

39e CONGRÈS ANNUEL DE L'ADARPEF

Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française

25 & 26 MARS 2022 MONTPELLIER Le Corum

Nutrition parentérale en réanimation pédiatrique : Comment je m'y prends?

Dr Julien Baleine, Dr C. Milesi, Dr S. Mounier, B. Pinard (diet), Pr G. Cambonie

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Réanimation pédiatrique Montpellier







conflit d'intérêt : invité par Fresenius Kabi

TAKE HOME MESSAGE

- La nutrition est aussi importante que les amines, la sédation, les antibiotiques
- La voie orale/entérale est à privilégier
- La nutrition parentérale (NP) peut être décalée de quelques jours
- En cas de NP, ne pas oublier les vitamines
- Des pistes potentiellement intéressantes
  - Supplémentation vitaminiques
  - Mélange lipidique/huile de poisson

INTRODUCTION

- Réanimation pédiatrique:
  - **Malnutrition** à l'entrée en réanimation: **18,5%** (données Nutrireaped 2014)
  - **Dénutrition acquise**

- Risque de dénutrition acquise en réanimation:
  - Modification profonde du métabolisme énergétique et protéique chez l'enfant sévèrement agressé
  - Catabolisme musculaire important, libérant des acides aminés
  - Intolérance digestive
  - Défauts d'apport d'origine multifactorielle

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Cible d'apports caloriques et balance cumulée en réanimation pédiatrique

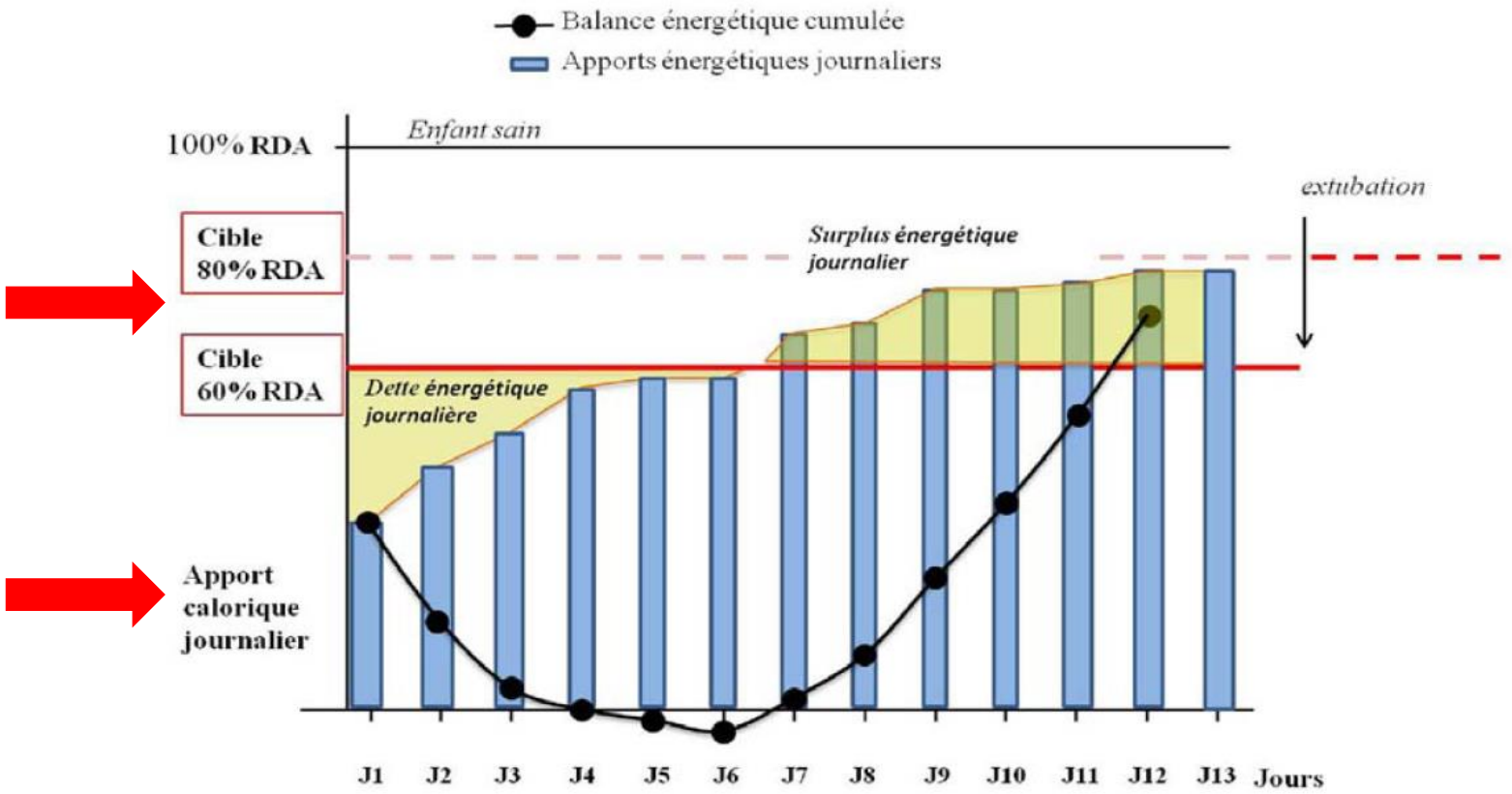


Fig. 2 Représentation schématique de la balance énergétique journalière d'un patient fictif en réanimation pédiatrique avec constitution d'une dette énergétique quotidienne en début de séjour. Représentation de la dette cumulée durant le séjour en utilisant le 60 % des RDA (*Recommended Dietary Allowances*) comme cible et 80 % après extubation

Augmentation de la dette énergétique = ↑ LOS, Inf noso, mortalité

Adequate enteral protein intake is inversely associated with 60-d mortality in critically ill children: a multicenter, prospective, cohort study[1]

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59 PICU
15 pays
1245 patients

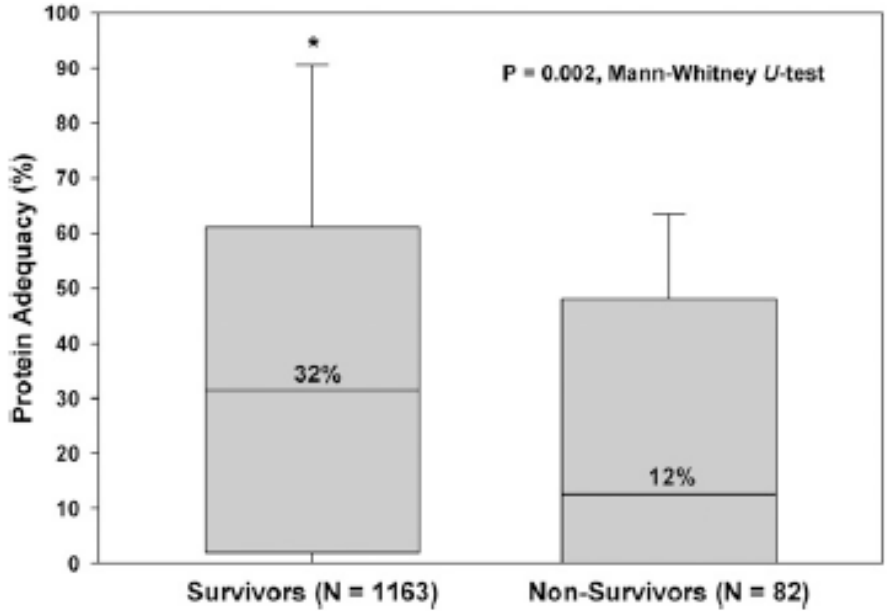
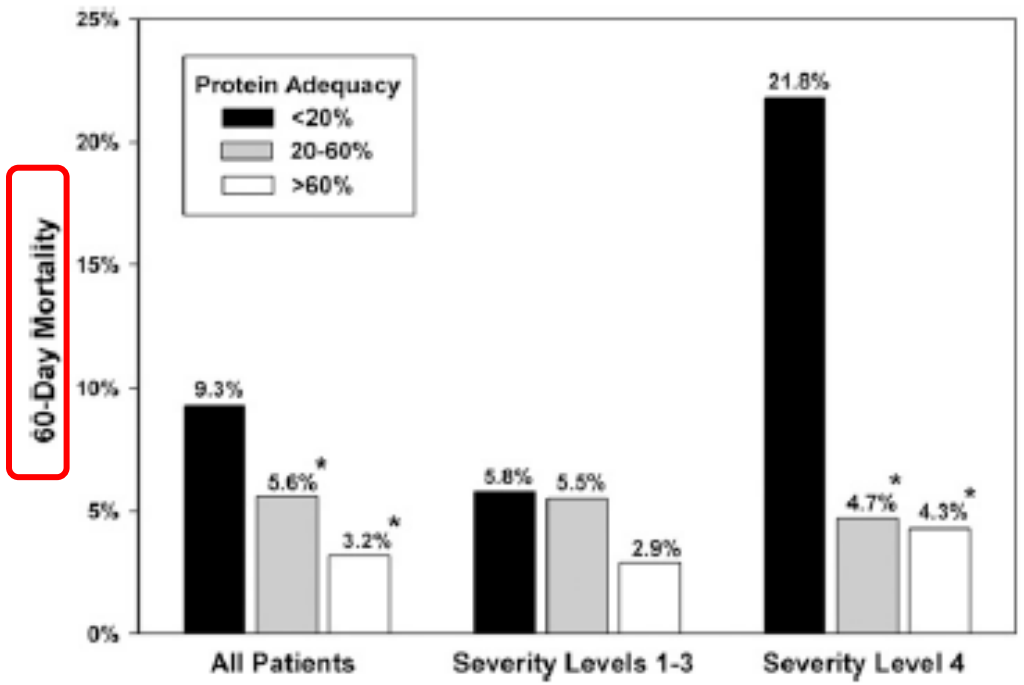


FIGURE 3 Median and interquartile values of protein intake adequacy (as a percentage of the prescribed goal) in survivors and nonsurvivors: a cohort of mechanically ventilated children (n = 1245).



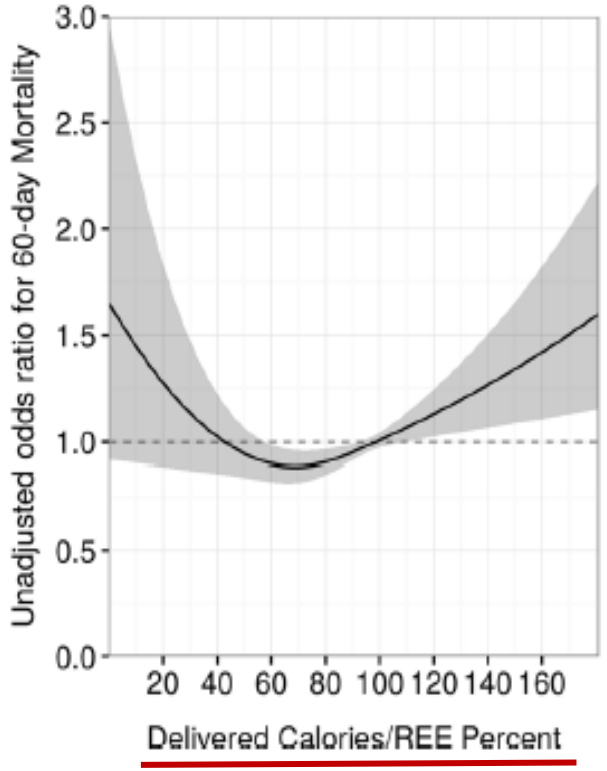
Risque de mortalité plus élevée en cas d'insuffisance d'apports protéiques

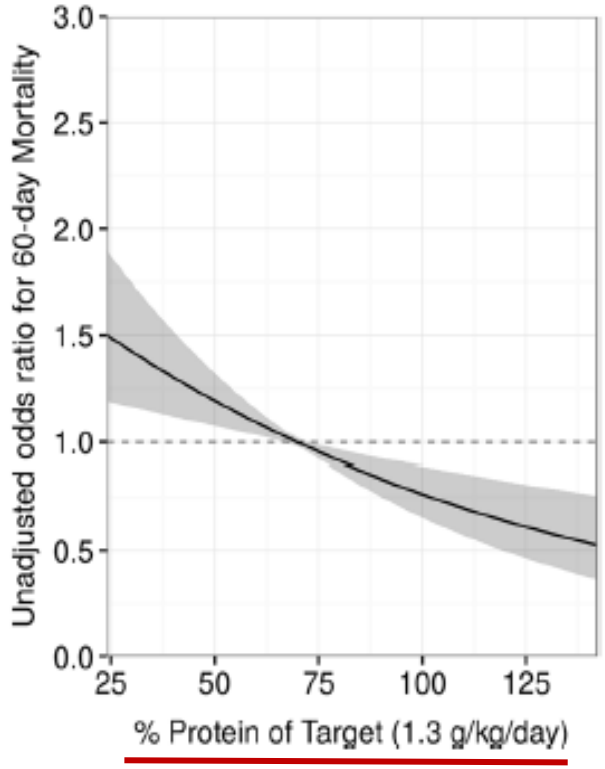
Facteurs de réussite : initiation précoce, post-pylorique, réductions des interruptions, réa de grande taille, diététicienne dédiée

Mehta Am J Clin Nutr 2015

Underfeeding / Overfeeding / optimal feeding

Energie





Protéines

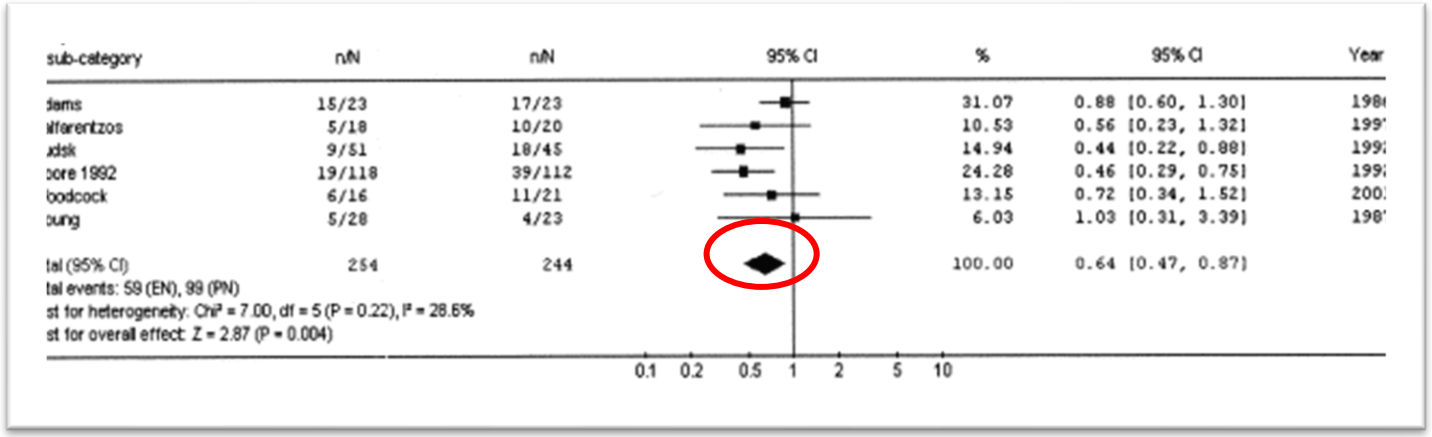
Fig. 2 Association of administered calories/resting energy expenditure (Adcal/REE) percent with 60-day mortality (*left*), and protein intake by daily requirement (1.3 g/kg/d) with 60-day mortality (*right*) by odds ratio. *REE* resting energy expenditure

Zusman et al. Crit Care2016

Entérale ou parentérale?

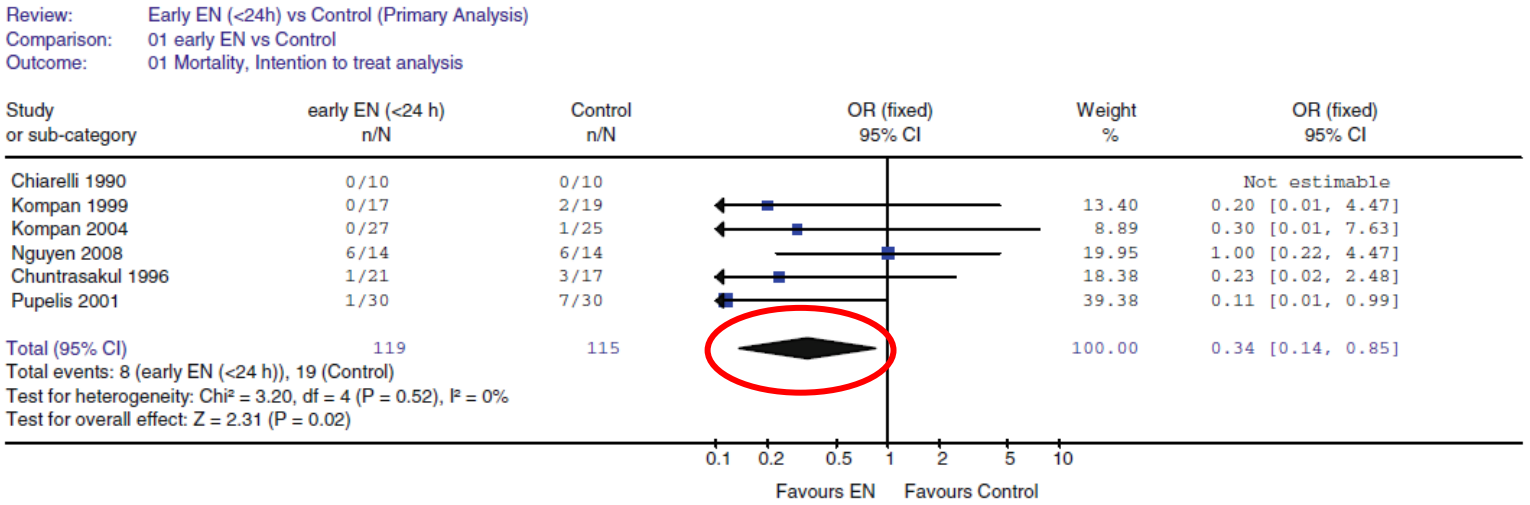
- chez l'adulte

Inf noso



Gramlich Nutrition 2004

mortalité



Doig ICM 2009

Entérale ou parentérale chez l'enfant?

Nutritional practices and their relationship to clinical outcomes in critically ill children—An international multicenter cohort study*

Nilesh M. Mehta, MD; Lori J. Bechard, MEd, RD, LDN; Naomi Cahill, RD, MSc; Miao Wang, MSc; Andrew Day, MSc; Christopher P. Duggan, MD, MPH; Daren K. Heyland, MD, MSc

(Crit Care Med 2012; 40:2204–2211)

Entéral + parentéral

Entéral seul

Table 6. Relationship between energy adequacy and 60-day hospital mortality

		Unadjusted				Adjusted			
	N[a]	Odds Ratio	95% Confidence Limits		p[b]	Odds Ratio	95% Confidence Limits		p
Energy delivered (as a percentage of energy prescribed) from enteral nutrition + parenteral nutrition	498				.84				.84[c]
<33.3%	141	referent				referent			
33.3%–66.7%	220	0.79	0.35	1.75		0.79	0.34	1.83	
>66.7%	137	0.88	0.35	2.19		0.78	0.3	2.05	
Energy delivered (as a percentage of energy prescribed) from enteral nutrition only	498				.005				.002[d]
<33.3%	247	referent				referent			
33.3%–66.7%	167	0.38	0.18	0.83		0.27	0.11	0.67	
>66.7%	84	0.16	0.04	0.67		0.14	0.03	0.61	

[a]The sample includes 500 patients who had at least 3 days prior to permanent oral intake. For energy intake as % of prescribed from enteral nutrition + parenteral nutrition, the adjusted odds ratios (95% confidence interval) and *p* values are based on 483 patients due to 15 patients with missing values in Z-scores and two patients with missing prescribed calories. For energy intake as percent of prescribed from enteral nutrition only, the adjusted odds ratios (95% confidence interval) and *p* values are based on 478 patients due to 20 patients with missing duration of ventilation and two patients with missing prescribed calories; [b]adjusting evaluable nutrition days; [c]adjusting evaluable nutrition days, Z-score for body mass index, and severity and use of parenteral nutrition by backward selection at p <.15; [d]adjusting evaluable nutrition days, age, severity, use of motility agent, and duration of ventilation by backward selection at *p* <.15.

Early Enteral Nutrition Is Associated With Improved Clinical Outcomes in Critically Ill Children: A Secondary Analysis of Nutrition Support in the Heart and Lung Failure-Pediatric Insulin Titration Trial

Vijay Srinivasan, MBBS, MD[1,2]; Natalie R. Hasbani, MPH[3]; Nilesh M. Mehta, MD[4]; Sharon Y. Irving, PhD, CRNP[5,6]; Sarah B. Kandil, MD[7]; H. Christine Allen, MD[8]; Katri V. Typpo, MD, MPH[9]; Natalie Z. Cvijanovich, MD[10]; E. Vincent S. Faustino, MD, MHS[7]; David Wypij, PhD[3,11,12]; Michael S. D. Agus, MD[13]; Vinay M. Nadkarni, MD, MS[1,2]; for the Heart and Lung Failure-Pediatric Insulin Titration (HALF-PINT) Study Investigators

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HALF PINT Trial
RCT pour contrôle glycémique strict – 35 PICU
Patient sous VM et/ou amines
Etude ancillaire
entérale <48 h après randomisation vs >48h.

Nutrition and Glycemia Measures	Early EN ($n = 331$)	No Early EN ($n = 277$)	p^a
Nutrition summary			
Average daily total caloric intake over first 8 study days (kcal/kg/d), median (IQR)	36 (22–56)	36 (21–58)	0.93

Clinical Outcomes	Early EN ($n = 331$)	No Early EN ($n = 277$)	Estimate (95% CI)[a]	p^b
90-d hospital mortality, *n* (%)	25 (8)	46 (17)	OR = 0.43 (0.24–0.80)	0.007
28-d hospital mortality, *n* (%)	23 (7)	35 (13)	OR = 0.56 (0.31–1.03)	0.06
ICU-free days (through day 28), median (IQR)	20.2 (9.1–23.7)	17.2 (0–22.3)	HR = 1.26 (1.03–1.55)	0.02
Hospital-free days (through day 28), median (IQR)	8 (0–17)	0 (0–12)	HR = 1.62 (1.18–2.23)	0.003
Ventilator-free days (through day 28), median (IQR)	21.4 (13.2–24.8)	19.0 (3.0–23.2)	HR = 1.29 (1.07–1.57)	0.009
Maximum Pediatric Logistic Organ Dysfunction score (day 2 through day 28), median (IQR)	11 (11–20)	12 (11–22)	Mean difference = −3.1 (−4.8 to −1.4)	< 0.001
Healthcare-associated infections, *n* (%)	6 (2)	10 (4)	OR = 0.47[c] (0.15–1.48)	0.20[c]

Srinivasan PCCM 2020

PEPaNIC trial

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Early versus Late Parenteral Nutrition in Critically Ill Children

Tom Fivez, M.D., Dorian Kerklaan, M.D., Dieter Mesotten, M.D., Ph.D., Sascha Verbruggen, M.D., Ph.D., Pieter J. Wouters, M.Sc., Ilse Vanhorebeek, Ph.D., Yves Debaveye, M.D., Ph.D., Dirk Vlasselaers, M.D., Ph.D., Lars Desmet, M.D., Michael P. Casaer, M.D., Ph.D., Gonzalo Garcia Guerra, M.D., Jan Hanot, M.D., Ari Joffe, M.D., Dick Tibboel, M.D., Ph.D., Koen Joosten, M.D., Ph.D., and Greet Van den Berghe, M.D., Ph.D.

2016

3 centres (Belgique, Pays-Bas, canada)*=

Critères d'inclusion :

durée prévue ≥ 24h

STRONGKids ≥ 2 (risque modéré à élevée de dénutrition)

critères d'exclusion :

<37 SAC, DNR, décès attendu < 12h, réadmission, séjour > 7 j dans autre réa, acidocétose diab, mal héréditaire métabolisme, grêle court ou Nut parentérale antérieure

Table 2. Outcomes.*

Outcome	Early Parenteral Nutrition (N=723)	Late Parenteral Nutrition (N=717)	P Value	Adjusted Odds Ratio or Hazard Ratio (95% CI)†	P Value
Primary					
New infections — no. (%)	134 (18.5)	77 (10.7)	<0.001	0.48 (0.35–0.66)‡	<0.001
Airway	59 (8.2)	30 (4.2)	0.002		
Bloodstream	23 (3.2)	10 (1.4)	0.03		
Urinary tract	7 (1.0)	2 (0.3)	0.17		
Central nervous system	3 (0.4)	2 (0.3)	1.00		
Soft tissue	7 (1.0)	4 (0.6)	0.54		
Other focus	5 (0.7)	8 (1.1)	0.42		
No focus identified	30 (4.1)	21 (2.9)	0.25		
Total duration of antibiotic treatment for patients with new infection — days	21.3±3.1	17.4±1.9	0.77		
Total duration of stay in pediatric ICU — days§	9.2±0.8	6.5±0.4	0.002	1.23 (1.11–1.37)	<0.001
Patients requiring ≥8 days in pediatric ICU — no. (%)	216 (29.9)	159 (22.2)	<0.001		
Secondary					
Safety					
Death — no. (%)					
Within 8 days of admission to pediatric ICU	21 (2.9)	19 (2.6)	0.87	0.73 (0.34–1.51)‡	0.39
During stay in pediatric ICU	36 (5.0)	32 (4.5)	0.70	0.73 (0.42–1.28)‡	0.27
During hospital stay	44 (6.1)	37 (5.2)	0.49	0.72 (0.43–1.19)‡	0.20
Within 90 days after enrollment	49 (6.8)	38 (5.3)	0.26	0.64 (0.39–1.05)‡	0.08
Hypoglycemia: glucose <40 mg/dl during first 7 days in pediatric ICU — no. (%)	35 (4.8)	65 (9.1)	0.001		
Hypoglycemia refractory to treatment for ≥2 hr — no. (%)	0	1 (0.1)	1.00		
Readmission to pediatric ICU within 48 hr after discharge — no. (%)	9 (1.2)	13 (1.8)	0.39		
Efficacy					
Duration of mechanical ventilatory support — days	6.4±0.7	4.4±0.3	0.01	1.19 (1.07–1.32)	0.001
Duration of hemodynamic support — days	3.0±0.3	2.4±0.2	0.35		
Kidney failure with renal-replacement therapy — no. (%)	26 (3.6)	18 (2.5)	0.28	0.49 (0.24–0.96)‡	0.04
Liver dysfunction during first 7 days in pediatric ICU¶					
Highest plasma level of total bilirubin — mg/dl	1.5±0.1	1.7±0.1	0.003		
Highest plasma level of alkaline phosphatase — IU/liter	171±3	171±5	0.04		
Highest plasma level of γ-glutamyltransferase — IU/liter	58±6	45±3	0.001		
Highest plasma level of alanine aminotransferase — IU/liter	72±8	113±20	0.64		
Highest plasma level of aspartate aminotransferase — IU/liter	179±26	262±48	0.76		
Highest plasma level of C-reactive protein during first 7 days in pediatric ICU, as measure of inflammation — mg/liter	79±4	90±4	0.007		
Duration of hospital stay — days					
Index hospital	21.3±1.3	17.2±1.0	0.005	1.19 (1.07–1.33)	0.001
Index and transfer hospital	22.6±1.3	18.6±1.0	0.01	1.21 (1.08–1.34)	<0.001

The Lancet Child & Adolescent Health
Volume 2, Issue 7, July 2018, Pages 505-515



Articles

Early versus late parenteral nutrition in critically ill, term neonates: a preplanned secondary subgroup analysis of the PEPaNIC multicentre, randomised controlled trial

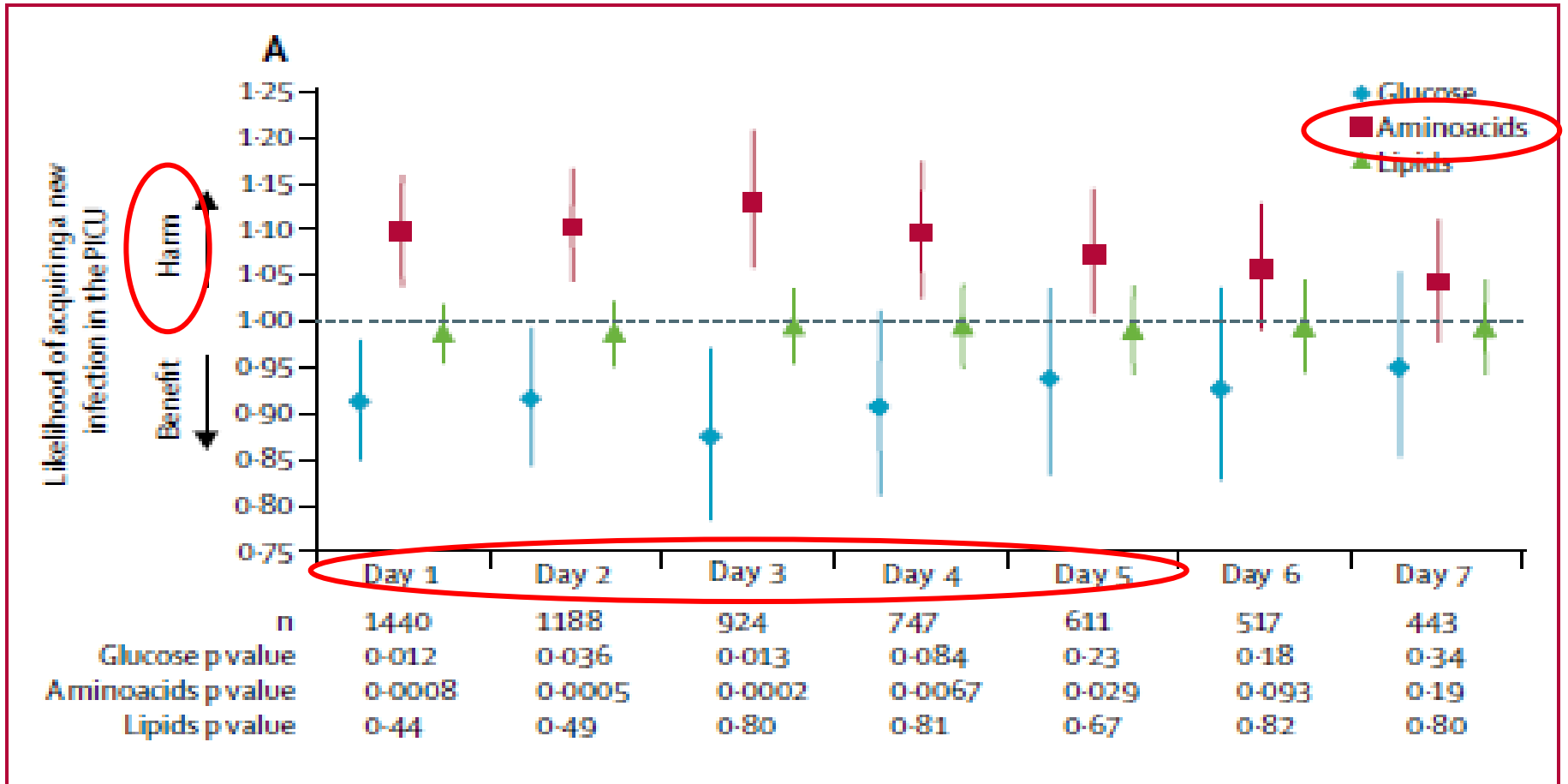
Esther van Puffelen MD [a, †], Ilse Vanhorebeek PhD [b, †], Koen F M Joosten MD [a], Pieter J Wouters MSc [b], Prof Greet Van den Berghe MD [b], Sascha C A T Verbruggen MD [a]

- 209 nouveau-nés
  98 early parenteral vs 111 late parenteral nutrition
  environ 1/3 medical, 1/3 chir cardiaque, 1/3 autres chir

- Critères principaux:
  - **durée en réa** 7 vs 5 j OR 1,61 (1,19-2,2) p =0,0021
  - réduction des **Inf noso** 31 vs 16% mais NS aOR 0,54 (0,27-1,08) p =0,082

- Critères 2aires :
  - **Diminution durée VM** : 5 vs 3j, **LOS** : 18 vs 14j OR 1,38, **Coût**
  - sans augmentation mortalité
  - Plus d'hypoglycémie 14 vs 23 % mais 94 % sous insuline !!!

Effect of early supplemental parenteral nutrition in the paediatric ICU: a preplanned observational study of post-randomisation treatments in the PEPaNIC trial. **Vanhorebeek et al. 2017** lancet resp med



Apports protéiques réa adulte



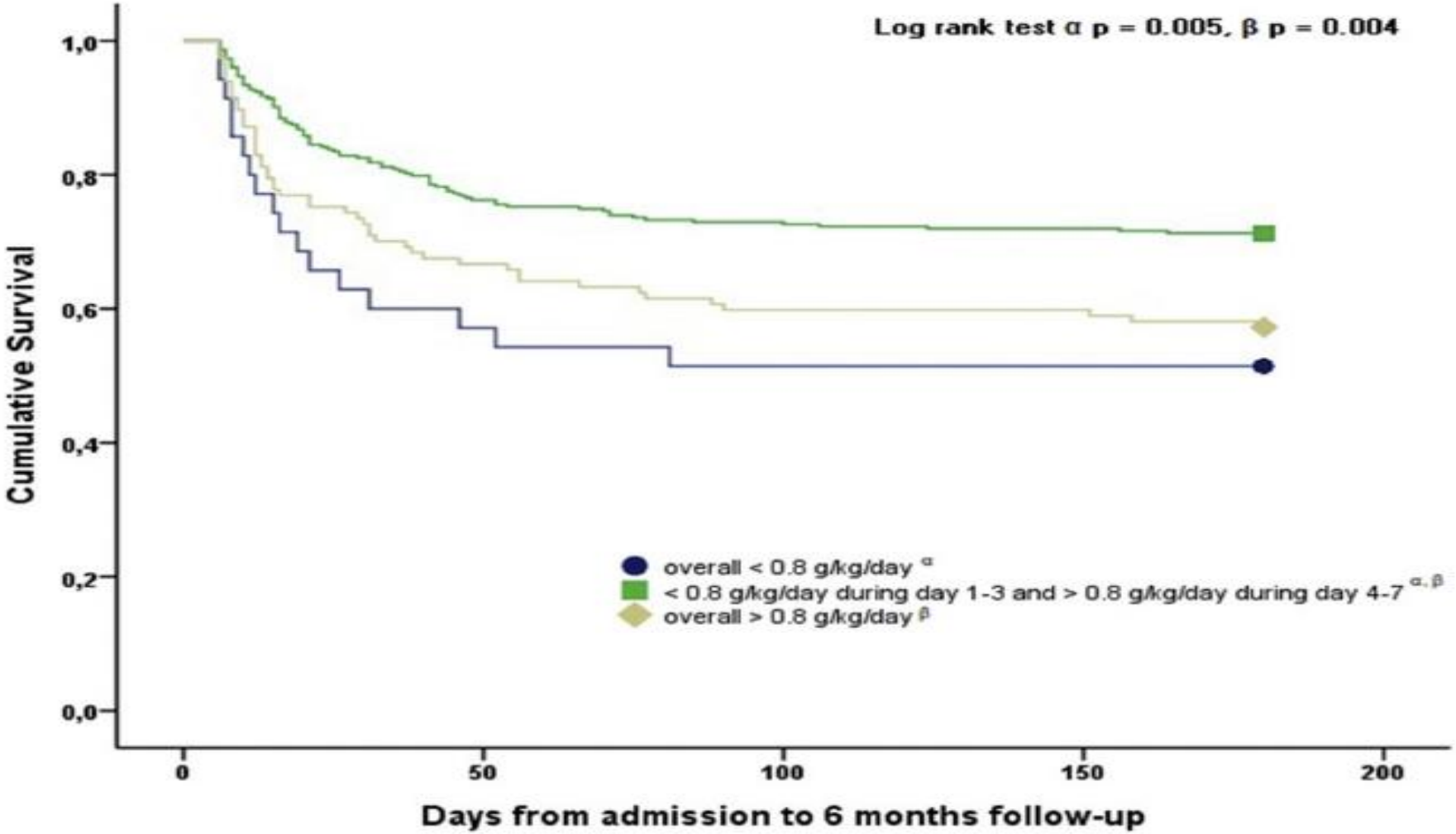


Fig. 2. Six-months survival by Kaplan–Meier estimates for time-dependent protein intake groups.

Retrospective study

455 patients

VM> 7 jours

Apports protéiques entéraux + parentéraux

Koekkoek et al. Clin Nut 2019

En pratique…

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu



ESPGHAN/ESPEN/ESPR/CSPEN guidelines on pediatric parenteral nutrition

2018

EXPERT STATEMENT

Nutritional support for children during critical illness: European Society of Pediatric and Neonatal Intensive Care (ESPNIC) metabolism, endocrine and nutrition section position statement and clinical recommendations

Lyvonne N. Tume[1,2*], Frederic V. Valla[3], Koen Joosten[4], Corinne Jotterand Chaparro[5,6], Lynne Latten[7], Luise V. Marino[8], Isobel Macleod[9], Clémence Moullet[5,6], Nazima Pathan[10], Shancy Rooze[11], Joost van Rosmalen[12] and Sascha C. A. T. Verbruggen[4]

2020

In critically ill children, when should Parenteral Nutrition (PN) be started?	14.1: Withholding parenteral nutrition for up to one week can be considered in critically ill term neonates and children, independent of nutritional status, while providing micronutrients	B	Consensus	[8, 9, 22, 25–27, 156]

Que faire pendant 1 semaine?



Définir les besoins du patient

Evaluation	In critically ill children, what is the most accurate method of determining or predicting energy expenditure?	6.1 Measuring resting energy expenditure using a validated indirect calorimeter should be considered to guide nutritional support in critically ill infants and children after the acute phase	GCP	Strong consensus	[114–119]
		6.2 Schofield equation (for age and gender and using an accurate weight) is recommended to estimate resting energy expenditure	C	Strong consensus	[120–125]
Phases	In critically ill children what are their energy requirements?	5.1 In the acute phase, energy intake provided to critically ill children should not exceed resting energy expenditure	C	Strong consensus	[26, 101–104]
		5.2. After the acute phase, energy intake provided to critically ill children should account for energy debt, physical activity, rehabilitation and growth	GCP	Strong consensus	[105–113]

Tume ICM 2020

Définir les besoins du patient

- Estimation par **Equation de prédiction (=DER)**

Schofield W

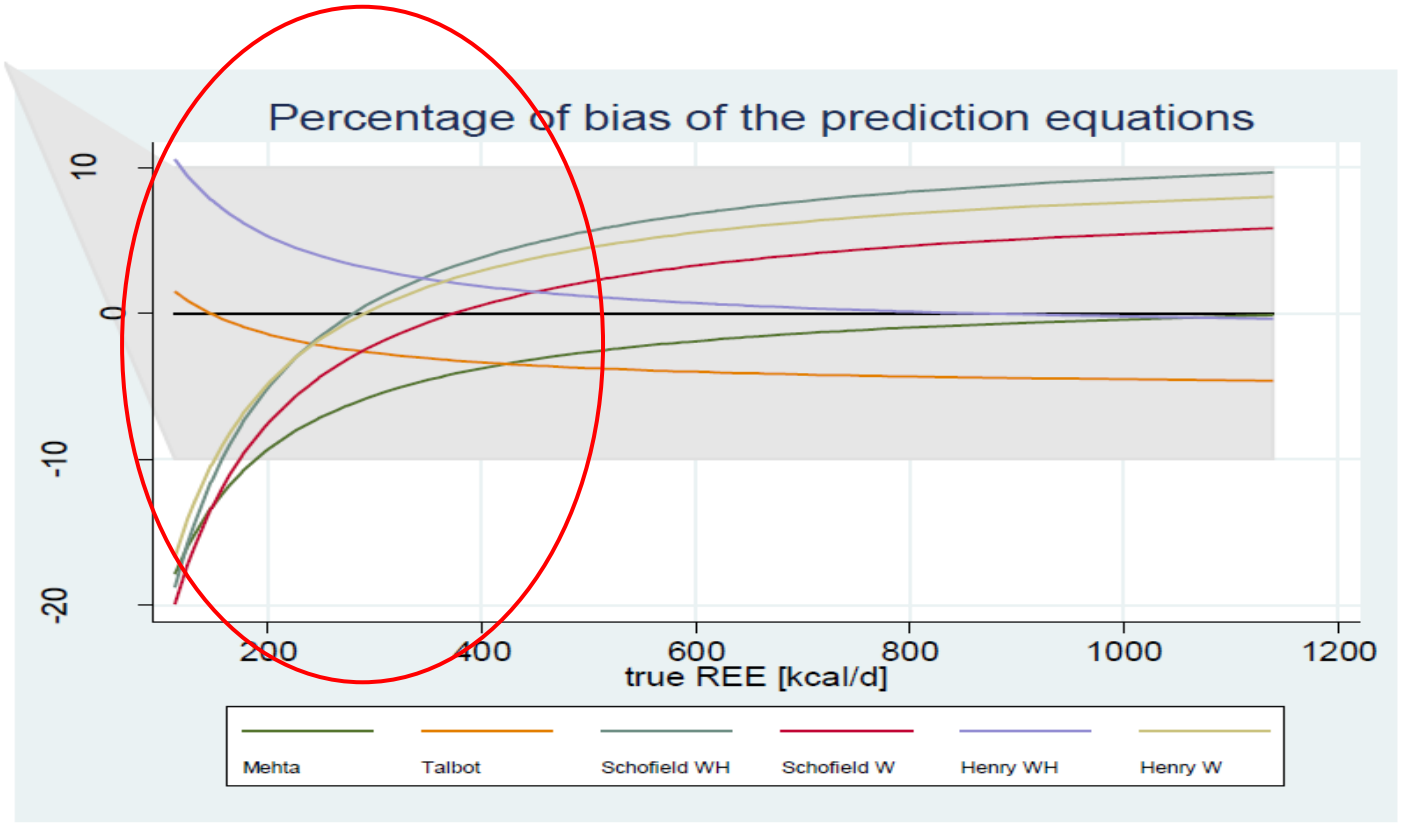
Age	Male	Female
< 3 yrs	(59.512 x W) – 30.4	(58.317 x W) – 31.1
3–10 yrs	(22.7 x W) + 503.3	(22.706 x W) + 485.9
10–18 yrs	(17.5 x W) + 651	(17.686 x W) + 692.6

- Estimation en fonction du **poids cible** (pour les petits poids)

Poids attendu pour la taille	Apports
0-10 kg	100 kcal/kg
10-20 kg	1 000 kcal + 50 kcal/kg au-dessus de 10 kg
> 20 kg	1 500 kcal + 25 kcal/kg au-dessus de 20 kg

Par exemple, pour un enfant de 22 kg, il faut compter : 1 500 kcal+ 2 kg à 25 kcal/kg, soit 1 550 kcal/J.

Equations de prédiction de la dépense énergétique

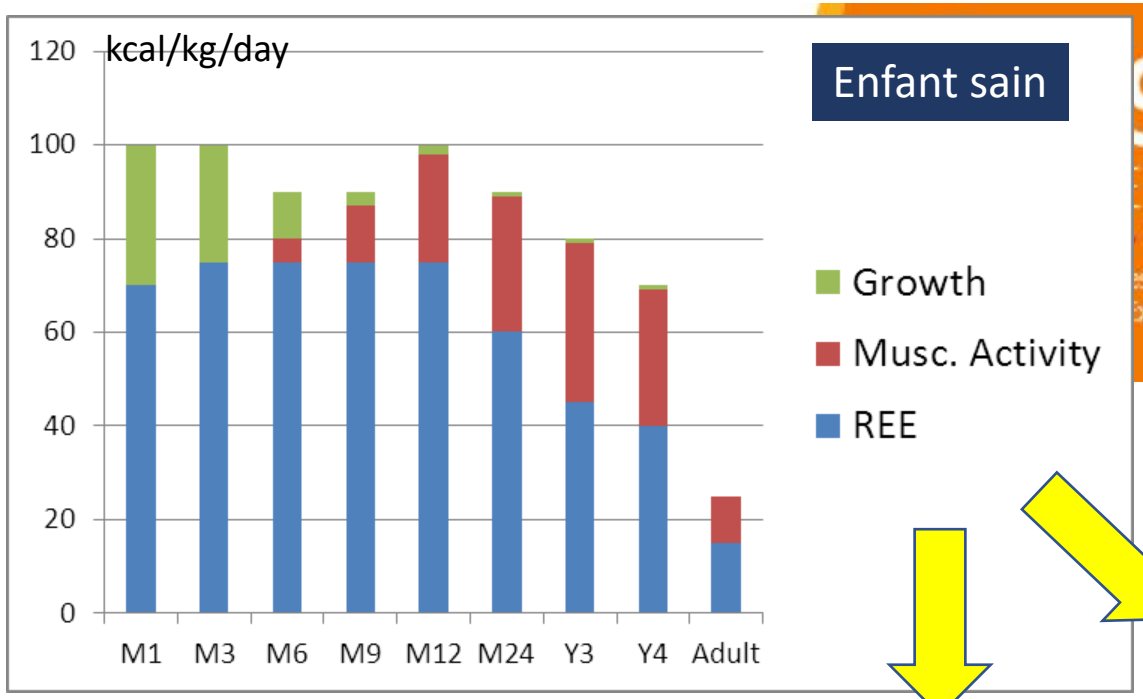


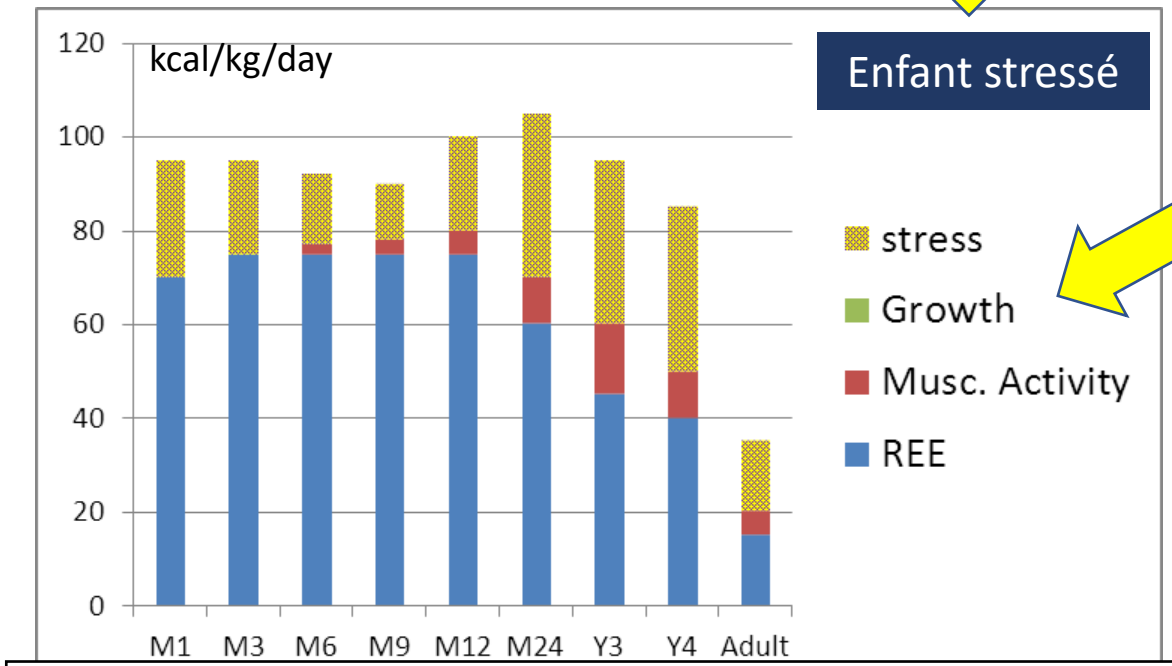
- Schofield (P ou P&T) et Talbot sont les moins fausses !
- Fiables à l'échelle d'une population, pas à l'échelle individuelle

Jotterand et al J Ped 2017

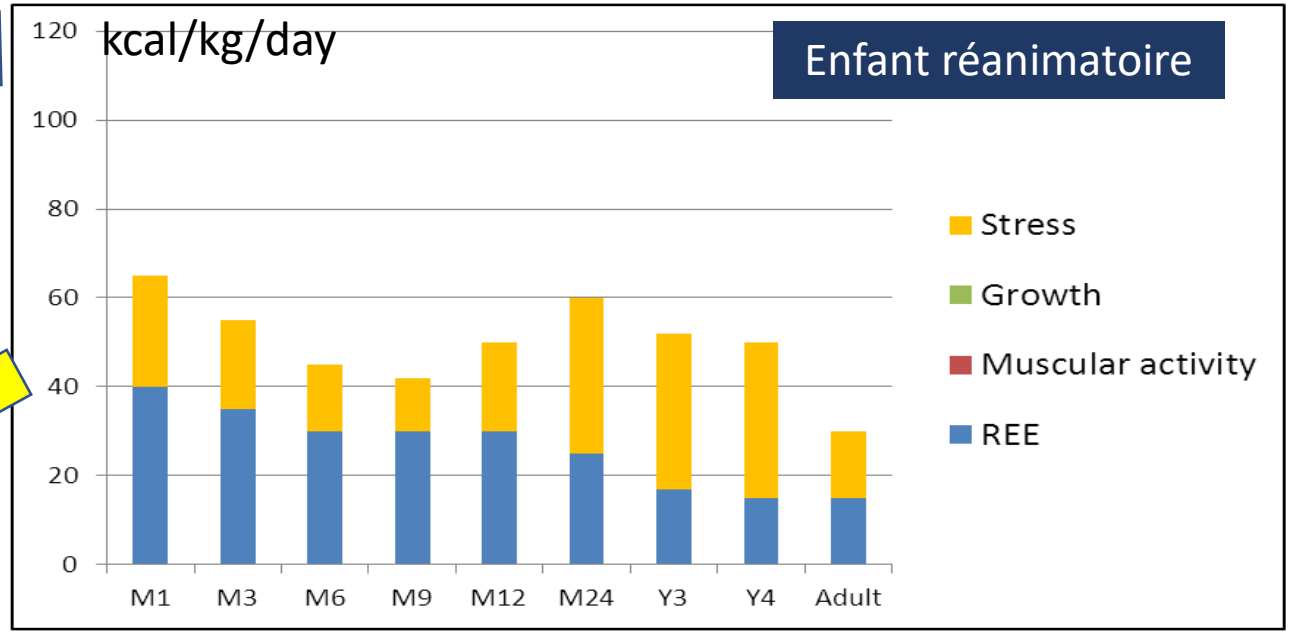
Jotterand et al JPEN 2018

Quels besoins énergétiques?





Stress : fièvre, infection, détresse respiratoire, cicatrisation



réanimatoire : intubé, ventilé, profondément sédaté

Avec l'amabilité du Dr Valla F, Lyon

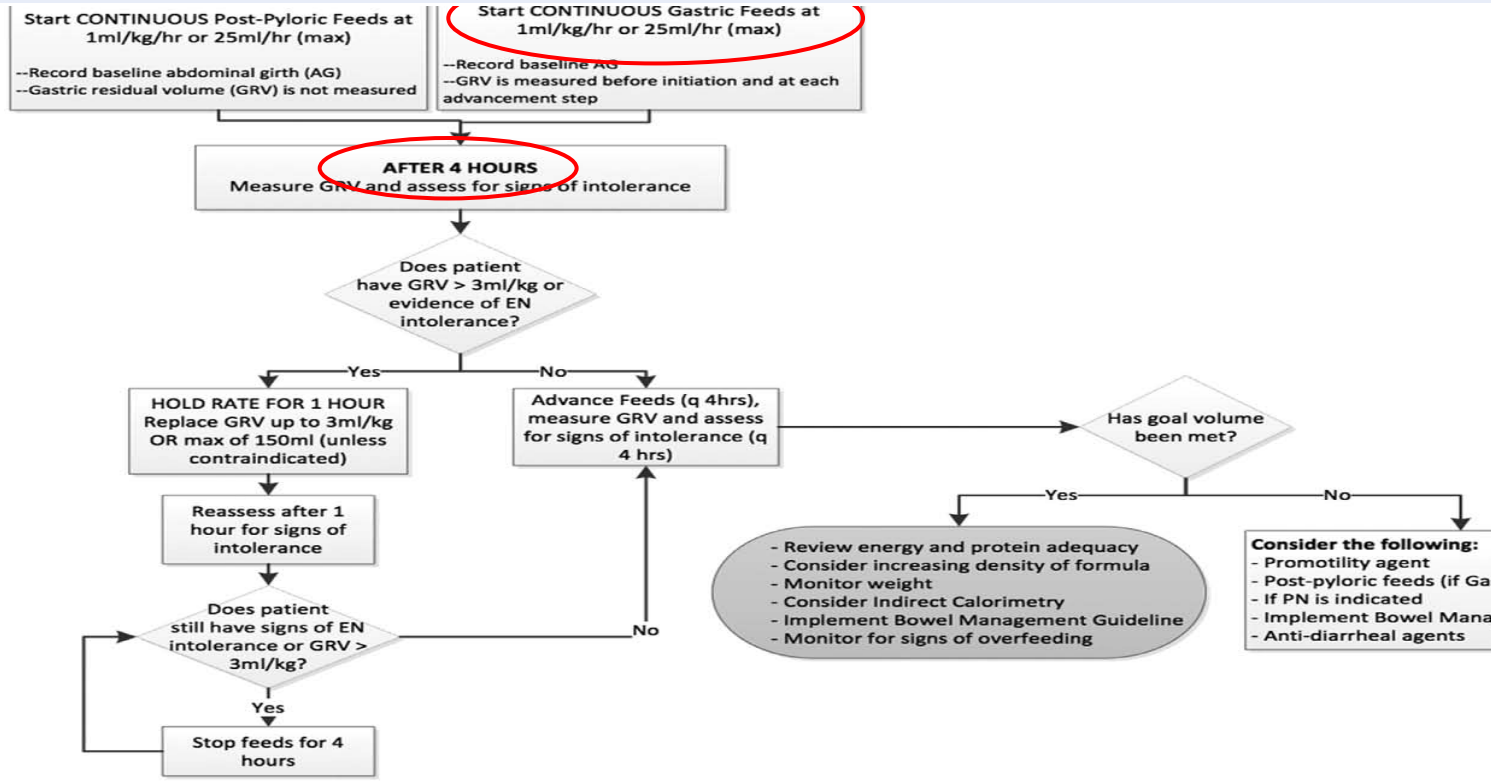
Apports en macro et micronutriments

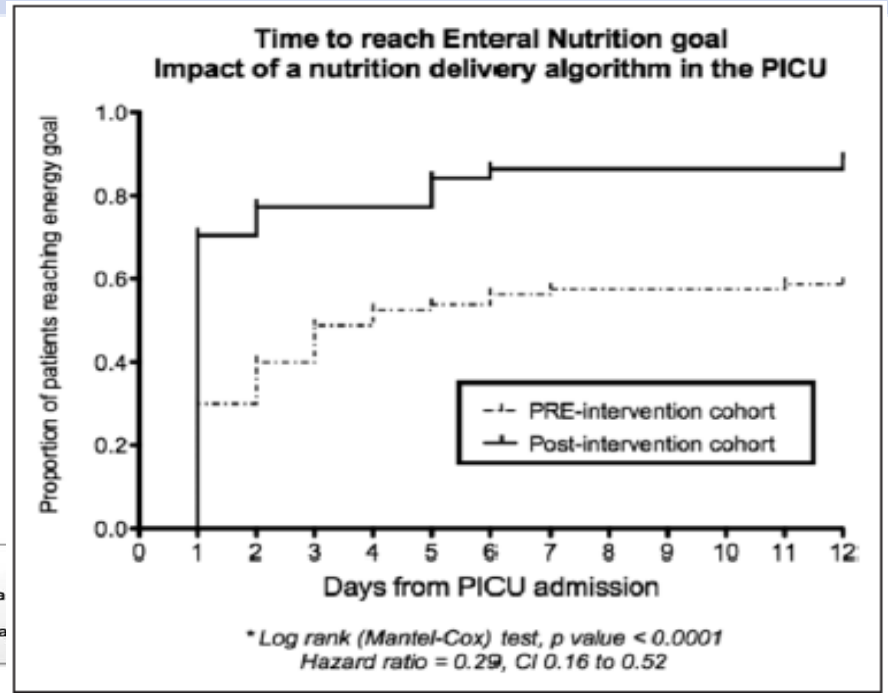
Apports/ kg/j	NNé à terme			1 mois à 10 Kg			10 Kg à 30 Kg			30 Kg à 45 Kg			> 45 Kg		
Phase	Aiguë	Stable	récup	Aiguë	Stable	récup	Aiguë	Stable	récup	Aiguë	stable	récup	Aiguë	Stable	récup
Eau (ml)	J0 : 40-50 +10-20 ml/kg/j Max 140-160			120-150			1-2 ans : 80-120 3-5 ans : 80-100 6-12 ans : 60-80			50-70					
Glucides (g)	3,6-7,2	7-14 (max 17)		2,9-5,8	5,8-8,6	8,6-14	2,2-3,6	2,8-5,8	4,3-8,6	1,4-2,2	2,2-4,3	4,3-5,8	0,7-1,4	1,4-2,9	2,9-4,3
Lipides (g)	Max 4			Max 3			Max 3								
Protéines (g)	Min : 1,5 Max 3			1,5 à 2 (max)			1,5 à 2 (max)								
Na (meq)	J1-3 : 0-2 1-3			2-3			1-3								
K (meq)	J1-3 : 0-3 2-3			1-3			1-3								
Ca (mg)	30-60			1m-6m : 30-60 7m-12m : 20			10-16								
Ph (mg)	20-40			1m-6m : 20-40 7m-12m : 15			6-22								
Mg (mg)	2,4-5			1m-6m : 2,4-5 7m-12m : 4			2,4								

Selon recos ESPGHAN 2018

Débuter précocement une entérale ++++

In critically ill children, when should enteral nutrition be commenced and how should it be increased?	2.1: It is recommended to commence early enteral nutrition within 24 h of admission unless contraindicated	D	Strong consensus	[58, 61, 64–69, 71]
	2.2: It is recommended to increase enteral nutrition in a stepwise fashion until goal for delivery is achieved using a feeding protocol or guideline	D	Strong consensus	[59, 60, 62, 63, 71, 72, 74–76]





Hamilton PCCM 2014

Early enteral feeding in newborn surgical patients

Gülşen Ekingen, M.D.[a], Canan Ceran, M.D.[b], B. Haluk Guvenc, M.D.[a,*], Ayse Tuzlaci, M.D.[a], Hayrünisa Kahraman, M.D.[a]

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[b] *Department of Pediatric Surgery, Cumhuriyet University Medical School, Sivas, Turkey*

Manuscript received February 19, 2004; accepted May 17, 2004.

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RCT 56 nouveau-nés (33 EN précoce vs standard)
2 sous groupes, anastomosis vs laparotomy

Comparison of clinical and laboratory data

	EEN-L	C-L	*P*	EEN-A	C-A	*P*
First defecation (h)	25.3 ± 12.8	52.2 ± 32.9	0.002*	35.8 ± 18.1	59.8 ± 31.7	0.02*
Duration of NG feeding (d)	4.7 ± 3.0	7.9 ± 8.9	0.96	6.9 ± 2.5	13.6 ± 9.3	0.01*
Full oral feeding (d)	6.3 ± 3.4	9.5 ± 9.3	0.61	8.4 ± 2.6	15.4 ± 10.2	0.01*
Hospital stay (d)	9.6 ± 6.1	14.1 ± 11.2	0.36	12.3 ± 6.1	21.4 ± 10.4	0.001*
WBC (after feeding)	12 400 ± 5378.8	11 533 ± 3910.6	0.44	17 113 ± 2438.4	13 363 ± 6365.4	0.44
Total bilirubin	12.2 ± 2.1	11.7 ± 4.1	0.07	12.8 ± 24.2	13.1 ± 18.5	0.07
Blood albumin	5.6 ± 3.1	5.8 ± 2.4	0.07	5.32 ± 3.7	5.11 ± 4.2	0.07

C-A, patients who underwent fasting and anastomosis; C-L, patients who underwent fasting and laparotomy; EEN-A, patients who received early enteral nutrition and anastomosis; EEN-L, patients who received early enteral nutrition and laparotomy; NG, nasogastric; WBC, white blood cells

* Significant at $P < 0.05$.

Pas plus de résidus, pas de lachage d'anastomose !!!

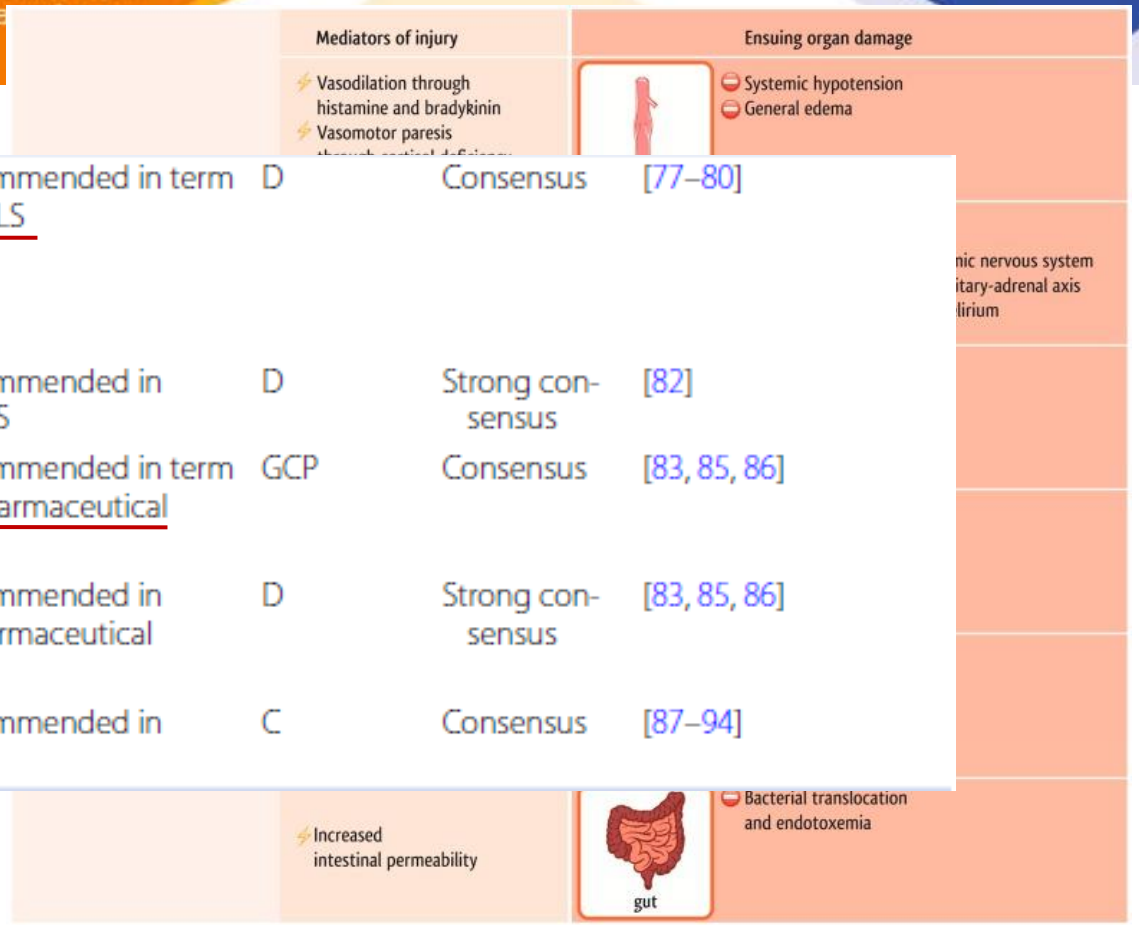
Ekingen Nutrition 21, 2005

Post-opératoire de chirurgie cardiaque

Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Fra
5 & 26 2022 ELLIER Le Corum



In critically ill children on haemodynamic support (vasoactive medications, extra-corporeal life support ECLS) does enteral feeding compared to no enteral feeding affect outcomes?	3.1: Early enteral nutrition is recommended in term neonates who are stable on ECLS	D	Consensus	[77–80]
	3.2: Early enteral nutrition is recommended in children who are stable on ECLS	D	Strong con-sensus	[82]
	3.3: Early enteral nutrition is recommended in term neonates who are stable on pharmaceutical haemodynamic support	GCP	Consensus	[83, 85, 86]
	3.4: Early enteral nutrition is recommended in children who are stable on pharmaceutical haemodynamic support	D	Strong con-sensus	[83, 85, 86]
	3.5: Early enteral nutrition is recommended in children after cardiac surgery	C	Consensus	[87–94]



Hill et al Nutrients 2018

Faut-il réellement attendre 7 jours?

The NEW ENGLAND JOURNAL of MEDICINE

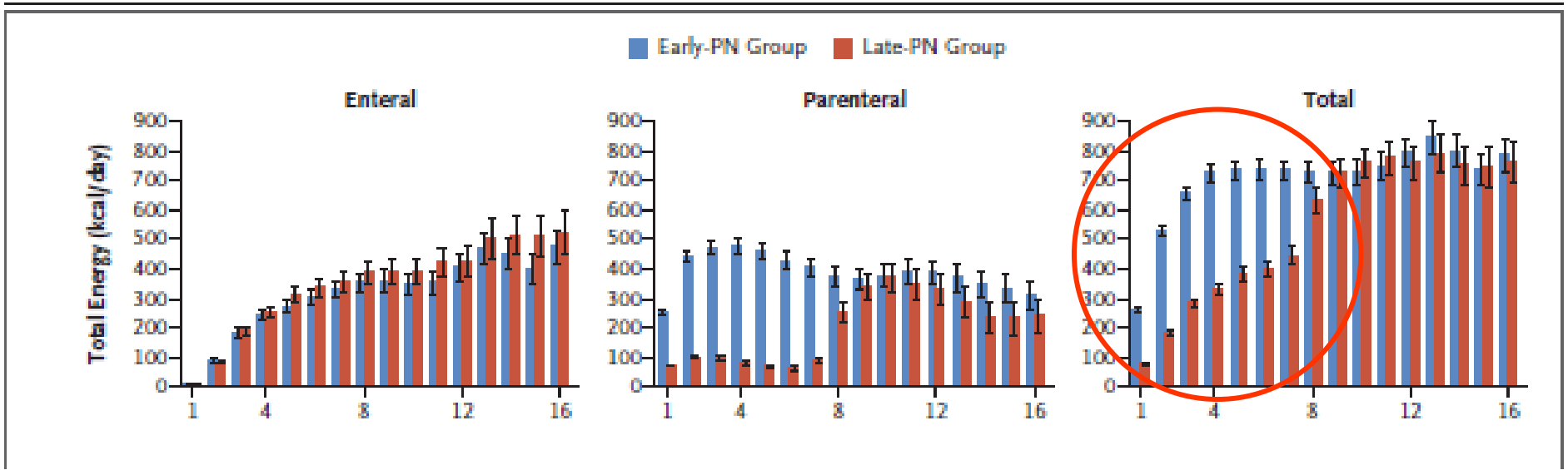
ORIGINAL ARTICLE

Early versus Late Parenteral Nutrition in Critically Ill Children

Tom Fivez, M.D., Dorian Kerklaan, M.D., Dieter Mesotten, M.D., Ph.D., Sascha Verbruggen, M.D., Ph.D., Pieter J. Wouters, M.Sc., Ilse Vanhorebeek, Ph.D., Yves Debaveye, M.D., Ph.D., Dirk Vlasselaers, M.D., Ph.D., Lars Desmet, M.D., Michael P. Casaer, M.D., Ph.D., Gonzalo Garcia Guerra, M.D., Jan Hanot, M.D., Ari Joffe, M.D., Dick Tibboel, M.D., Ph.D., Koen Joosten, M.D., Ph.D., and Greet Van den Berghe, M.D., Ph.D.

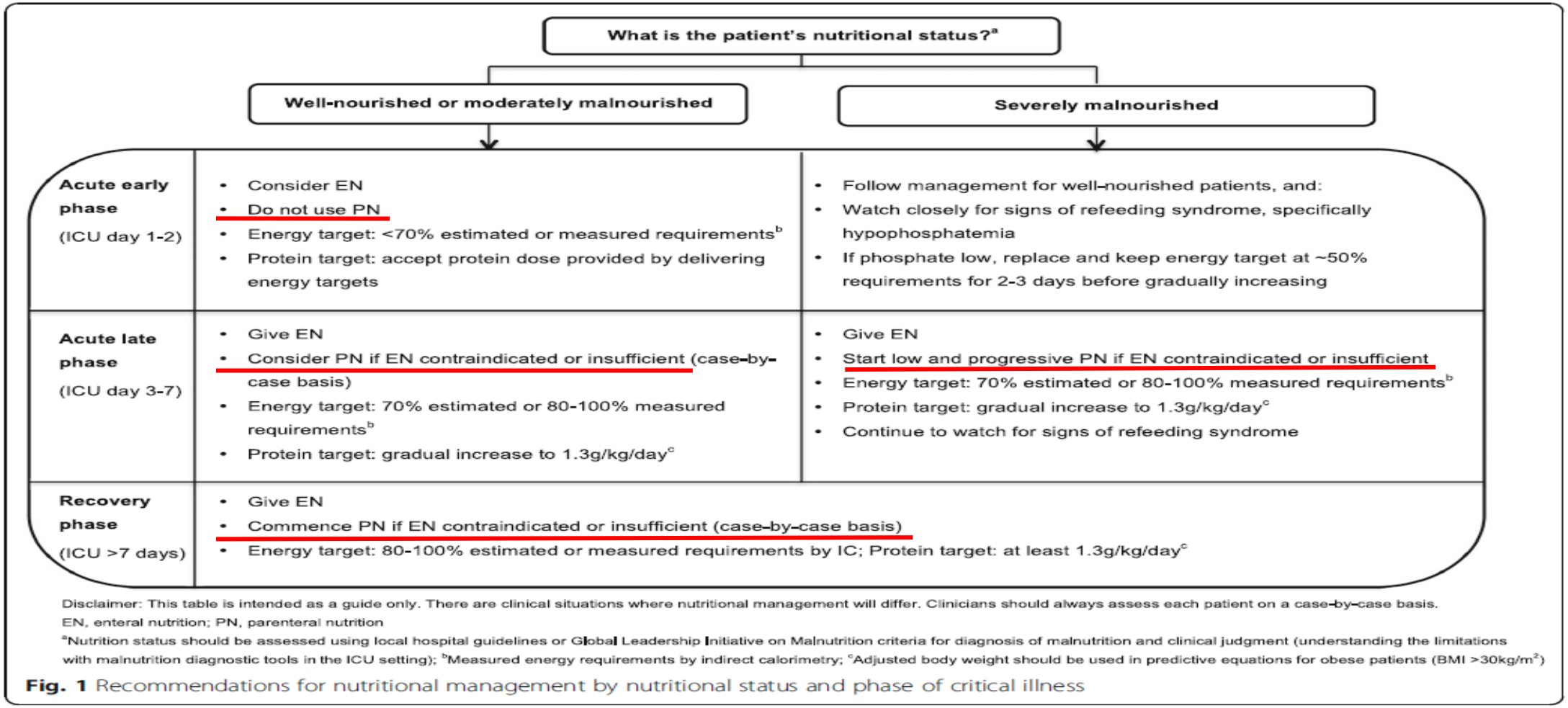
- Overfeeding en cas de NP précoce
- Mais si NP adaptée/REE : quel impact?

N Engl J Med. 2016 Mar 24;374(12):1111-22.



Indications de nutrition parentérale

- Parentérale de complément
  - Entérale insuffisante
- Parentérale totale
  - Entérale impossible



What is the patient's nutritional status?[a]

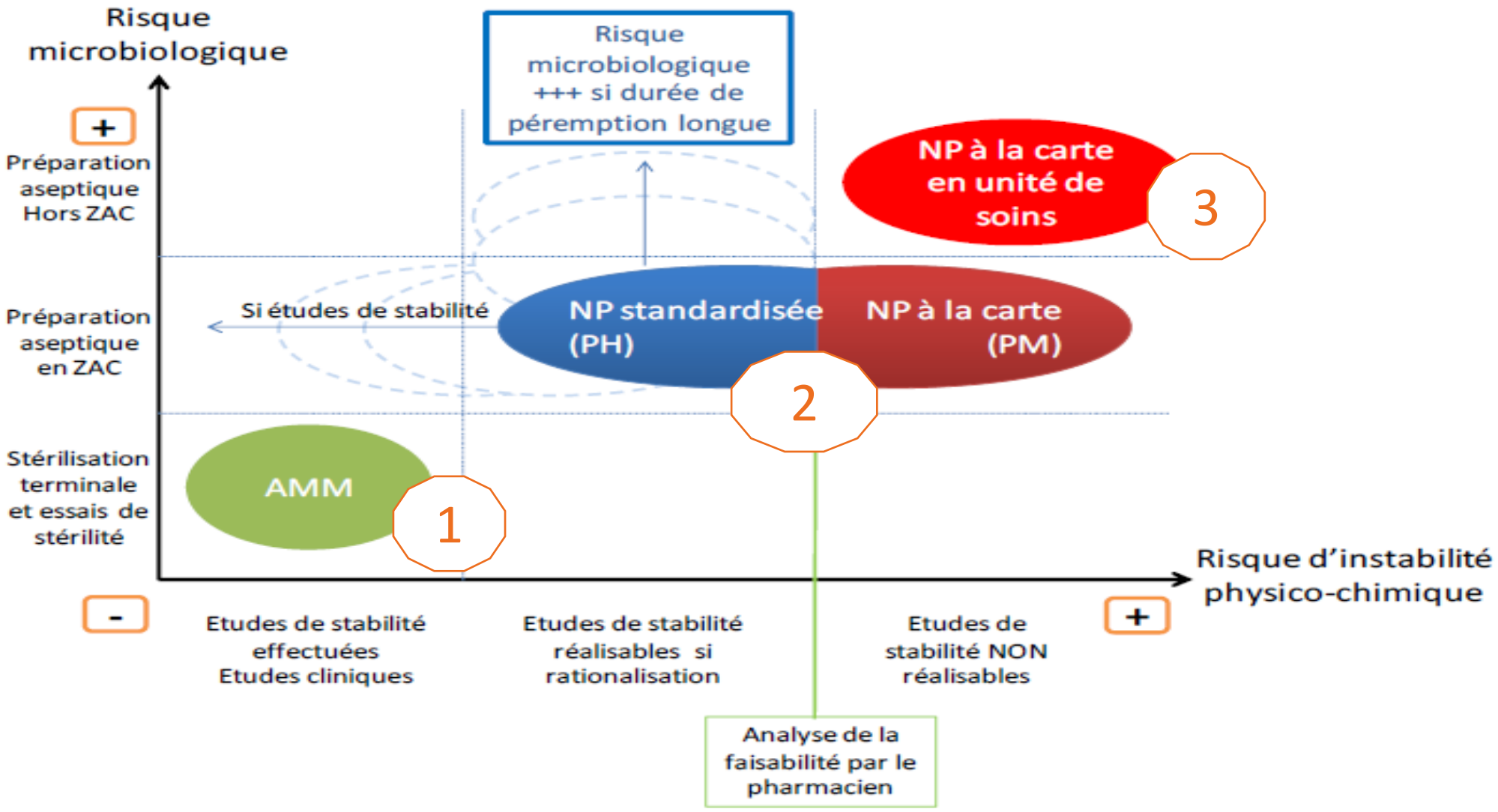
	Well-nourished or moderately malnourished	Severely malnourished
Acute early phase (ICU day 1-2)	• Consider EN • Do not use PN • Energy target: <70% estimated or measured requirements[b] • Protein target: accept protein dose provided by delivering energy targets	• Follow management for well-nourished patients, and: • Watch closely for signs of refeeding syndrome, specifically hypophosphatemia • If phosphate low, replace and keep energy target at ~50% requirements for 2-3 days before gradually increasing
Acute late phase (ICU day 3-7)	• Give EN • Consider PN if EN contraindicated or insufficient (case-by-case basis) • Energy target: 70% estimated or 80-100% measured requirements[b] • Protein target: gradual increase to 1.3g/kg/day[c]	• Give EN • Start low and progressive PN if EN contraindicated or insufficient • Energy target: 70% estimated or 80-100% measured requirements[b] • Protein target: gradual increase to 1.3g/kg/day[c] • Continue to watch for signs of refeeding syndrome
Recovery phase (ICU >7 days)	• Give EN • Commence PN if EN contraindicated or insufficient (case-by-case basis) • Energy target: 80-100% estimated or measured requirements by IC; Protein target: at least 1.3g/kg/day[c]	

Disclaimer: This table is intended as a guide only. There are clinical situations where nutritional management will differ. Clinicians should always assess each patient on a case-by-case basis.
EN, enteral nutrition; PN, parenteral nutrition
[a]Nutrition status should be assessed using local hospital guidelines or Global Leadership Initiative on Malnutrition criteria for diagnosis of malnutrition and clinical judgment (understanding the limitations with malnutrition diagnostic tools in the ICU setting); [b]Measured energy requirements by indirect calorimetry; [c]Adjusted body weight should be used in predictive equations for obese patients (BMI >30kg/m^2)

Fig. 1 Recommendations for nutritional management by nutritional status and phase of critical illness

Lambell et al, Critical care 2020

Quel type de soluté?



Rapport IGAS 2015

Les possibilités de parentérale

Soluté ternaire

Nné : Numetah G13%

<2 ans : Numetah G16%

>2ans : Numetah G19%



Soluté binaire +/- Lipides

Nné : Pediaven N2 (G11) ou sans OE (= G15%)

< 2 ans : Pediaven G15%

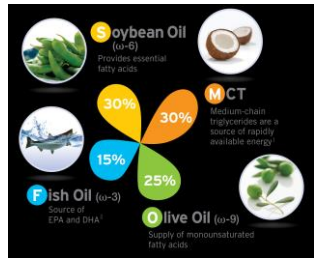
> 2 ans : Pediaven G20%





50 % soja, 50 % TCM





Alternative pour les >30 Kg (soluté adulte avec AMM à 2 ans)

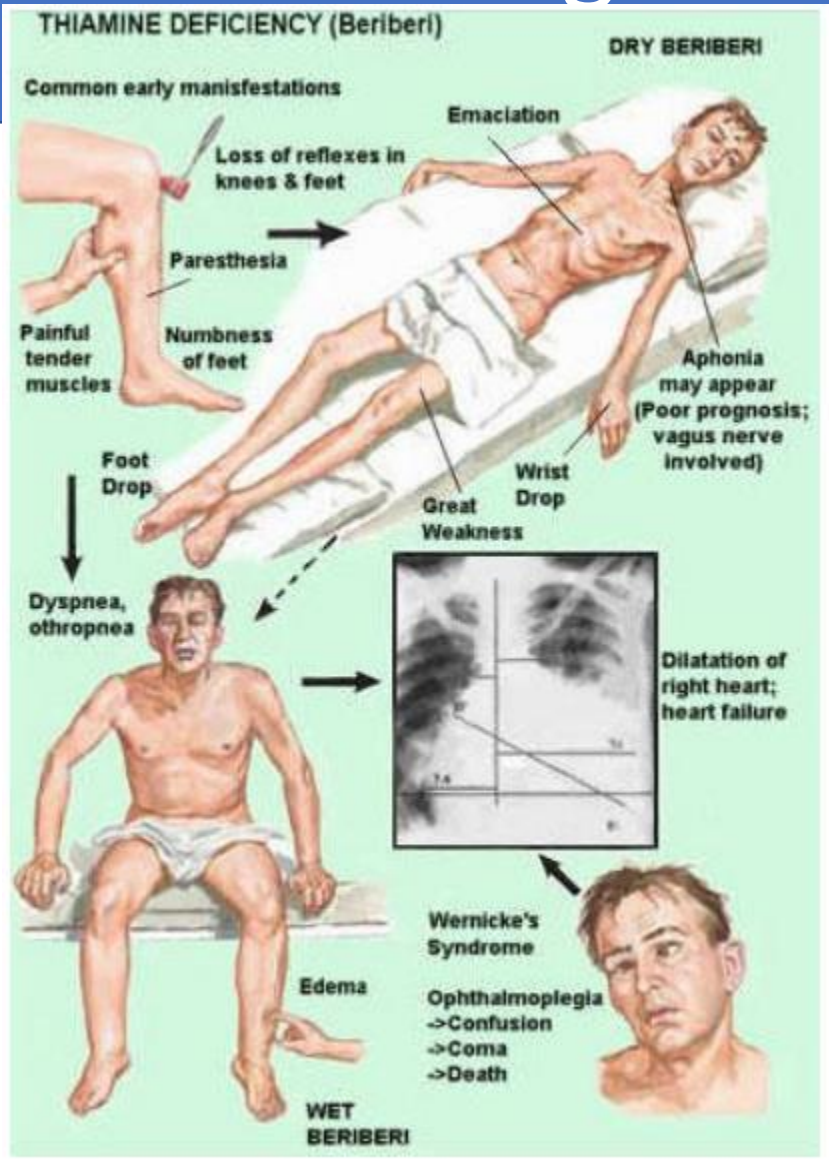
Olimel (N7E)



SmofKabivenE



Vitamines et oligo-éléments



urée d'administration pour éviter la dégradation

< 75-80 % des recos

ce dès la phase d'hydratation IV

CARENCE en B1

Polypnée d'acidose
Acidose lactique +++ (lactates jusqu'à 10 mmol/l)
Insuffisance cardiaque à haut débit ++

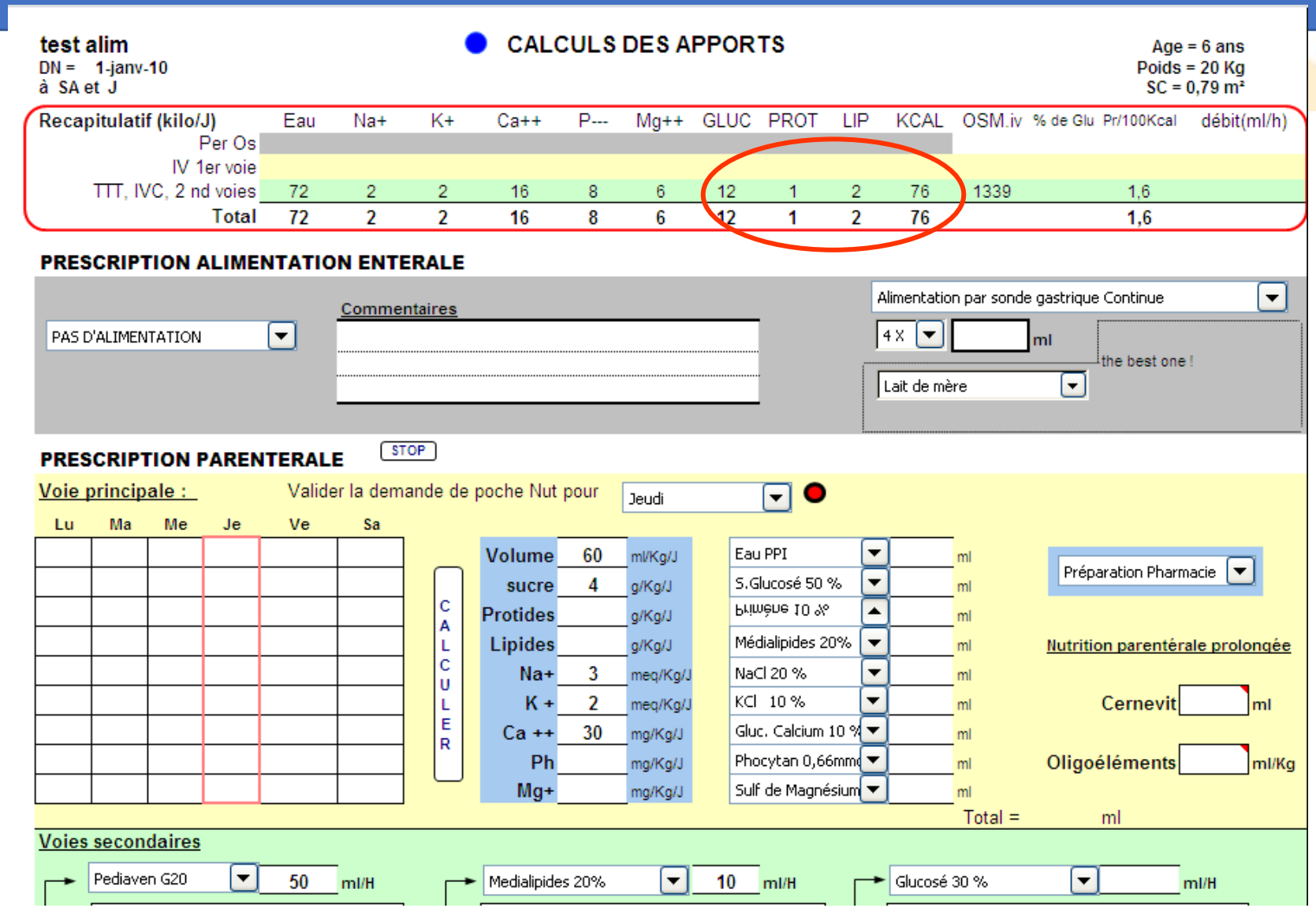
À ne pas confondre avec choc septique ++

Les conseils de prescription

- En **solution binaire** : ajuster le débit en fonction de la **quantité de glucide quotidienne** souhaitée et compléter avec du SSI ou G2,5 ou 5%
  - (Si débit poche nut= apports hydriques totaux -> Apports glucosé +++ et risque hyperglycémie)

- En **solution ternaire** : ajuster le débit pour un **apport calorique** quotidien. Si hydratation insuffisante adjonction de SSI ou G5%

Informatisation de la prescription



test alim
DN = 1-janv-10
à SA et J

CALCULS DES APPORTS

Age = 6 ans
Poids = 20 Kg
SC = 0,79 m²

Recapitulatif (kilo/J)	Eau	Na+	K+	Ca++	P---	Mg++	GLUC	PROT	LIP	KCAL	OSM.iv	% de Glu	Pr/100Kcal	débit(ml/h)
Per Os														
IV 1er voie														
TTT, IVC, 2 nd voies	72	2	2	16	8	6	12	1	2	76	1339		1,6	
Total	72	2	2	16	8	6	12	1	2	76			1,6	

PRESCRIPTION ALIMENTATION ENTERALE

PAS D'ALIMENTATION

Commentaires

Alimentation par sonde gastrique Continue
4 X ml
the best one !
Lait de mère

PRESCRIPTION PARENTERALE

STOP

Voie principale :

Valider la demande de poche Nut pour Jeudi

Lu	Ma	Me	Je	Ve	Sa

CALCULER

Volume	60	ml/Kg/J
sucre	4	g/Kg/J
Protides		g/Kg/J
Lipides		g/Kg/J
Na+	3	meq/Kg/J
K +	2	meq/Kg/J
Ca ++	30	mg/Kg/J
Ph		mg/Kg/J
Mg+		mg/Kg/J

Eau PPI		ml
S.Glucosé 50 %		ml
Primène 10 %		ml
Médialipides 20%		ml
NaCl 20 %		ml
KCl 10 %		ml
Gluc. Calcium 10 %		ml
Phocytan 0,66mm		ml
Sulf de Magnésium		ml

Total = ml

Préparation Pharmacie

Nutrition parentérale prolongée

Cernevit ml

Oligoéléments ml/Kg

Voies secondaires

Pediaven G20 50 ml/H

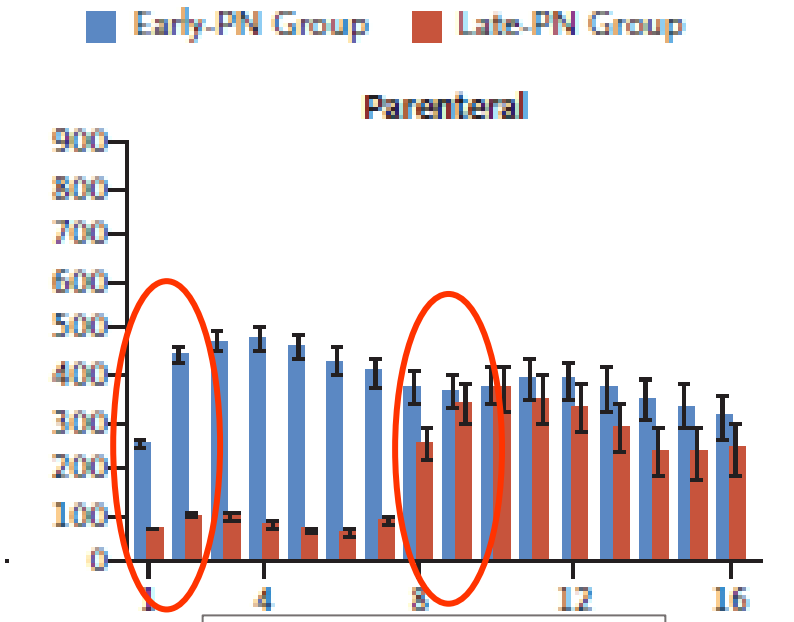
Medialipides 20% 10 ml/H

Glucosé 30 % ml/H

Vitesse introduction et augmentation

Pas de malnutrition ou modérée

Malnutrition sévère



Sur 2-3 jours

Fivez et al, NEJM, 2016

Augmentation lente et progressive des apports caloriques

Augmentation 10 à 25 % / 48h
Puis /j après 3-7 jours

Madre et al Réanimation 2012

Recommandations de bonnes pratiques

- PROCEDURE ECRITE DANS CHAQUE SERVICE
- Une parentérale = une voie centrale
- Une parentérale = 24 heures
- **Le soluté de NP est lié à la tubulure** :
  - changement de soluté = changement de tubulure
- A l'abri de la lumière (note ANSM septembre 2019)
- Traçabilité

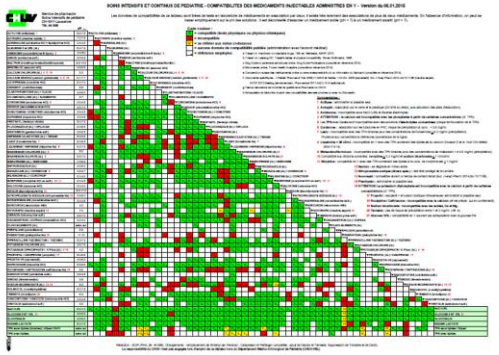
Recommandations de bonnes pratiques

- **Contrôles avant administration**
  - Contrôler **l'intégrité de la poche** par pression (absence de fuite).
  - Pour les poches bi- ou tri-compartimentées, contrôler la rupture complète des compartiments puis **homogénéisation** du mélange.
  - Contrôler la **limpidité de la solution** (mélanges binaires), l'absence de particules visibles ou précipités et de coloration anormale.
  - Vérifier **l'identité du patient**.
  - Vérifier **l'adéquation avec prescription**
  - Coller l'étiquette-patient sur la poche pour les poches non nominatives. Noter **l'heure limite de l'administration** (heure de pose + 24 heures).
  - Contrôler la **voie d'administration**

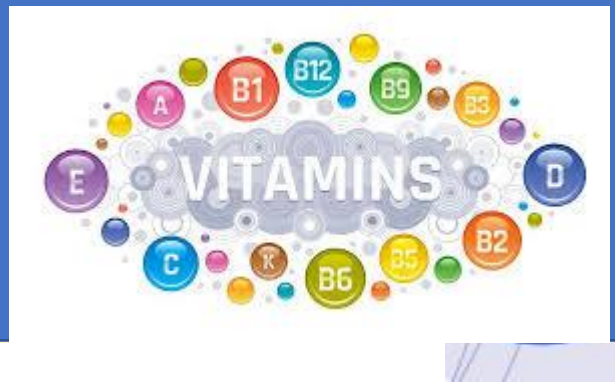
  - **Mise en place de filtres :** 1,2-1,5 µm pour les lipides; 0,2 µm pour les solutions aqueuses.

ATTENTION aux INCOMPATIBILITES

- Il existe les i**ncompatibilités physiques** et les **incompatibilités chimiques**.
  - **Incompatibilité physique** : changement physique: précipitation, coloration, aspect troubles
  - **Dégradation :** Résultat de réactions chimiques continues, irréversibles, aboutissant à la production d'entités chimiques distinctes, inactives et/ou potentiellement toxiques.
- Pour vous aider:
  - Trissel LA, Handbook of injectable drugs
  - Site STABILIS: incompatibilités entre tous les médicaments… site pas toujours simple à utiliser
  - Tableau pratique: CHU Genève



Quid de l'immunonutrition



- Non recommandée à ce jour…mais demain?

Vitamin A deficiency in critically ill children with sepsis

Xuepeng Zhang[1,2], Kaiying Yang[2], Linwen Chen[3], Xuelian Liao[1], Liping Deng[4], Siyuan Chen[1*†] and Yi Ji[2*†]

Vitamin D deficiency in critically ill children: a systematic review and meta-analysis

James Dayre McNally[1,2*], Nassr Nama[3], Katie O'Hearn[4], Margaret Sampson[1], Karin Amrein[5], Klevis Iliriani[6], Lauralyn McIntyre[7], Dean Fergusson[8] and Kusum Menon[1,2]

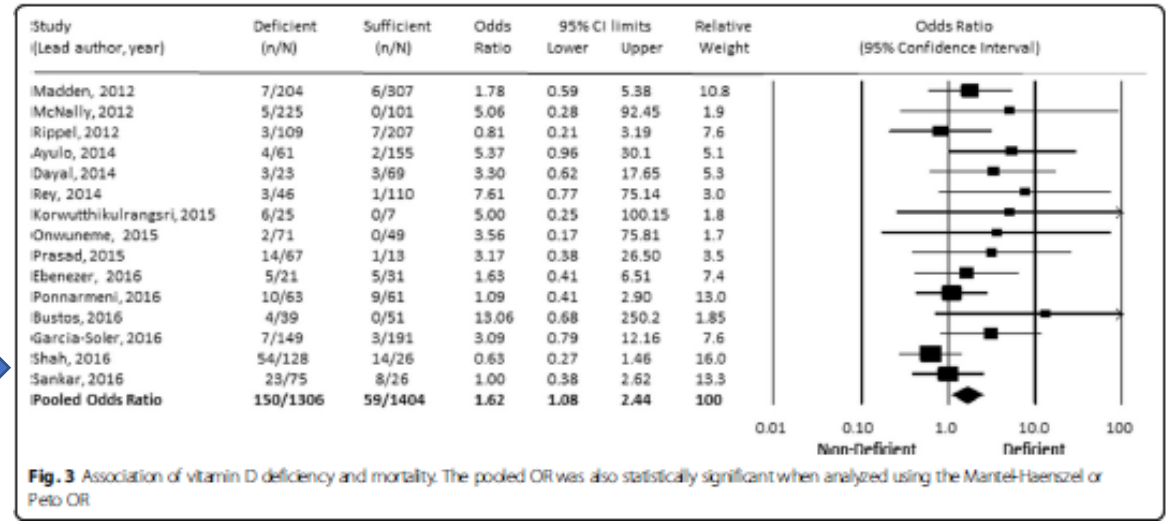


Fig. 3 Association of vitamin D deficiency and mortality. The pooled OR was also statistically significant when analyzed using the Mantel-Haenszel or Peto OR

WHAT'S NEW IN INTENSIVE CARE

Vitamin therapy in critically ill patients: focus on thiamine, vitamin C, and vitamin D

Karin Amrein[1*], Heleen M. Oudemans-van Straaten[2] and Mette M. Berger[3]

JAMA | Preliminary Communication | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Vitamin C, Hydrocortisone, and Thiamine vs Hydrocortisone Alone on Time Alive and Free of Vasopressor Support Among Patients With Septic Shock

The VITAMINS Randomized Clinical Trial

Lipides : Intérêt des huiles de poisson?



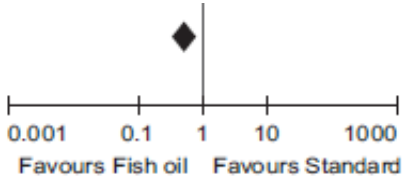
- Pas de soja seul +++
- Mélange avec ou sans huile de poisson
- Fish oil en **Post-op chirurgie adulte**



Infection

Total (95% CI)	**1419**	**1434**	**100.0%**	**0.52 [0.34, 0.80]**	
Total events	37	66			

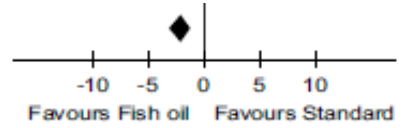
Heterogeneity: Chi² = 1.73, df = 8 (P = 0.99); I² = 0%
Test for overall effect: Z = 2.98 (P = 0.003)
Test for subgroup differences: Chi² = 0.51, df = 2 (P = 0.78), I² = 0%



Durée de séjour

Total (95% CI)	**529**	**522**	**100.0%**	**-2.14 [-3.02, -1.27]**	

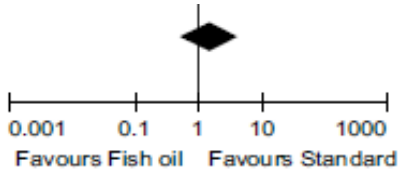
Heterogeneity: Chi² = 12.24, df = 10 (P = 0.27); I² = 18%
Test for overall effect: Z = 4.81 (P < 0.00001)
Test for subgroup differences: Chi² = 4.25, df = 3 (P = 0.24), I² = 29.4%



mortalité

Total (95% CI)	**418**	**408**	**100.0%**	**1.50 [0.54, 4.19]**	
Total events	9	6			

Heterogeneity: Chi² = 1.69, df = 1 (P = 0.19); I² = 41%
Test for overall effect: Z = 0.78 (P = 0.44)
Test for subgroup differences: Chi² = 1.69, df = 1 (P = 0.19), I² = 40.7%

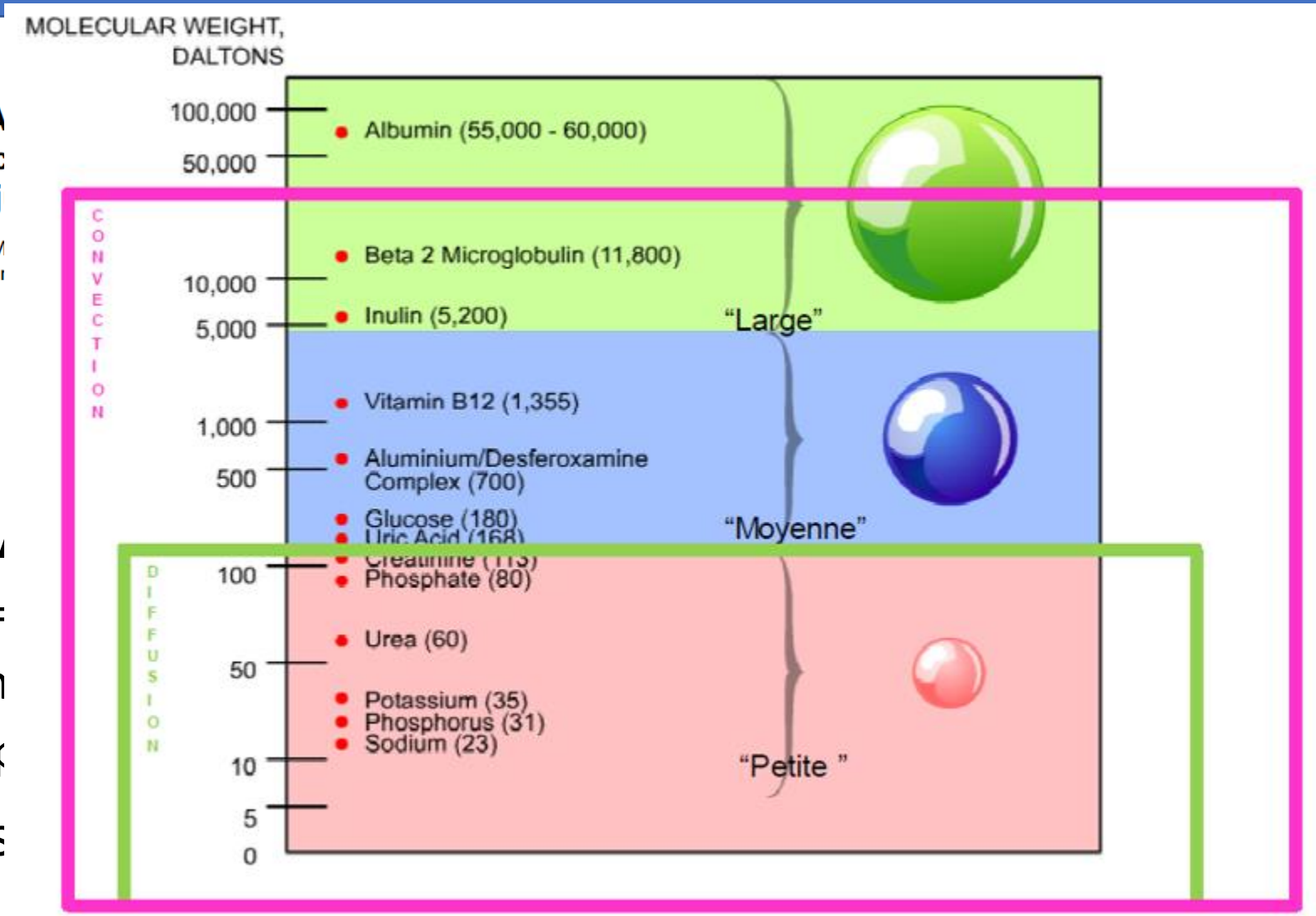


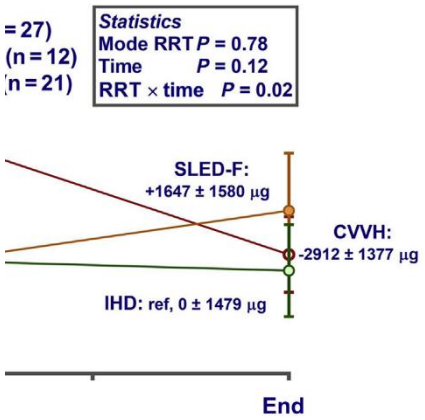
Li et al, Clinical Nutrition 2014

Cas particulier de l'épuration extra-rénale

Micronutrient and A
During Renal Replac
for Acute Kidney Inj

Weng C. Oh[1,4], Bruno Mafrici[1], M
Jennifer C. Allen[1,3], Ravi Mahajar





- **Perte d'A**
  - CVVH =
  - Environ
  - Des app
- Existe aus

old et al, CCM 2000

Cas particulier du brûlé

ESPEN endorsed recommendations: Nutritional therapy in major burns☆

2013

Anne-Françoise Rousseau[a], Marie-Reine Losser[b], Carole Ichai[c], Mette M. Berger[d,*]

Review

Nutritional therapy for burns in children and adults

2009

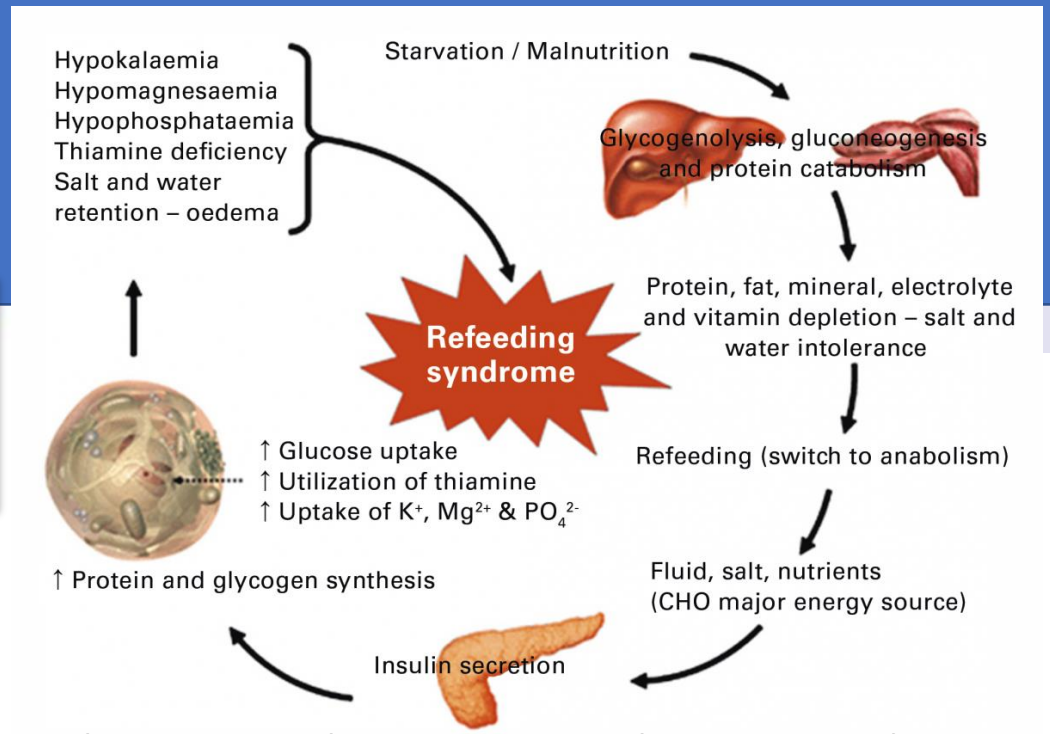
Melissa M. Chan, B.A., and Gary M. Chan, M.D.*

	Enfant
Apports caloriques	1,2 x mesuré en calorimétrie ou 1,5 X Schofield ou 65 Kcal/kg/j
Apports protidiques	2,5-4 g/kg/j
Calcul balance azotée	Protéine (g/j)/6.25 – [(urée urinaire (g) 24h/2.1)x1.2 + N selle + N brûlure (0.12g/kg/j)] Azote selles : 2g/j si < 4ans, 3g/j si 4-10 ans, 4g/j > 10 ans Urée mmol/16,6 = urée g Objectif balance +
Répartition macronutriments	glucides 60-70% – lipides 20-25% des calories totales
Vitamines quotidiennes	Vit A 5000UI, vit C 500 mg, vit D 600 UI, Ca 1000-1500 mg
Elt traces	Glutamine 0,3-0,5 g/kg/j les 5-10 1ers jours, Vit C 66 mg/kg/h pdt 24h Zinc 30-110 mg/j, Cu 0,08 mg/kg (max 4,5 mg), Se 50-200 µg/kg/j Durée : brulures 20-40% : 7-8 jours, 40-60% : 2 semaines, > 60% : 30 jours
Surveillance hebdo	Préalbumine 14-43 mg/dL, vit A, E, D, Cu, Zn, Se, ostéodensitométrie à la sortie

Syndrome de renutrition

ASPEN Consensus Recommendations for Refeeding Syndrome

Nutrition in Clinical Practice
Volume 35 Number 2
April 2020 178–195
© 2020 American Society for Parenteral and Enteral Nutrition
DOI: 10.1002/ncp.10474
wileyonlinelibrary.com
WILEY



- Si FDR : dénutrition, perte de poids récente

- Def : baisse de Ph et/ou K et/ou Mg de 10-20% (minime) 20-30 % (modéré) ou > 30% et/ou dysfonction d'organe (tb ionique ou carence en Vit B1) (sévère) dans les 5 jours de réintroduction des calories
- Risques: Retention hydrosodée ++, trouble neuro, trouble hémodynamique

→ Baisse des apports caloriques +++

correction des carences en électrolytes +++/vitamines B1-B6

TAKE HOME MESSAGE

- La nutrition est aussi importante que les amines, la sédation, les antibiotiques
- La voie orale/entérale est à privilégier
- La nutrition parentérale (NP) peut être décalée de quelques jours
- En cas de NP, ne pas oublier les vitamines
- Des pistes potentiellement intéressantes
  - Cocktails vitaminiques
  - Mélange lipidique/huile de poisson