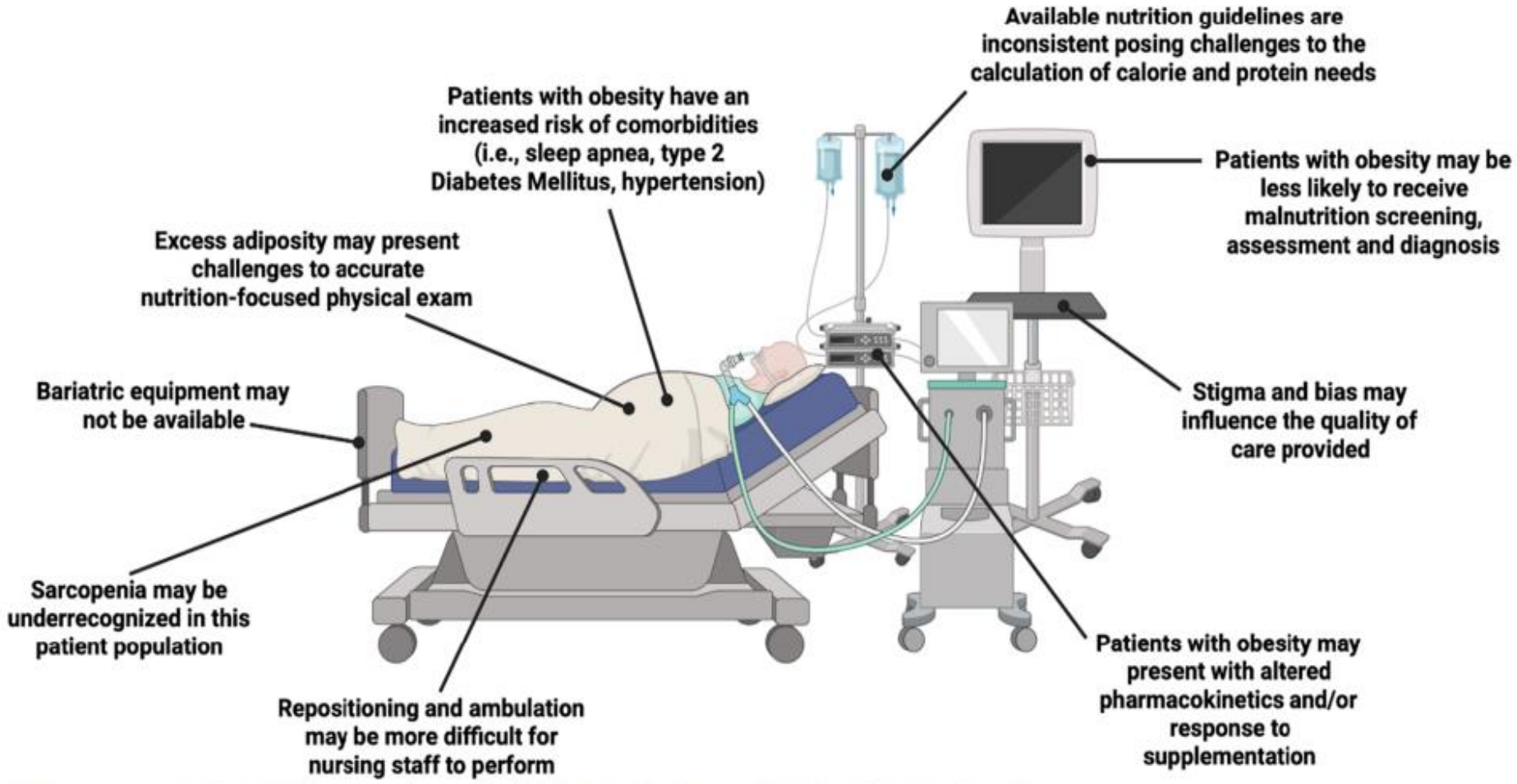


Fig. 1 Factors complicating the care of critically ill patients with obesity. Created with BioRender.com

Identificação: RMS, 50 anos, feminino, do lar, procedente Ribeirão Preto

Diagnósticos principais:

1) Obesidade há 25 anos
2) Diabetes mellitus tipo II (há 15 anos)
3) Acidente vascular encefálico há 2 anos

Internada para tratamento de erisipela em membro inferior esquerdo

Evoluiu com septicemia, intubação orotraqueal, ventilação mecânica

Avaliação antropométrica:

Peso habitual 185 (kg):	IMC (kg/m^2): 68
Altura (m): 1,65	CB (cm): 62 cm

Avaliação laboratorial inicial

Hb (g/dL)	10,8	Prot totais (g/dL)	5,0	Uréia (mg/dL)	30
Linfócitos (/mm^3)	900	Albumina (g/dL)	2,6	Creatinina (mg/dL)	1,0
Glicemia (mg/dL)	250				

Statement 1

Every critically ill patient staying for more than 48 h in the ICU should be considered at risk for malnutrition.

Strong consensus (96% agreement)

Table 5
Thresholds for severity grading of malnutrition into Stage 1 (Moderate) and Stage 2 (Severe) malnutrition according to the recent ESPEN GLIM recommendations [23].

	Phenotype criteria			Etiology criteria	
	Weight loss (%)	Body mass index (kg/m^2)	Muscle mass[a]	Food intake, malabsorption or GI symptoms	Disease burden/ inflammation
Stage 1/Moderate Malnutrition (Requires 1 phenotypic and 1 etiologic criterion)	5–10% within the past 6 mo, or 10–20% beyond 6 mo	<20 if <70 yr, <22 if ≥70 yr Asia:<18.5 if <70 yr, <20 if ≥70 yr	Mild to moderate deficit (per validated assessment methods – see below)	Any reduction of intake below ER for >2 weeks, or moderate mal-absorption/GI symptoms[b]	Acute disease/injury[d], or chronic disease-related[e]
Stage 2/Severe Malnutrition (Requires 1 phenotypic and 1 etiologic criterion)	>10% within the past 6 mo, or >20% beyond 6 mo	<18.5 if <70 yr, <20 if ≥70 yr Asia: TBD	Severe deficit (per validated assessment methods – see below)	≤50% intake of ER for >1 week, or severe mal-absorption/GI symptoms[c]	Acute disease/injury[d], or chronic disease-related[e]

GI = gastro-intestinal, ER = energy requirements, yr = year, mo = month.

[a] For example fat free mass index (FFMI, kg/m^2) by dual-energy absorptiometry or corresponding standards using other body composition methods like bioelectrical impedance analysis (BIA), CT or MRI. When not available or by regional preference, physical exam or standard anthropometric measures like mid-arm muscle or calf circumferences may be used. Thresholds for reduced muscle mass need to be adapted to race (Asia). Functional assessments like hand-grip strength may be used as a supportive measure.

[b] Gastrointestinal symptoms of moderate degree – dysphagia, nausea, vomiting, diarrhea, constipation or abdominal pain.

[c] Gastrointestinal symptoms of severe degree – dysphagia, nausea, vomiting, diarrhea, constipation or abdominal pain.

[d] Acute disease/injury-related with severe inflammation. For example major infection, burns, trauma or closed head injury.

[e] Chronic disease-related with chronic or recurrent mild to moderate inflammation. For example malignant disease, chronic obstructive pulmonary disease, congestive heart failure, chronic renal disease or any disease with chronic or recurrent Inflammation. CRP may be used as a supportive laboratory measure.

NUTRIC

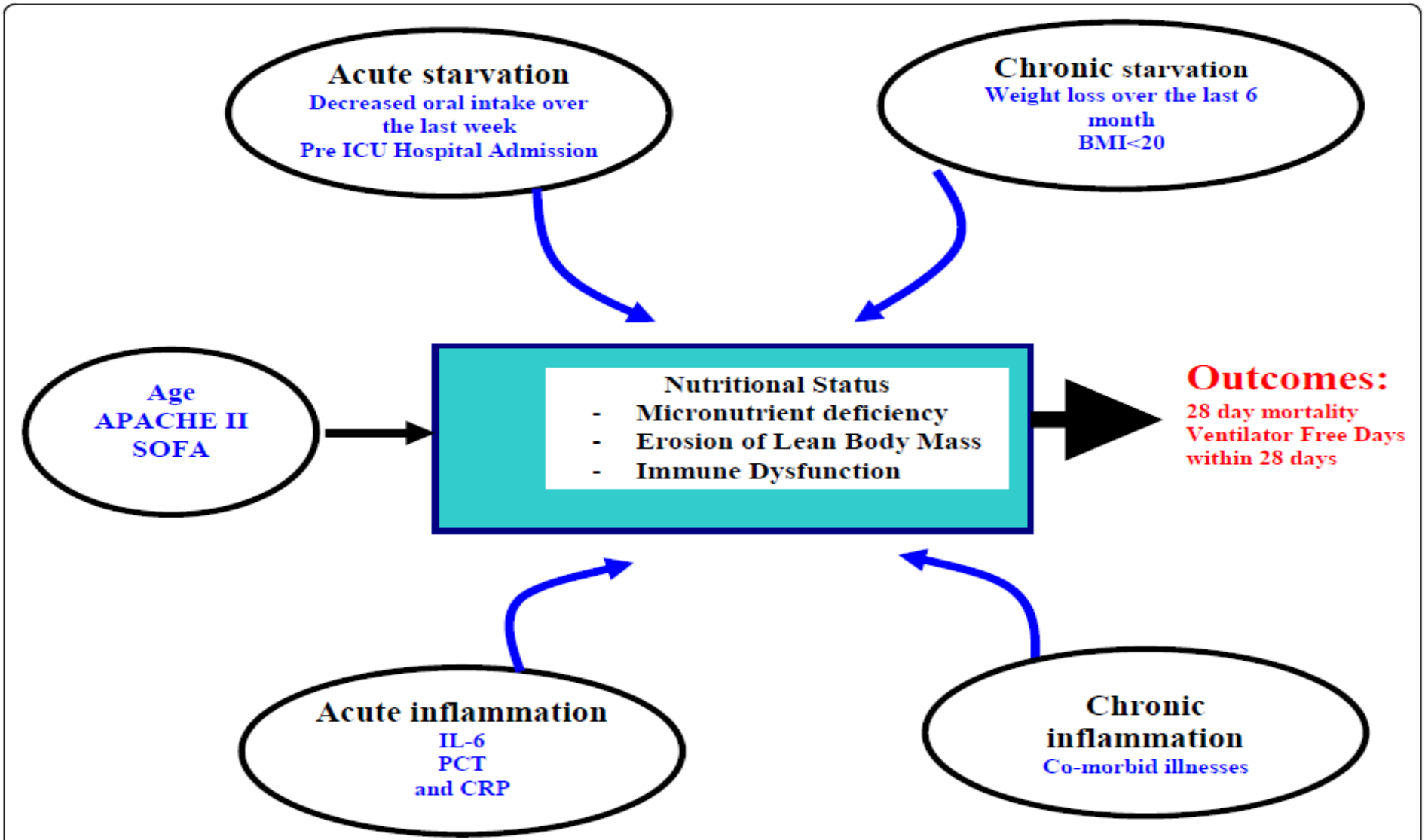


Figure 1 Conceptual model for nutrition risk assessment in the critically ill. APACHE, Acute physiology and chronic health evaluation score; BMI, body mass index; CRP, C-reactive protein; IL-6, interleukin 6; PCT, procalcitonin; SOFA, sequential organ failure assessment score.

NUTRIC

Table 1: NUTRIC Score variables

Variable	Range	Points
Age	<50	0
	50 - <75	1
	≥75	2
APACHE II	<15	0
	15 - <20	1
	20-28	2
	≥28	3
SOFA	<6	0
	6 - <10	1
	≥10	2
Number of Co-morbidities	0-1	0
	≥2	1
Days from hospital to ICU admission	0 - <1	0
	≥1	1
IL-6	0 - <400	0
	≥ 400	1

NUTRIC

Table 1: NUTRIC Score variables

Variable	Range	Points
Age	<50	0
	50 - <75	1
	≥75	2
APACHE II	<15	0
	15 - <20	1
	20-28	2
	≥28	3
SOFA	<6	0
	6 - <10	1
	≥10	2
Number of Co-morbidities	0-1	0
	≥2	1
Days from hospital to ICU admission	0 - <1	0
	≥1	1
IL-6	0 - <400	0
	≥ 400	1

Table 2: NUTRIC Score scoring system: if IL-6 available

Sum of points	Category	Explanation
6-10	High Score	➢ Associated with worse clinical outcomes (mortality, ventilation). ➢ These patients are the most likely to benefit from aggressive nutrition therapy.
0-5	Low Score	➢ These patients have a low malnutrition risk.

Table 3. NUTRIC Score scoring system: If no IL-6 available*

Sum of points	Category	Explanation
5-9	High Score	➢ Associated with worse clinical outcomes (mortality, ventilation). ➢ These patients are the most likely to benefit from aggressive nutrition therapy.
0-4	Low Score	➢ These patients have a low malnutrition risk.

*It is acceptable to not include IL-6 data when it is not routinely available; it was shown to contribute very little to the overall prediction of the NUTRIC score.

Recommendation 5

If oral intake is not possible, early EN (within 48 h) shall be performed/initiated in critically ill adult patients rather than early PN

Grade of recommendation: A – strong consensus (100% agreement)

Recommendation 6

In case of contraindications to oral and EN, PN should be implemented within three to seven days

Grade of recommendation: B – consensus (89% agreement)

Recommendation 7

Early and progressive PN can be provided instead of no nutrition in case of contraindications for EN in severely malnourished patients.

Grade of Recommendation: 0 – strong consensus (95% agreement)

Recommendation 8

To avoid overfeeding, early full EN and PN shall not be used in critically ill patients but shall be prescribed within three to seven days.

Grade of recommendation: A – strong consensus (100% agreement)

Recommendation 9

Continuous rather than bolus EN should be used.

Grade of recommendation: B – strong consensus (95% agreement)

In patients deemed to be at high risk for aspiration, post-pyloric, mainly jejunal feeding can be performed.

Grade of recommendation: GPP – strong consensus (95% agreement)

Recommendation 52

In obese patients, energy intake should be guided by indirect calorimetry.

Protein delivery should be guided by urinary nitrogen losses or lean body mass determination (using CT or other tools).

If indirect calorimetry is not available, energy intake can be based on "adjusted body weight".

If urinary nitrogen losses or lean body mass determination are not available, protein intake can be 1.3 g/kg "adjusted body weight"/d.

Grade of recommendation: GPP – consensus (89% agreement)

Several authors advocate a controlled undernutrition of obese subjects while providing a relatively larger dose of protein between 2 and 2.5 g/kg/day (ideal body weight as reference) [339]. An observed 2.7 kg weight loss per week was considered to be advantageous when nitrogen balance could be achieved. It remains unclear whether overweight and obese critically ill patients have a higher nitrogen loss than patients with a normal BMI when adjusted for actual lean body mass.

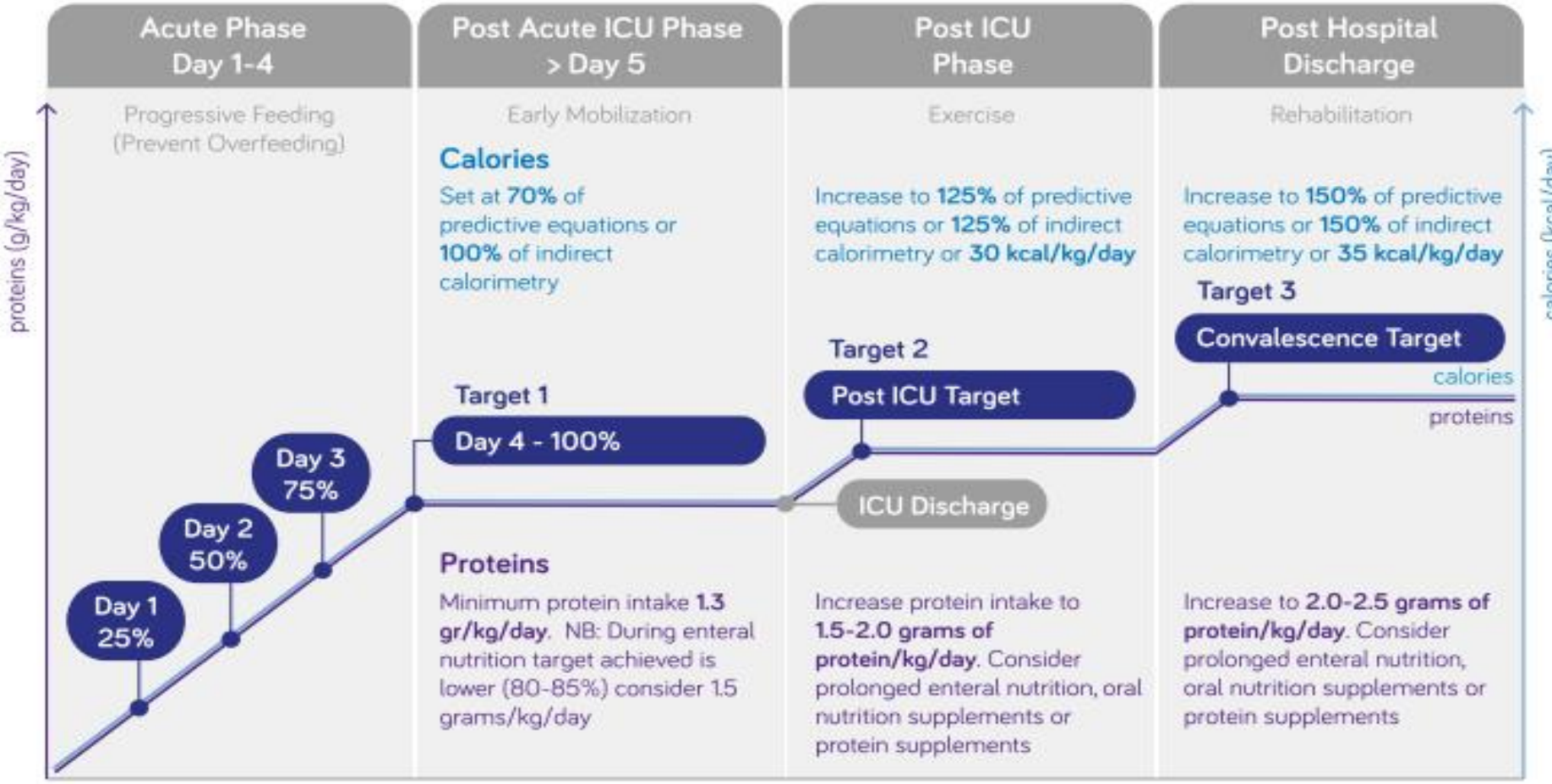
Questões:

1- Qual a terapia nutricional indicada nesse momento?

2- Quais as ofertas calóricas mínima e máxima?

3- Quais as ofertas proteicas mínima e máxima?

4- Qual dieta ou formulação seria indicada nesse momento?



Recommendations

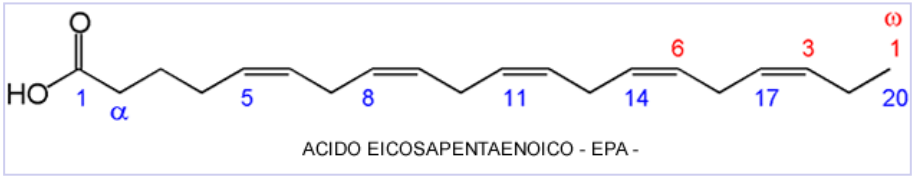
	Adjust caloric intake for non-nutritional calories from: glucose, propofol and citrate	Patients are at-risk for reductions in caloric intake after cessation of enteral nutrition	Patients are at-risk for prolonged reduced caloric intake consider the use of oral nutrition supplements
	When feeding is reduced to prevent overfeeding due to non-nutritional calories, use very-high protein feeds or protein supplements	Patients are at-risk for reductions in protein intake after cessation of enteral nutrition and feeding tube removal	Patients are at-risk for prolonged reduced protein intake consider the use of oral nutrition supplements

Imunonutrição

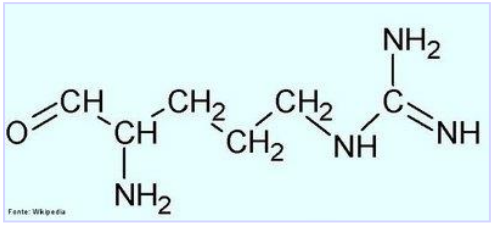
- **Definição**
  - Adição de nutrientes epecíficos em concentrações maiores do que as usuais em nutrição enteral e parenteral para modular a função imune e melhorar desfecho
- **Objetivos:**
  - Modular resposta inflamatória
  - Contrabalançar alterações do sistema imune no pós operatório

Mizock BA, Nutrition 26 (2010) 701–707

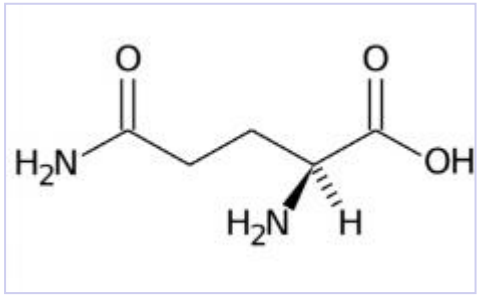
Imunonutrientes



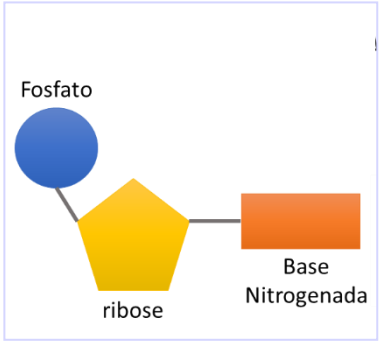
Ácido graxo ômega-3



Arginina

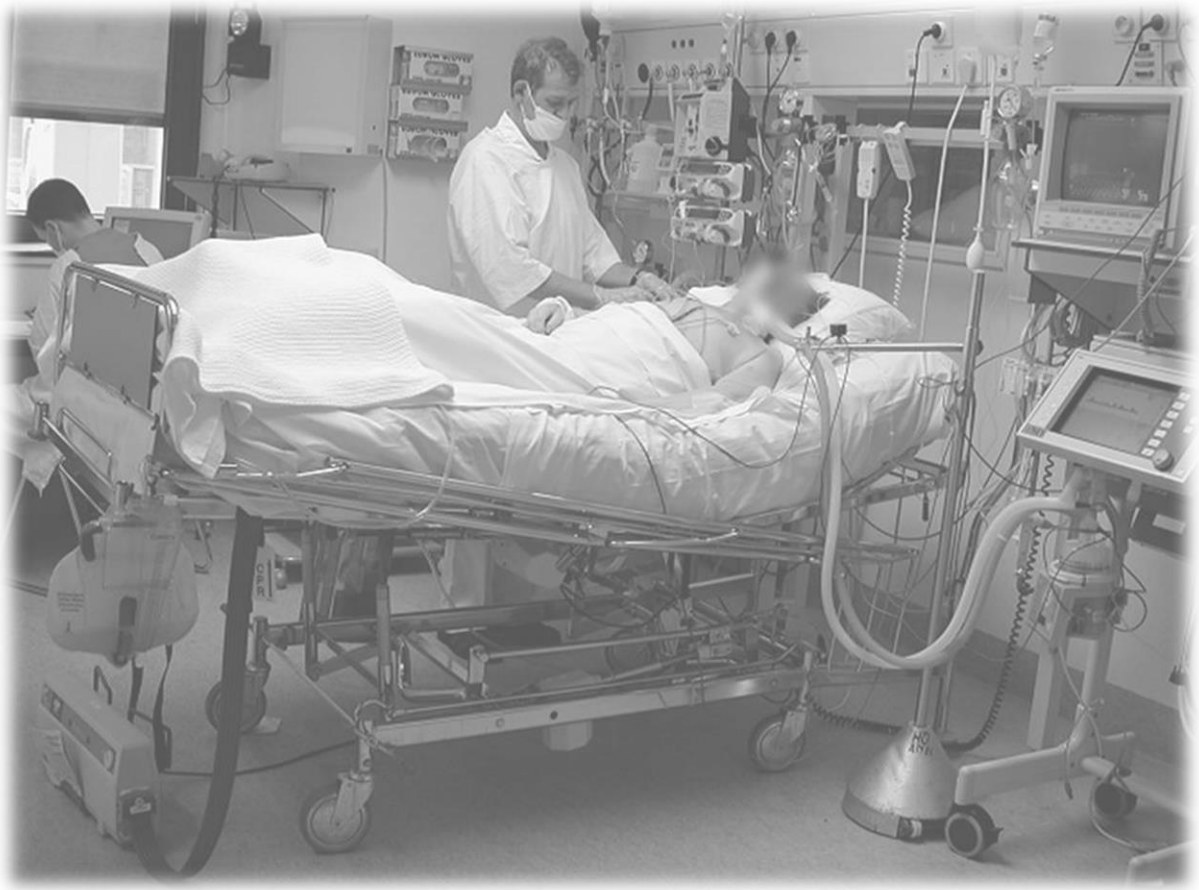


Glutamina



Nucleotídeo

Paciente crítico?



Imunonutrição

- Após trauma:
- Resposta imune: aumento produção mediadores inflamatórios (citocinas) no local da injúria
- Objetivo: restaurar a homeostase: resposta inflamatória precoce fisiológica
- Infecção persistente ou fonte adicional de infecção: aumento da desordem immune local e sistêmica (SIRS)
- Sepsis e falência de múltiplos órgãos
- Apoptose das células imunes macrófagos, neutrófilos e linfócitos: imunossupressão (CARS): Síndrome da resposta compensatória sistêmica

Gentile LF et al, J Trauma Acute Care Surg 72: 1491-1501
Gogos CA et al, J Infect Dis 181: 176-180.

SIRS

Figure 1. The Systemic Inflammatory Response Syndrome (SIRS).[8]

Two or more of the following:

- Temperature >38° C or <36° C
- Heart rate >90 beats/min
- Respiratory rate >20 breaths/min or $PaCO_2$<32 torr
- WBC >12,000 cell/mm^3, <4,000 cells/mm^3, or >10% immature (band) forms

Members of the American College of Chest Physicians / Society of Critical Care Medicine Consensus Conference Committee Definitions for Sepsis and Organ Failure and Guidelines for the Use of Innovative Therapies in Sepsis. Crit Care Med. 1992;20:864–874.

CARS

Box 1 Characterization of compensatory anti-inflammatory response syndrome

Cellular/molecular elements

Lymphocyte dysfunction (ie, reduced proliferative and/or type 1 helper T-cell [Th1] cytokine production in response-defined antigens or specific T-cell stimuli)

Lymphocyte Apoptosis

Down-regulation of monocyte HLA receptors Monocyte deactivation (ie, reduced Th1/ proinflammatory cytokine production in response stimuli)

IL-10 production

Transforming growth factor-beta production Prostaglandin E2 production

Clinical elements

Cutaneous anergy

Hypothermia

Leukopenia

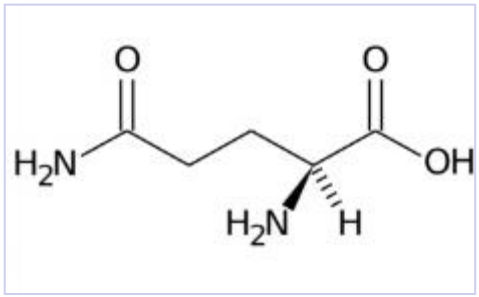
Susceptibility to infection

Failure to clear infection

Ward N et al,Clin Chest Med. 2008 December ; 29(4): 617

Glutamina

- Aminoácido livre mais abundante no organismo humano
- No músculo esquelético: 50% *pool* de aminoácidos livres
- No stress catabólico (trauma, sepse, queimadura): depleção rápida dos estoques de glutamina
- No stress: condicionalmente essencial
- Substrato para intestino, células imunes e rins



Wischmeyer PE. Crit Care Med 2007;35(suppl):S541–4.

Glutamina

- Efeitos benéficos
  - Antioxidante (precursos de glutationa)
  - Indução síntese *heat shock proteins*
  - Manutenção função barreira intestinal
  - Substrato para os enterócitos
  - Substrato energético para linfócitos e neutrófilos
  - Estímulo sintese nucleotídeos

Wischmeyer PE. Crit Care Med 2007;35(suppl):S541–4.

Glutamina

- Pacientes cirurgia eletiva: reduziu complicações infecciosas e tempo de internação hospitalar
- Resultados positivos em pacientes críticos: redução de complicações e taxa de mortalidade
- Maiores efeitos: dipeptideo L-alanil-glutamina em dose > 0,20 g/kg, via parenteral

Wischmeyer PE. Crit Care Med 2007;35(suppl):S541–4.

Novak F et al, Crit Care Med 2002;30:2022–9.

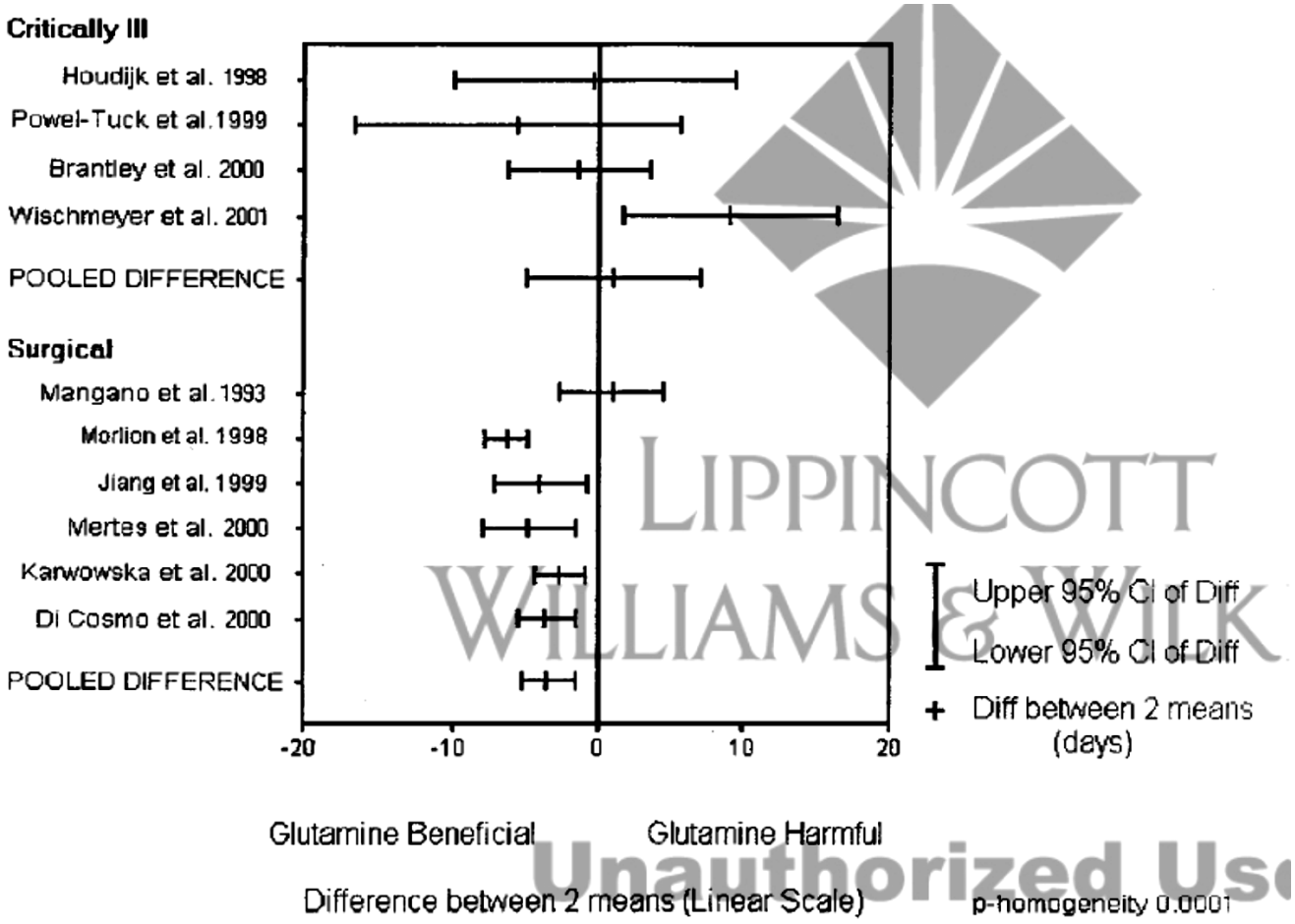


Figure 1. Differences between two means and associated 95% confidence intervals (*CI*) for the effect of glutamine on hospital length of stay.

Novak F et al, Crit Care Med 2002 Vol. 30, No. 9

Arginina

- Aminoácido condicionalmente essencial: trauma, pós operatório
- Secretagogo: liberação hormônios anabólicos
- Função imune: linfócitos T
- Melhora cicatrização: via metabolismo de poliaminas e prolina
- Após trauma grave ou grande cirurgia: deficiência de arginina por liberação de arginase pelos neutrófilos
- **Deficiência de arginina: piora função receptor de linfócitos**

Bansal V, Ochoa JB. Curr Opin Clin Nutr Metab Care 2003;6:223–8.
Popovic PJ et al, J Nutr 2007; 137(suppl):1681S–6.
Ochoa JB et al, Nutr Clin Pract 2004;19:216–25.
Munder M et al, Blood 2006;108:1627–34.

Arginina

- **Cuidado!!!**
- Efeitos benéficos da suplementação: estágios precoces da sepsis
- Pacientes com APACHE II < 15
- **Por que?**
- Aumento produção óxido nítrico
- Metabolizado em peroxinitrito
- Substância oxidante: dano mitocôndria, aumento permeabilidade intestinal e disfunção de órgãos

Pacher P et al, Physiol Rev 2007;87:315–424.
Fink MP, Delude RL.. Crit Care Clin 2005;21:177–96.
Bistrian BR, McCowen KC. Crit Care Med 2006;34:1525–31.

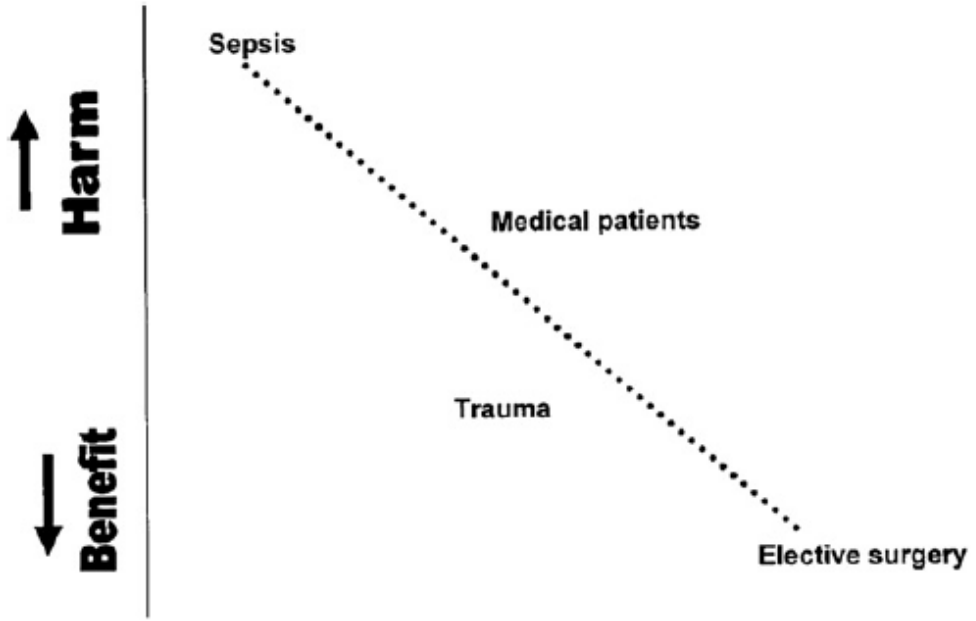
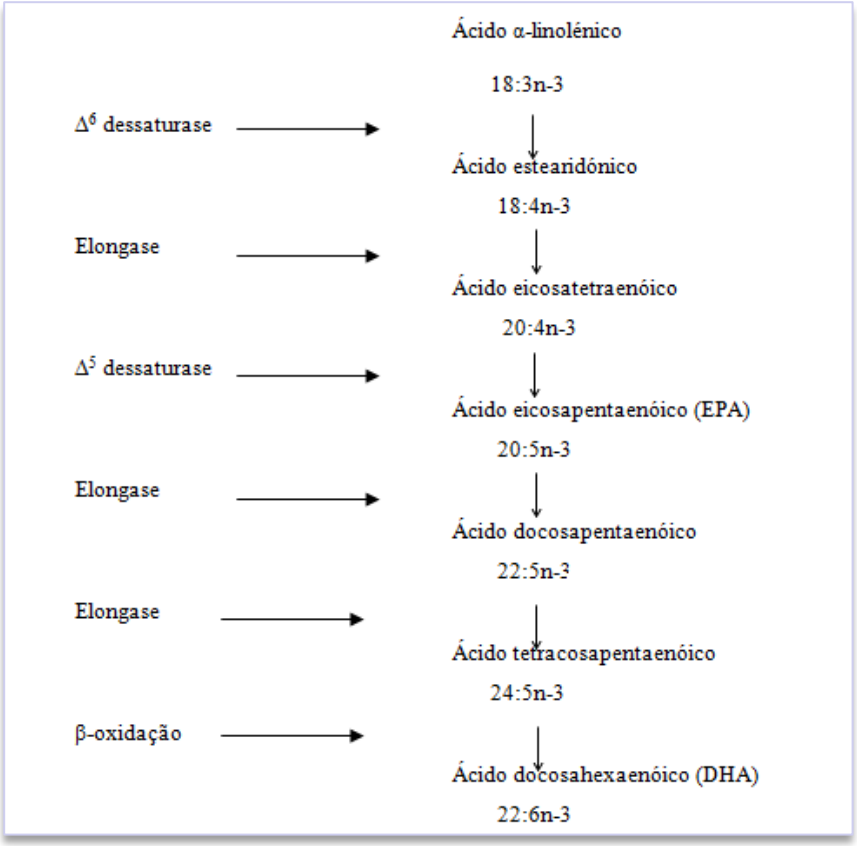


Fig. 2. Benefit versus harm of arginine-supplemented immune-enhancing diets (IED). Patients undergoing elective surgery benefit from the use of IED, exhibiting a significant decrease in infection rates. Trauma patients may benefit, but only if they receive adequate amounts of an IED early after their injury. Medical patients appear to exhibit little if any benefit. Medical patients with severe sepsis exhibit little benefit; potential for increased mortality. Used with permission [16].

Óleo de Peixe

- EPA e DHA: Sintetisados a partir do ácido alfalinolênico (ômega 3 de origem vegetal, ácido graxo essencial
- Na doença crítica: quase inibida a conversão do ALA em EPA e DHA
  - *(Mizock BA, Nutrition 26 (2010) 701–707)*



Óleo de Peixe

- **Suplementação de ômega 3 em pacientes críticos:**
- Redução síntese eicosanoides próinflamatórios
- Redução adesão de leucócitos e plaquetas ao endotélio
- Redução lesão oxidativa pelo estímulo síntese de glutationa
- Aumento síntese resolvinas antiinflamatórias
- Redução liberação de mediadores inflamatórios derivados do intestino nos linfáticos mesentéricos e ducto toráxico

Mizock BA, DeMichele SJ. Nutr Clin Pract 2004;19:563–74.
Serhan CN et al, Lipids 2004;39:1125–32.
Glatzle J et al, J Gastrointest Surg 2007;11:719–24.

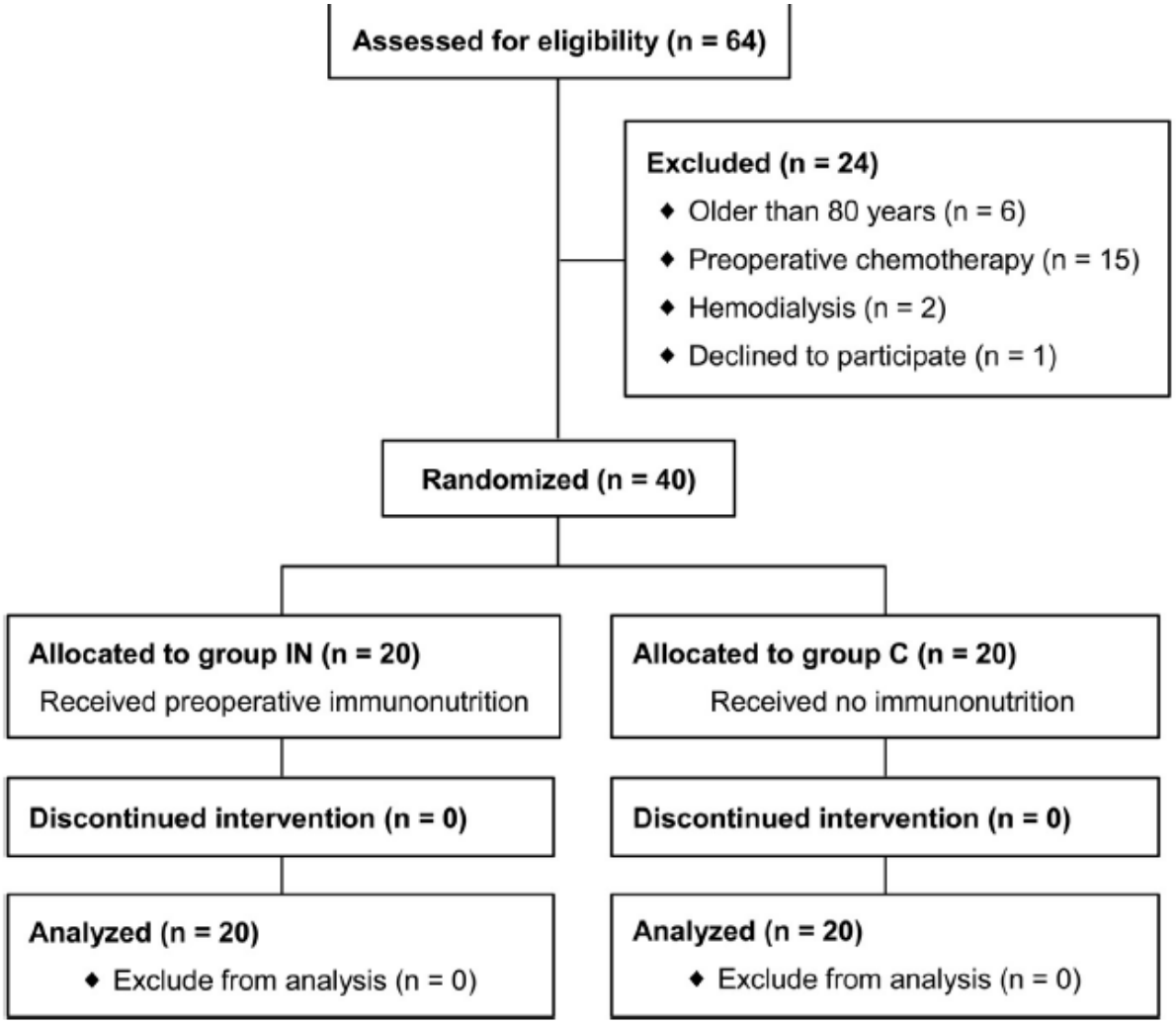
- Três clinical trials randomizados, grandes: Efeitos positivos de formula com óleo de peixe, óleo de borragem e antioxidantes em pacientes em ventilação mecânica com SARA
- Redução tempo ventilação mecânica
- Redução tempo internação CTI e hospitalar

Gadek JE et al, Crit Care Med 1999;27:1409–20.
Singer P, et al, Crit Care Med 2006;34: 1033–8.
Pontes-Arruda A, et al, Crit Care Med 2006;34:2325–33.

Immunonutrition suppresses acute inflammatory responses through modulation of resolvin E1 in patients undergoing major hepatobiliary resection

Hidehiko Uno, MD, Katsunori Furukawa, MD, Daisuke Suzuki, MD, Hiroaki Shimizu, MD, Masayuki Ohtsuka, MD, Atsushi Kato, MD, Hideyuki Yoshitomi, MD, *and* **Masaru Miyazaki, MD,**
Chiba, Japan

Surgery, 2016



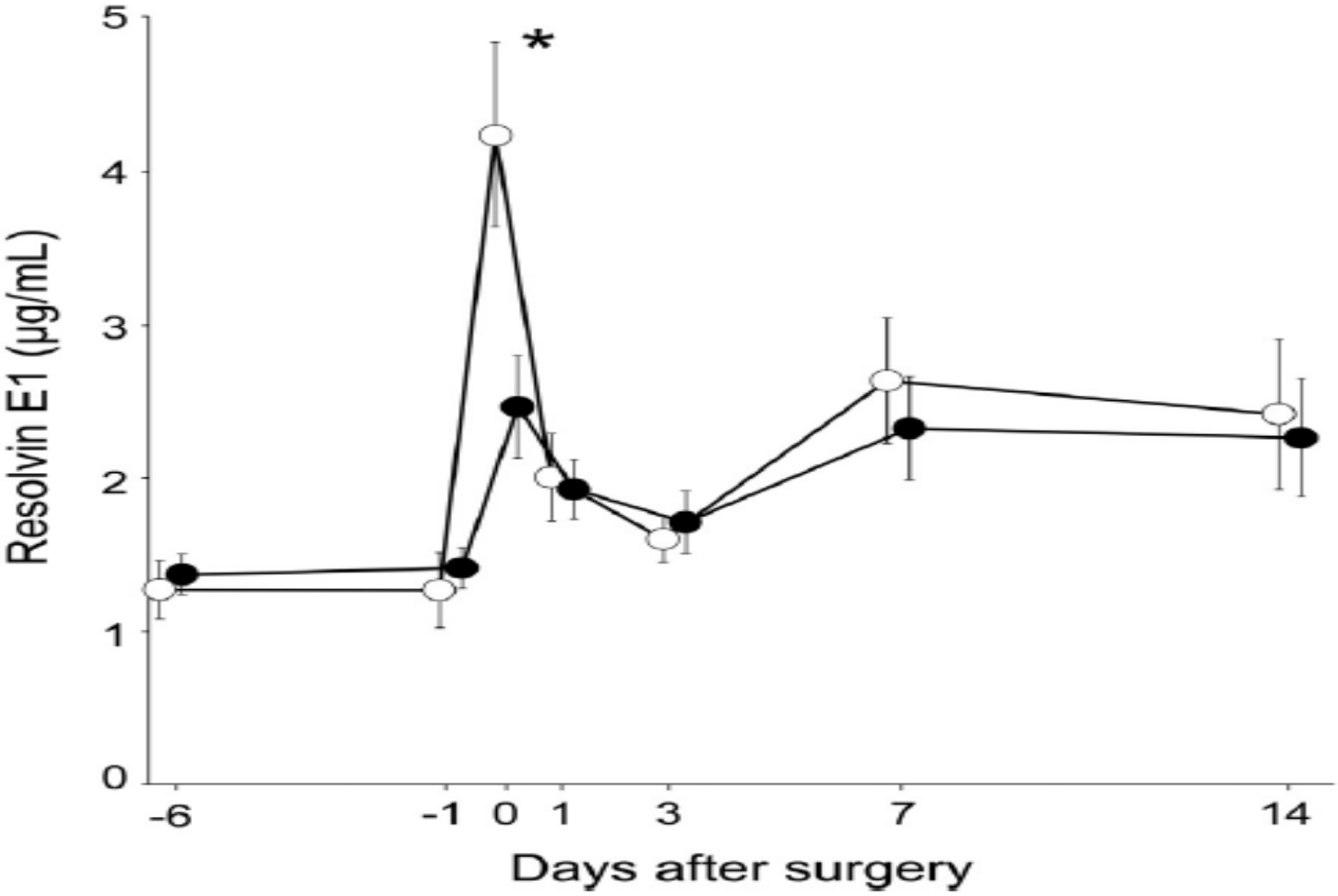
Surgery, 2016

Table I. Background of patients

	Group IN (n = 20)	*Group C (n = 20)*
Age (*n*)	65.5 ± 1.9	66.4 ± 1.6
Sex (male/female)	10/10	15/5
Albumin (g/dL)	3.7 ± 0.1	3.6 ± 0.1
Triglycerides (mg/dL)	88.8 ± 4.7	91.7 ± 6.0
PHA (stimulation index)	168 ± 25	200 ± 22
Con A (stimulation index)	127 ± 18	148 ± 16
Biliary drainage methods (*n*)		
PTBD	5	5
ENBD/EBS	14	14
Diagnosis		
Bile duct carcinoma	17	16
Intrahepatic cholangiocarcinoma	2	2
IPNB	1	1
Gall bladder carcinoma	0	1
pTNM classification (I/II/III/IVa/IVb)	3/4/4/7/2	4/1/4/8/3
Total liver volume (cm^3)	1,139 ± 41	1,192 ± 48
Remnant liver volume (cm^3)	556 ± 50	602 ± 37
RLV/TLV ratio (%)	48.6	51.1
Surgical procedure (*n*)		
Right hemihepatectomy	12	10
Left hemihepatectomy	4	5
Right trisectionectomy	2	5
Left trisectionectomy	2	0
Operative time (min)	445 ± 17	449 ± 15
Blood loss (g)	1,157 ± 137	1,332 ± 182
Combined portal vein resection	4	3
Blood transfusion (*n*)	3	4

Table II. Postoperative complications, hospital stay, and mortality

	Group IN (n = 20)	*Group C (n = 20)*	P†
Infectious complications	8 (40)	15 (75)	.025
Wound infection	6	10	.197
Intra-abdominal abscess	6	12	.057
Pneumonia	1	3	.292
Sepsis	1	1	1.000
Noninfectious complications	11 (55)	14 (70)	.327
Liver failure (grade B/C)	2	5	.212
Bile leakage	4	5	.705
Portal vein thrombosis	3	2	.633
Others	6	7	.736
Duration of SIRS (days)*	1.71 ± 0.2	2.3 ± 0.3	.108‡
Postoperative hospital stay (days)*	36.9 ± 3.3	53.9 ± 5.0	.006‡
Clavien-Dindo classification (I/II/III/IV/V)	2/2/6/1/0	1/1/13/2/0	.024§
Mortality	0	0	1.000


Resolvin E1 (µg/mL)
5
4
3
2
1
0
*
-6
-1
0
1
3
7
14
Days after surgery

Imunonutrição

- Minerva Anestesiol. 2015 May 13. [Epub ahead of print]
- **Immunonutrients in critically ill patients: an analysis of the most recent literature.**
- Annetta MG[1], Pittiruti M, Vecchiarelli P, Silvestri D, Caricato A, Antonelli M.
- **Author information**
- **Abstract**
- Modulation of inflammatory and immune response to critical illness has been the goal of much research in the last decade and a variety of drugs and nutrients (so called 'immunonutrients') have been tested in experimental models with promising results. Though, in the clinical setting of intensive care, their efficacy have been inconsistently proven, most likely because the effects of each drug may vary in relation to the timing, the dose, the route of administration, the interaction with other nutrients, the severity of illness and many other factors. Though the early studies of the beginning of this century (2000-2009) have shown some clinical benefits, recent multicenter trials (2011-2015) have failed to prove a consistent benefit of immunonutrition in terms of mortality or other clinical endpoints. Reviewing the latest evidence-based documents on this subject (multicenter trials, systematic reviews, meta-analyses and international guidelines), there is no convincing evidence that immunonutrients may be beneficial in the critically ill. Considering that these substances invariably increase the costs of health care and may be unsafe or even harmful in some subgroups, particularly in septic patients, we conclude that routine administration of immune-nutrients (glutamine, arginine, omega-3 fatty acids, selenium, etc.) cannot be currently recommended in the critically ill.

Custos!

Mauskopf *et al. World Journal of Surgical Oncology* 2012, **10**:136
http://www.wjso.com/content/10/1/136

WORLD JOURNAL OF SURGICAL ONCOLOGY

RESEARCH Open Access

Immunonutrition for patients undergoing elective surgery for gastrointestinal cancer: impact on hospital costs

Josephine A Mauskopf[1*], Sean D Candrilli[1], Hélène Chevrou-Séverac[2] and Juan B Ochoa[3]

Table 1 Perioperative immunonutrition support: clinical outcomes[a]

Outcome variable	With perioperative immunonutrition[b]	Without immunonutrition	Difference or RR (95% CI)
	N = 442	N = 447	
Mean length of stay	13.31	15.48	Δ = −2.18
Percentage reduction in length of stay			14.1%
Percentage with any infectious complications	14.71%	31.32%	RR = 0.46
Number (%) in pooled trial populations with specific complications[c]			
Wound infection	26 (5.9%)	43 (9.6%)	RR 0.61
			(0.38, 0.96)
Abdominal abscess	9 (2.0%)	21 (4.7%)	RR 0.43
			(0.21, 0.91)
Pneumonia	25 (5.7%)	47 (10.5%)	RR 0.54
			(0.34, 0.87)
Urinary tract infection	11 (2.5%)	20 (4.5%)	RR 0.53
			(0.23, 1.19)
Sepsis	8 (1.8%)	16 (3.6%)	RR 0.53
			(0.22, 1.27)
Anastomotic leak	15 (3.4%)	29 (6.5%)	RR 0.52
			(0.28, 0.95)

Abbreviations: Δ, absolute difference; *RR* relative risk with 95% confidence interval in ().

[a] Calculated from data reported in Waitzberg et al. [4].

[b] Three 240-mL (8-ounce) servings of oral supplement per day for five days prior to surgery, followed by early enteral feeding (within 24 hours postsurgery) at a goal of one liter per day.

[c] Note that a patient may experience more than one complication.

Table 3 Estimated cost savings per patient with the use of immunonutrition

Population	Cost Savings per Patient by Costing Method[a]	
	Cost Savings Due to Reduced Hospital LOS	Cost Savings Due to Lower Infectious Complication Rates
Base-case estimates		
Waitzberg et al. [4].	$6,000	$3,300
ΔLOS = 2.18; ICR, 14.71% vs. 31.32%		
Estimates using lower LOS and infectious complication rates for the control population[b]		
Upper + lower GI	$3,200	$1,600
ΔLOS = 1.21; ICR, 5.2% vs. 11.2%		
Upper GI only	$6,300	$4,300
ΔLOS = 1.78; ICR, 7.9% vs.17.1%		
Lower GI only	$2,800	$1,200
ΔLOS = 1.14; ICR, 4.8% vs. 10.4%		

Abbreviations: Δ, absolute difference; *GI* gastrointestinal; *HCUP* Healthcare Cost and Utilization Project; *ICR* infectious complication rate for perioperative immunonutrition vs. standard nutrition; *LOS* length of stay.

[a] Rounded to the nearest $100.

[b] Infectious complication rates and length of stay for the control population taken from 2008 HCUP NIS values presented in Table 2 and relative risk of infectious complications and percentage reduction in length of stay presented in Table 1 and taken from Waitzberg et al. [4].

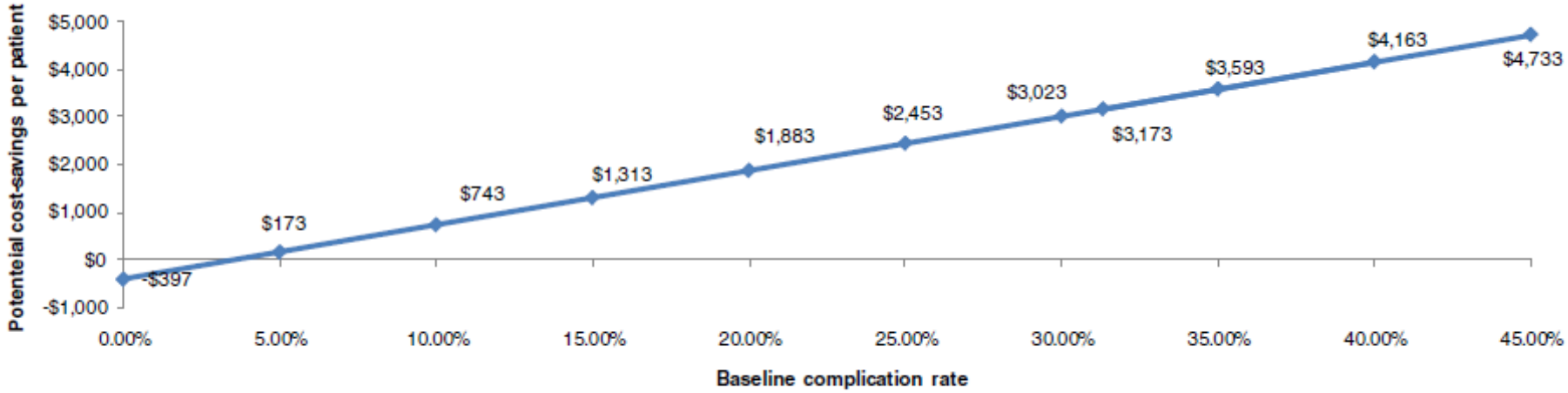


Figure 1 Cost savings attributable to reduced infectious complications (presented in 2010 US dollars).

Preiser *et al. Critical Care* (2015) 19:35
DOI 10.1186/s13054-015-0737-8

CRITICAL CARE

REVIEW Open Access

Metabolic and nutritional support of critically ill patients: consensus and controversies

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Table 1 Areas of uncertainty – opposing views

Topic/area	One viewpoint	Opposing view
Optimal caloric intake	Early match of EE.	Less than EE during the early phase.
Supplemental PN	When EN provision is less than 60% in early course of ICU stay not contraindicated.	Not before day 8 in patients with a body mass index of at least 17.
Optimal protein intake	Equal to nitrogen losses, up to 1.5 g/kg per day.	Less than nitrogen losses.
Re-feeding syndrome	Slowly increase nutritional support to prevent re-feeding syndrome consequences even if this results in increased energy deficit.	Early nutritional support improves outcome also in malnourished patients; re-feeding syndrome consequences should be monitored and immediately treated if necessary.
Role of indirect calorimetry	Yes (patients staying more than 4 days).	No.
Autophagy	Provision of nutrients should be reduced so as not to reduce autophagy capacity as early nutrients provoke a phenotype of suppressed autophagy in human and animal experiments, with functional consequences that impair recovery.	Although experimentally autophagy may be reduced in early critical illness, pharmacological autophagy activation remains to be tested clinically.
Antioxidants	Supplement in case of low levels of antioxidants.	Use pharmacological dosages.
Glutamine	In all patients on PN.	High-dose glutamine increases mortality in critically ill patients, regardless of route of administration.
Omega-3 lipid formulations	Use continuous enteral administration and avoid bolus administration.	Not beneficial in acute respiratory distress syndrome.
High-dose selenium 800 to 4,000 μg/day	High-dose trials (1,000 μg) show greater improvement than low-dose trials.	Potential for toxicity. In selenium-replete populations, 800 to 1,000 μg may be ineffective.
Probiotics	Safe. Avoid use in pancreatitis patients with multiple organ dysfunction syndrome.	May be harmful in ICU patients when given post-pyloric with fiber.
Monitoring GRV	Accept GRV of 250 up to 500 mL per 6 hours.	Abandon GRV monitoring in medical patients and consider in surgical patients.

EE, energy expenditure; EN, enteral nutrition; GRV, gastric residual volume; PN, parenteral nutrition.

Table 2 Areas of consensus (ICU patients with a more than 4-day length of stay)

	Consensus
Early enteral feeding	Consider in each patient without absolute contraindication; prevents mucosal atrophy
Risks of overfeeding	Early phase
Estimation of energy expenditure	Requires indirect calorimetry – cannot be predicted by equations
Arginine	Not recommended in sepsis; beneficial in perioperative patients outside the ICU
Vitamins, trace elements	Mandatory, in nutritional doses; particularly true in parenteral nutrition

Clinical Guidelines

Journal of Parenteral and Enteral Nutrition
Volume 40 Number 2
February 2016 159–211

DOI: 10.1177/0148607115621863
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Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)

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Question: Should EN formulas with fish oils (FOs), borage oil, and antioxidants be used in patients with ALI or ARDS?

E3. We cannot make a recommendation at this time regarding the routine use of an enteral formulation characterized by an anti-inflammatory lipid profile (eg, omega-3 FOs, borage oil) and antioxidants in patients with ARDS and severe ALI, given conflicting data.

[Quality of Evidence: Low to Very Low]

Question: Should immune-modulation formulas be used routinely to improve outcomes in a patient with severe trauma?

M1b. We suggest that immune-modulating formulations containing arginine and FO be considered in patients with severe trauma.

[Quality of Evidence: Very Low]