DEUXIÈME JOURNÉES
FRANCOPHONE
DE RÉANIMATION

Nutrition d'un patient sous hémodiafiltration / hémodialyse intermittente

Dr Imen Ben Saida
Réanimation médicale Farhat Hached Sousse

Global epidemiology and outcomes of acute kidney injury

Eric A. J. Hoste[1], John A. Kellum[2], Nicholas M. Selby[3], Alexander Zarbock[4], Paul M. Palevsky[5], Sean M. Bagshaw[6], Stuart L. Goldstein[7], Jorge Cerdá[8] and Lakhmir S. Chawla[9]*

Population	Age	Incidence (range)	RRT requirement (%)	Mortality (%)
Non-ICU hospitalized patients	Adult	<1 in 5 patients	<10	10–20
Critically ill patients	Adult	1 in 3 to 2 in 3 patients	5–11	NR
	Paediatric	1 in 4 patients (10–82%)	1–2	11
Patients undergoing cardiac surgery	Adult	1 in 5 patients (2–50%)	<5	10
	Paediatric	1 in 3 to 1 in 2 patients	NR	6
Patients with sepsis	Adult	1 in 20 to 1 in 2 patients	15	30–60

ICU, intensive care unit; NR, not reported; RRT, renal replacement therapy.

NATURE REVIEWS | NEPHROLOGY
VOLUME 14 | OCTOBER 2018

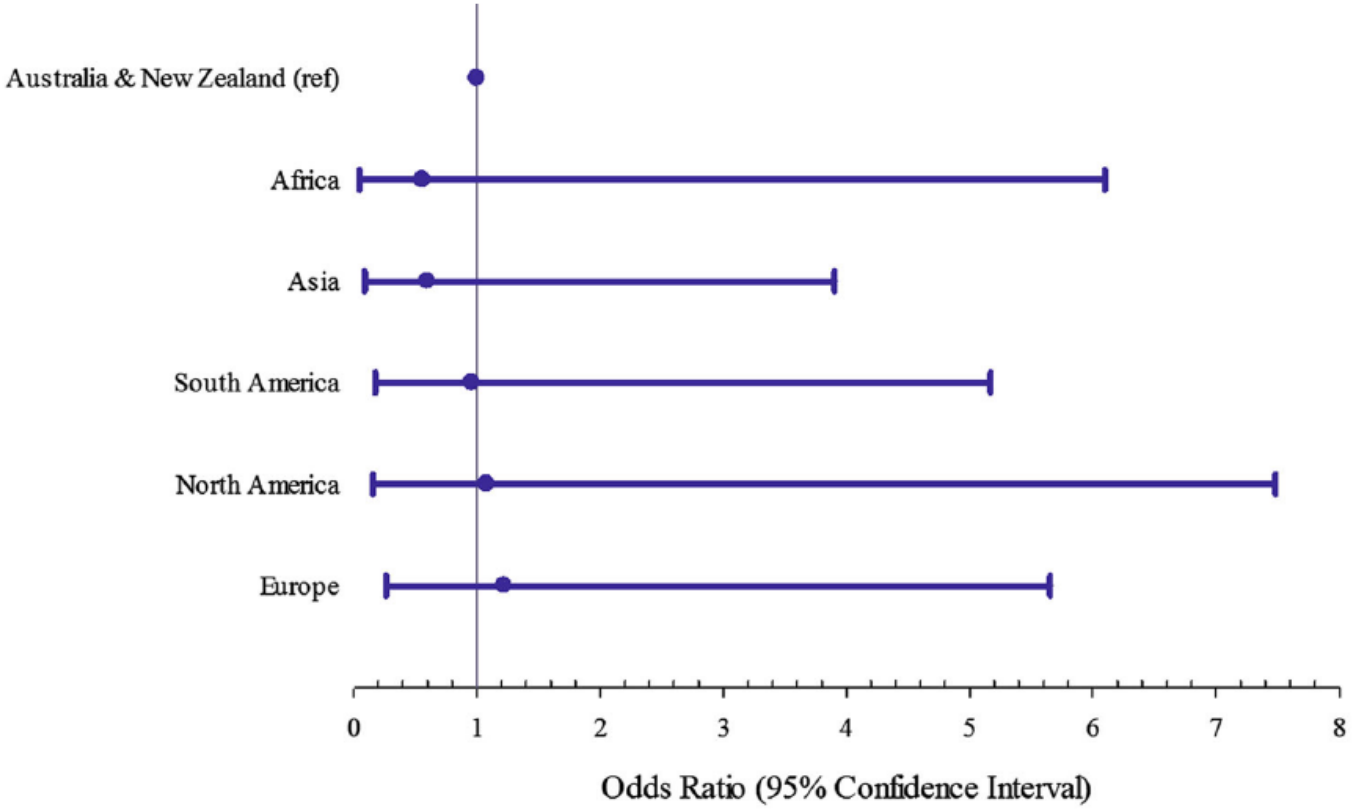
Intensive Care Med (2015) 41:1411–1423

Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study

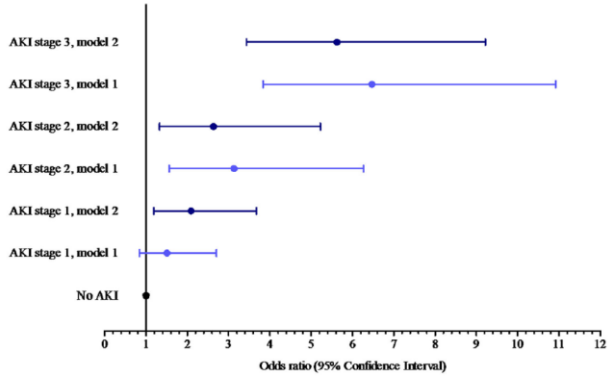
- Etude transversale multicentrique (1 semaine),
- plus de **1800** patients de **97 réanimations** dans **33** pays.
- Le diagnostic d'IRA selon **les critères KDIGO**
- 57% IRA toute gravité
- 39% stade 2 ou 3
- 13,5 % EER (23,5% IRA)

Intensive Care Med (2015) 41:1411–1423

Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study



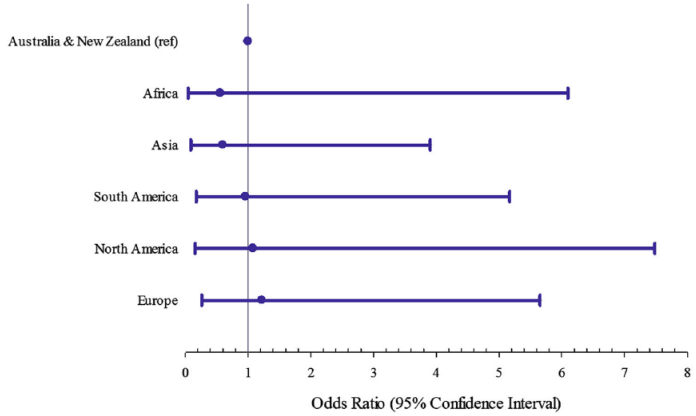
Adjusted association of continent and mortality of AKI



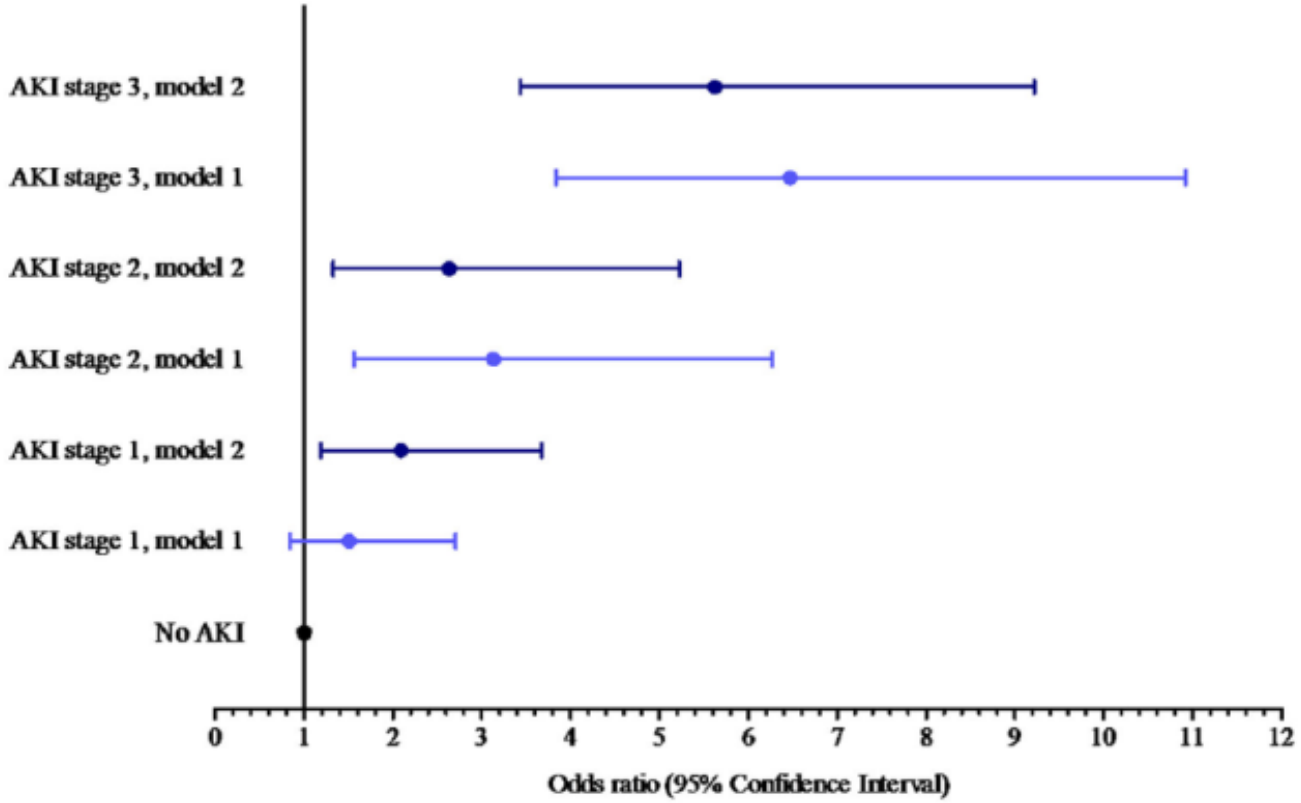
Adjusted odds ratio for mortality per AKI severity grade.

Intensive Care Med (2015) 41:1411–1423

Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study



Adjusted association of continent and mortality of AKI



Adjusted odds ratio for mortality per AKI severity grade.

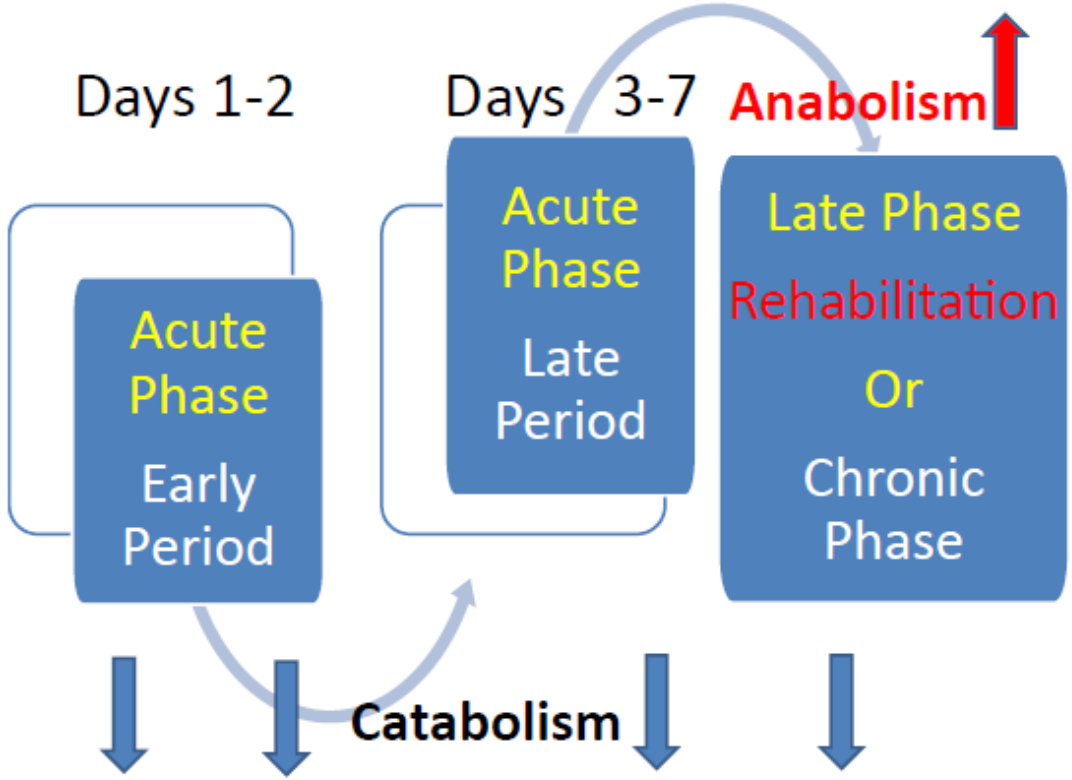
Clinical Nutrition 38 (2019) 48–79

ESPEN Guideline

ESPEN guideline on clinical nutrition in the intensive care unit

Pierre Singer [a, *], Annika Reintam Blaser [b, c], Mette M. Berger [d], Waleed Alhazzani [e], Philip C. Calder [f], Michael P. Casaer [g], Michael Hiesmayr [h], Konstantin Mayer [i], Juan Carlos Montejo [j], Claude Pichard [k], Jean-Charles Preiser [l], Arthur R.H. van Zanten [m], Simon Oczkowski [e], Wojciech Szczeklik [n], Stephan C. Bischoff [o]

La nutrition artificielle = le traitement de support de la **réponse métabolique** du **patient agressé**



Journal of Parenteral and Enteral Nutrition

Association Between Malnutrition and Clinical Outcomes in the Intensive Care Unit: A Systematic Review

Charles Chin Han Lew, B Nutr Diet (Hons), APD, CNSC[1,2]; Rosalie Yandell, PhD, APD[1]; Robert J. L. Fraser, PhD, MBBS, FRACP[3]; Ai Ping Chua, MBBS, MMed[4]; Mary Foong Fong Chong, PhD, BSc (Hons)[5]; and Michelle Miller, PhD, Adv APD[1]

Authors	n (m/s)	Age, y	Severity Score	Tool	Malnutrition, %	Mortality, %		Length of Stay, d
Sungurtekin et al[23]	124 (55/45)	56	APACHE II: 25[a]	SGA	Moderate: 26.6 Severe: 11.3	Total: Well-nourished: Malnourished:	ICU: 23.4 ICU: 14.3 ICU: 38.3 $P < .05$	— — —
Küçükardali et al[8]	342 (100/0)	67	APACHE II: 19[a]	NRS-2002	Moderate and severe: 39.4	Total: Well-nourished: Malnourished:	Hosp: 26.9 Hosp: 10.6 Hosp: 51.8 $P = .02$	Hosp: 6.6[a] Hosp: 6.4 Hosp: 7.9 $P < .05$
Sheean et al[27]	49 (100/0)	56	APACHE II: 24 (SD: NA) APACHE IV: 80 (SD: NA)	SGA	Moderate and severe: 49.0	Total: Well-nourished: Malnourished:	— — —	ICU: 10.8[a] ICU: 11.1 ICU: 10.5 $P = .76$
Caporossi et al[20]	246 (61/39)	62[b]	APACHE II: 18[b] (range, 5–37)	SGA	Moderate: 53.7 Severe: 24.4	Total: Well-nourished: Malnourished:	ICU: 20.3 ICU: 5.9 ICU: 24.5 AOR: 2.00 (95% CI: 0.50, 7.60); $P = .28$	ICU: 9.0 — — AOR: 21.00 (95% CI: 2.80, 157.70); $P < .01$
Coltman et al[21]	294 (NA)	59	APACHE II: 13 (SD: 6.2)	SGA	Moderate and severe: 37.8	Total: Well-nourished: Malnourished:	Hosp: 7.1 Hosp: 4.4[c] Hosp: 11.7 OR: 2.90 (95% CI: 1.16, 7.24); $P = .02$[c]	ICU: 4.3, Hosp: 8.5 ICU: 3.7, Hosp: 6.9 ICU: 5.4, Hosp: 9.9

La malnutrition était **indépendamment associée** à une augmentation de

- la **durée de séjour** en réanimation,
- aux **réadmissions** en réanimation,
- à **l'incidence des infections**
- et au risque de **mortalité hospitalière**.

Journal of Parenteral and Enteral Nutrition

Association Between Malnutrition and Clinical Outcomes in the Intensive Care Unit: A Systematic Review

Charles Chin Han Lew, B Nutr Diet (Hons), APD, CNSC[1,2];
Rosalie Yandell, PhD, APD[1]; Robert J. L. Fraser, PhD, MBBS, FRACP[3];
Ai Ping Chua, MBBS, MMed[4]; Mary Foong Fong Chong, PhD, BSc (Hons)[5];
and Michelle Miller, PhD, Adv APD[1]

Types of Patients in the ICU	Prevalence of Malnutrition
Heterogeneous group[8,20,21,23,26-32]	37.8%–78.1%
Elderly[34]	23.2%–34.4%
Cardiac surgery[22]	5.0%–20.0%
Liver transplantation[26,27]	52.6%
Acute kidney injury[39]	82.0%

ICU, intensive care unit.

Prevalence of Malnutrition.

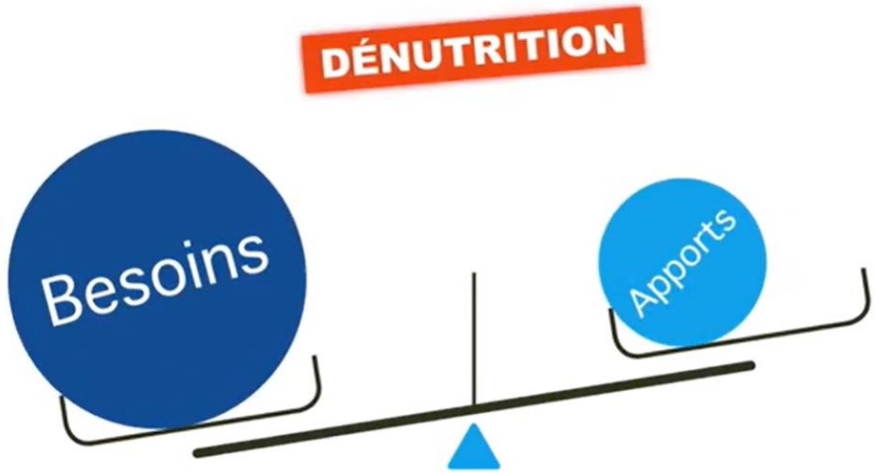
Clinical Nutrition ESPEN 65 (2025) 348–356

Clinical nutrition in patients with Acute Kidney Injury: Traditional approaches and emerging perspectives

Francesca Di Mario [a, *], Alice Sabatino [b], Enrico Fiaccadori [a, c]

- **International Society of Renal Nutrition and Metabolism (ISRNM)**
- **"Dénutrition Protéino-Énergétique " (ou "Protein Energy Wasting - PEW"**

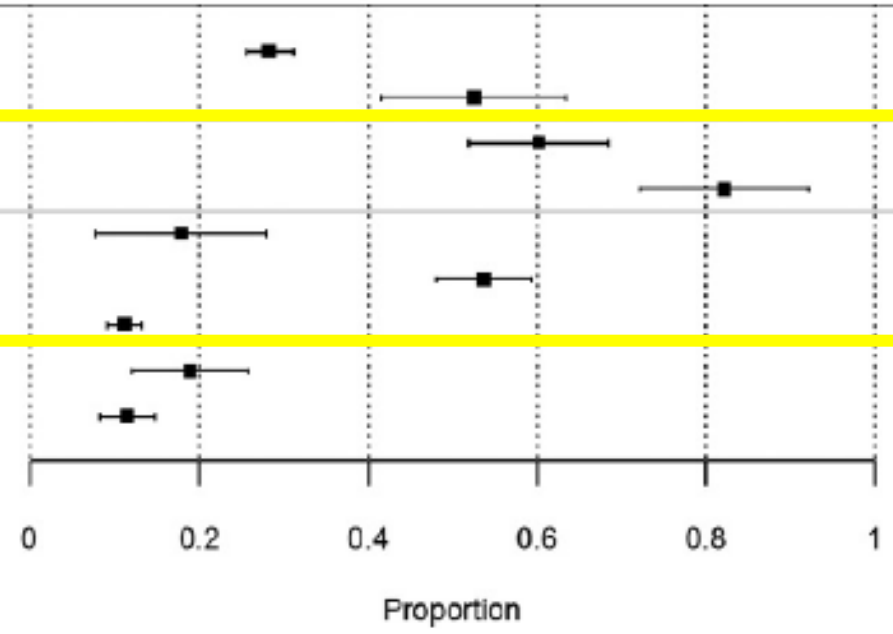
  un état de **diminution** des réserves corporelles en **protéines** et en **énergie** (**masse maigre** et **masse grasse**).



Journal of Renal Nutrition, Vol 28, No 6 (November), 2018: pp 380-392

Global Prevalence of Protein-Energy Wasting in Kidney Disease: A Meta-analysis of Contemporary Observational Studies From the International Society of Renal Nutrition and Metabolism

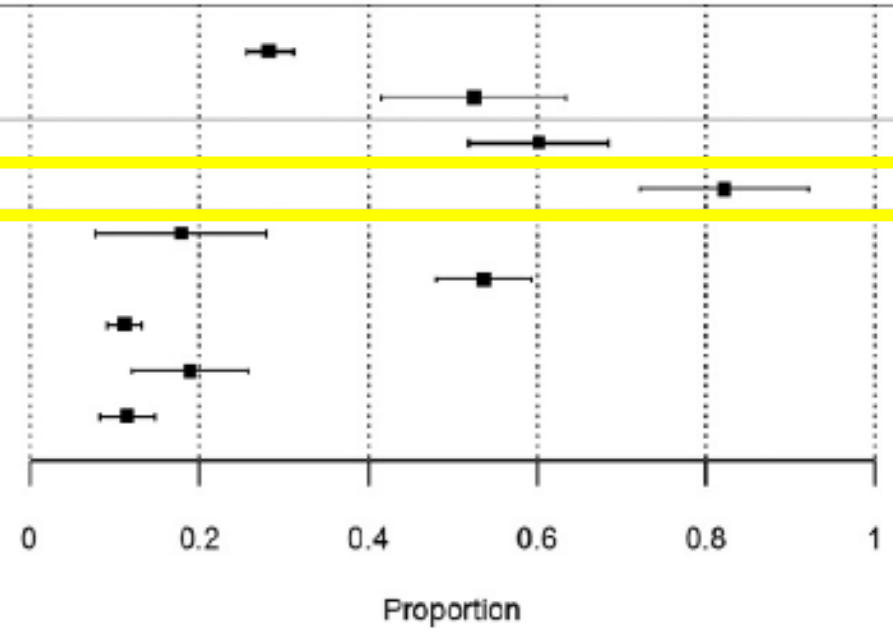
Author(s) and Year	Focus on	Country	N	Cases	Prop. [95% CI]
Molnar MZ - 2011	Tx	Hungary	987	279	0.28 [0.25, 0.31]
Malgorzewicz S - 2014	Tx	Poland	80	42	0.52 [0.42, 0.63]
Berbel MN - 2014	AKI	Brazil	133	80	0.60 [0.52, 0.68]
Guimarães SM - 2008	AKI	Brazil	56	46	0.82 [0.72, 0.92]
Campbell KL - 2008	CKD	Australia	56	10	0.18 [0.08, 0.28]
Amparo FC - 2014	CKD	Brazil	300	161	0.54 [0.48, 0.59]
Cuppari L - 2014	CKD	Brazil	922	102	0.11 [0.09, 0.13]
Sanches FMR - 2008	CKD	Brazil	122	23	0.19 [0.12, 0.26]
Westland GJ - 2014	CKD	Netherlands	376	43	0.11 [0.08, 0.15]



Journal of Renal Nutrition, Vol 28, No 6 (November), 2018: pp 380-392

Global Prevalence of Protein-Energy Wasting in Kidney Disease: A Meta-analysis of Contemporary Observational Studies From the International Society of Renal Nutrition and Metabolism

Author(s) and Year	Focus on	Country	N	Cases	Prop. [95% CI]
Molnar MZ - 2011	Tx	Hungary	987	279	0.28 [0.25, 0.31]
Malgorzewicz S - 2014	Tx	Poland	80	42	0.52 [0.42, 0.63]
Berbel MN - 2014	AKI	Brazil	133	80	0.60 [0.52, 0.68]
Guimarães SM - 2008	AKI	Brazil	56	46	0.82 [0.72, 0.92]
Campbell KL - 2008	CKD	Australia	56	10	0.18 [0.08, 0.28]
Amparo FC - 2014	CKD	Brazil	300	161	0.54 [0.48, 0.59]
Cuppari L - 2014	CKD	Brazil	922	102	0.11 [0.09, 0.13]
Sanches FMR - 2008	CKD	Brazil	122	23	0.19 [0.12, 0.26]
Westland GJ - 2014	CKD	Netherlands	376	43	0.11 [0.08, 0.15]

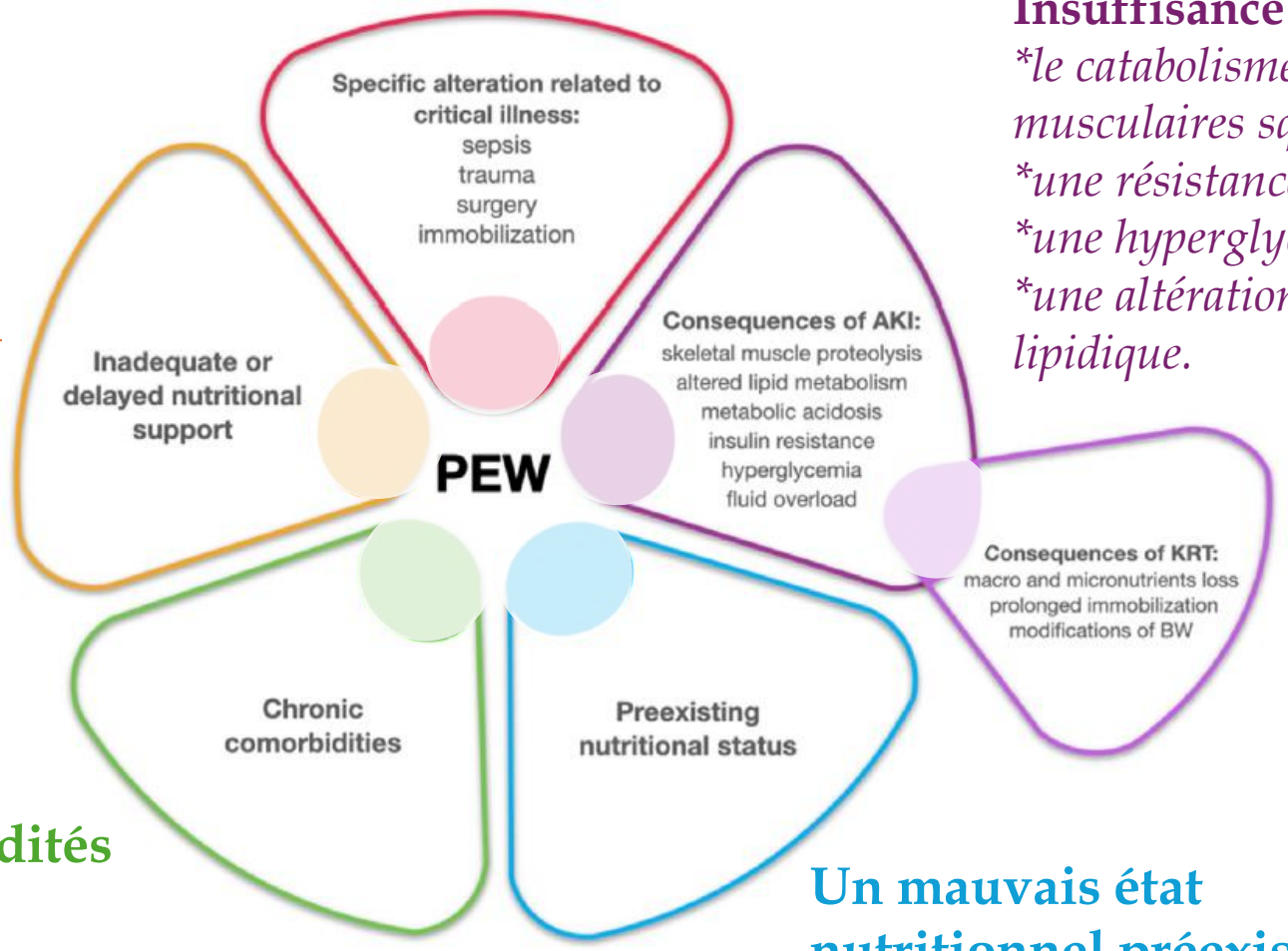


Clinical Nutrition ESPEN 65 (2025) 348–356
F. Di Mario, A. Sabatino and E. Fiaccadori

Hypercatabolisme
(sepsis, traumatisme, chirurgie,, etc.)

Insuffisance rénale aigue
**le catabolisme des protéines musculaires squelettiques*
**une résistance à l'insuline*
**une hyperglycémie*
**une altération du métabolisme lipidique.*

Un soutien nutritionnel inadéquat



EER
**Les pertes*
**Immobilisation*

Les comorbidités

Un mauvais état nutritionnel préexistant

Key predisposing factors contributing to PEW in hospitalized patients with AKI.

Clinical Nutrition ESPEN xxx (2018) e1–e5

Low caloric and protein intake is associated with mortality in patients with acute kidney injury

M.N.B. Bufarah [a, *], N.A. Costa [a], M.P.R.P. Losilla [b], N.S.C. Reis [a], M.Z.C. Silva [a], A.L. Balbi [a], D. Ponce [a]

- **Etude observationnelle prospective**
- **595 patients consécutifs** présentant une IRA et nécessitant une nutrition entérale ou parentérale

Logistic regression model for predicting mortality in patients with AKI.

Variable	OR	CI 95%	Value *p*
Calorie intake (kcal/day)	0.946	0.901–0.994	**0.029**
Protein intake (g/day)	0.947	0.988–0.992	**0.028**
Albumin (g/dl)	0.545	0.401–0.741	<0.001
Cholesterol (mg/dL)	0.995	0.991–1.000	0.052

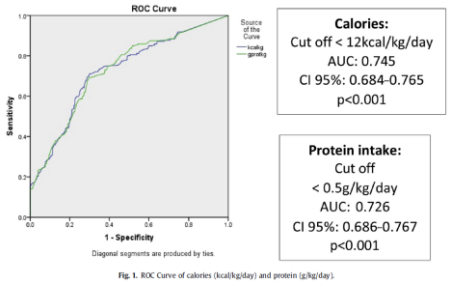
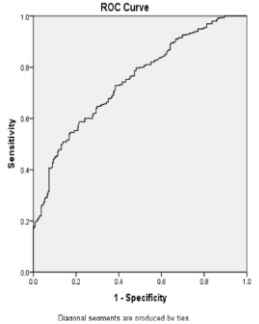


Fig. 1. ROC Curve of calories (kcal/kg/day) and protein (g/kg/day).

Calories:
Cut off < 12kcal/kg/day
AUC: 0.745
CI 95%: 0.684-0.765
p<0.001

Protein intake:
Cut off
< 0.5g/kg/day
AUC: 0.726
CI 95%: 0.686-0.767
p<0.001



Nitrogen Balance:
Cut off< -6.47gN/day
AUC: 0.745
IC 95%: 0.704-0.786
p<0.001

Clinical Nutrition ESPEN xxx (2018) e1–e5

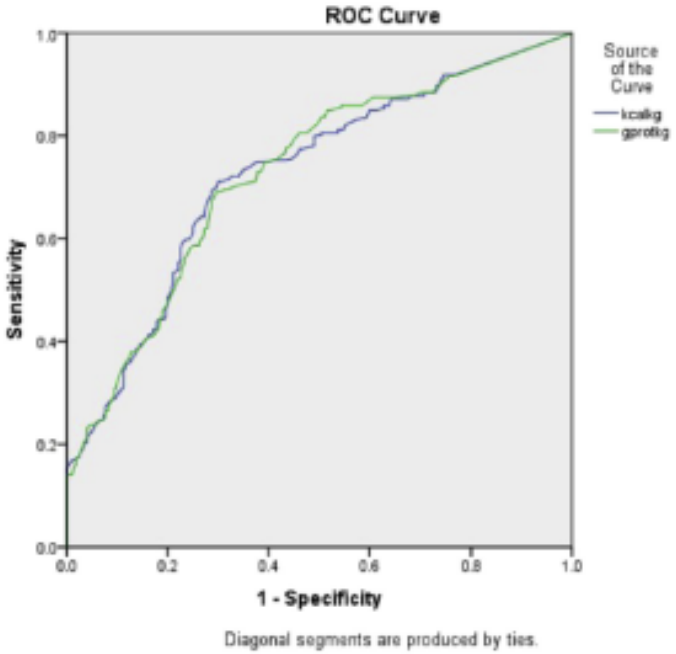
Low caloric and protein intake is associated with mortality in patients with acute kidney injury

M.N.B. Bufarah [a, *], N.A. Costa [a], M.P.R.P. Losilla [b], N.S.C. Reis [a], M.Z.C. Silva [a], A.L. Balbi [a], D. Ponce [a]

- **Etude observationnelle prospective**
- **595 patients consécutifs** présentant une IRA et nécessitant une nutrition entérale ou parentérale

Logistic regression model for predicting mortality in patients with AKI.

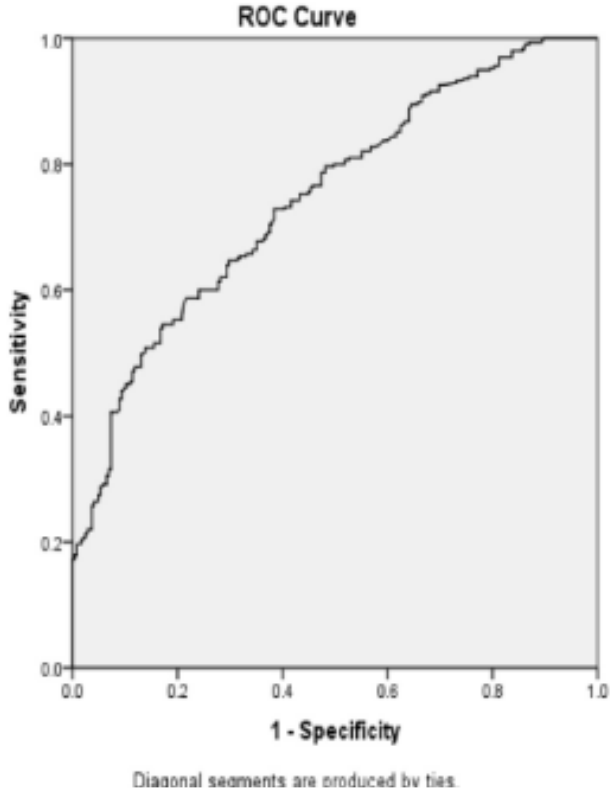
Variable	OR	CI 95%	Value *p*
Calorie intake (kcal/day)	0.946	0.901–0.994	**0.029**
Protein intake (g/day)	0.947	0.988–0.992	**0.028**
Albumin (g/dl)	0.545	0.401–0.741	<0.001
Cholesterol (mg/dL)	0.995	0.991–1.000	0.052



Calories:
Cut off < 12kcal/kg/day
AUC: 0.745
CI 95%: 0.684-0.765
p<0.001

Protein intake:
Cut off
< 0.5g/kg/day
AUC: 0.726
CI 95%: 0.686-0.767
p<0.001

Fig. 1. ROC Curve of calories (kcal/kg/day) and protein (g/kg/day).



Nitrogen Balance:
Cut off< -6.47gN/day
AUC: 0.745
IC 95%: 0.704-0.786
p<0.001

PLOS ONE | DOI:10.1371/journal.pone.0156634 June 28, 2016

The Impact of Macro-and Micronutrients on Predicting Outcomes of Critically Ill Patients Requiring Continuous Renal Replacement Therapy

Kittrawee Kritmetapak[1☯], Sadudee Peerapornratana[2☯], Nattachai Srisawat[2]*, Nicha Somlaw[3], Narisorn Lakananurak[3], Thasinas Dissayabutra[4], Chayanat Phonork[1], Asada Leelahavanichkul[5], Khajohn Tiranathanagul[2], Paweena Susantithapong[2], Passisd Loaveeravat[2], Nattachai Suwachittanont[2], Thaksa-on Wirotwan[2], Kearkiat Praditpornsilpa[2], Kriang Tungsanga[2], Somchai Eiam-Ong[2], Piyawan Kittiskulnam[2]

- **70 patients** de réanimation sous EER continue

Table 2. Comparison of macronutrient/micronutrient parameters between survivor and non-survivor group.

Macronutrients	Survivor (n = 27)	Non-survivor (n = 43)	P value
DPI (g/kg/day)	0.8 (0.2)	0.5 (0.3)	<0.001
Nitrogen balance (g/day)	-9.3 (6.1)	-11.8 (6.8)	0.13
nPCR(g/kg/day)	2.1 (0.6)	2.0 (0.8)	0.76
Serum albumin (g/dL)	3.2 (0.5)	2.9 (0.5)	0.03
CRP (mg/L)	119.4 (49.5)	112.8 (42.3)	0.72
Micronutrients	**Survivors (n = 13)**	**Non-survivors (n = 24)**	**P value**
Zinc (mg/L)	0.86 (1.27)	1.06 (1.66)	0.71
Selenium (mg/L)	0.09 (0.05)	0.08 (0.07)	0.80
Copper (mg/L)	0.61 (0.54)	0.80 (0.65)	0.39

Values are given as mean (standard deviation). nPCR: normalized protein catabolic rate, CRP: C-reactive protein.

PLOS ONE | DOI:10.1371/journal.pone.0156634 June 28, 2016

The Impact of Macro-and Micronutrients on Predicting Outcomes of Critically Ill Patients Requiring Continuous Renal Replacement Therapy

Kittrawee Kritmetapak[1☯], Sadudee Peerapornratana[2☯], Nattachai Srisawat[2]*, Nicha Somlaw[3], Narisorn Lakananurak[3], Thasinas Dissayabutra[4], Chayanat Phonork[1], Asada Leelahavanichkul[5], Khajohn Tiranathanagul[2], Paweena Susantithapong[2], Passisd Loaveeravat[2], Nattachai Suwachittanont[2], Thaksa-on Wirotwan[2], Kearkiat Praditpornsilpa[2], Kriang Tungsanga[2], Somchai Eiam-Ong[2], Piyawan Kittiskulnam[2]

Table 2. Comparison of macronutrient/micronutrient parameters between survivor and non-survivor group.

Macronutrients	Survivor (n = 27)	Non-survivor (n = 43)	P value
DPI (g/kg/day)	0.8 (0.2)	0.5 (0.3)	<0.001
Nitrogen balance (g/day)	-9.3 (6.1)	-11.8 (6.8)	0.13
nPCR(g/kg/day)	2.1 (0.6)	2.0 (0.8)	0.76
Serum albumin (g/dL)	3.2 (0.5)	2.9 (0.5)	0.03
CRP (mg/L)	119.4 (49.5)	112.8 (42.3)	0.72
Micronutrients	**Survivors (n = 13)**	**Non-survivors (n = 24)**	**P value**
Zinc (mg/L)	0.86 (1.27)	1.06 (1.66)	0.71
Selenium (mg/L)	0.09 (0.05)	0.08 (0.07)	0.80
Copper (mg/L)	0.61 (0.54)	0.80 (0.65)	0.39

Values are given as mean (standard deviation). nPCR: normalized protein catabolic rate, CRP: C-reactive protein.

- Une ↑ de l'apport protéique de **0,2 g/kg/jour** a réduit le risque de mortalité de **9%**
- chaque ↑ de **1g/dL d'albumine** a exercé un effet protecteur **de 223%** sur le risque de décès chez ces patients.

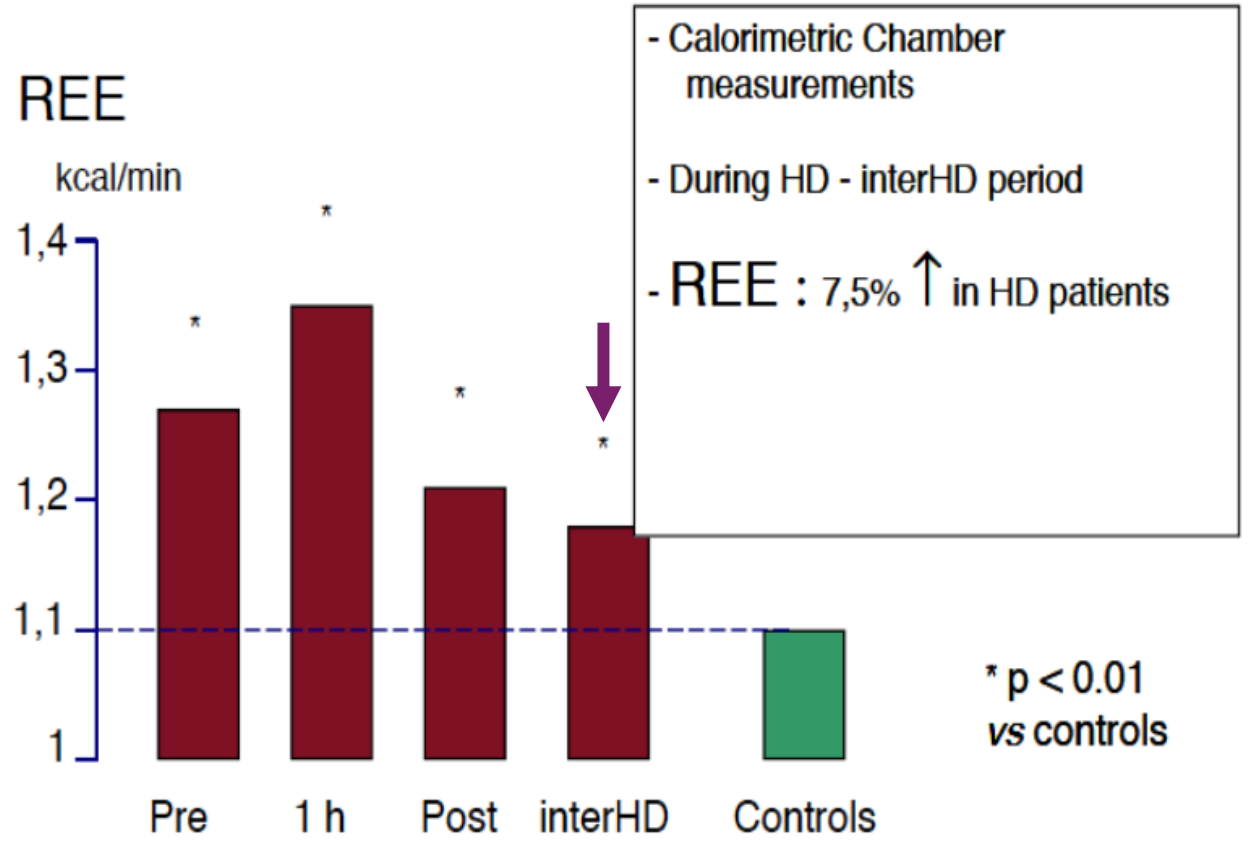
Nutrition d'un patient sous hémodiafiltration / hémodialyse intermittente est un véritable défi

- **Modifications métaboliques complexes**
  - ✓ IRA
  - ✓ La pathologie sous jacente
- **Impact des techniques d'épuration extra-rénale**
  - ✓ Hypercatabolisme
  - ✓ Pertes (via le dialysat ou l'ultrafiltrat) : macronutriments (protéines, acides aminés, glucides) et micronutriments (vitamines hydrosolubles, oligo-éléments)

Increased energy expenditure in hemodialysis patients.

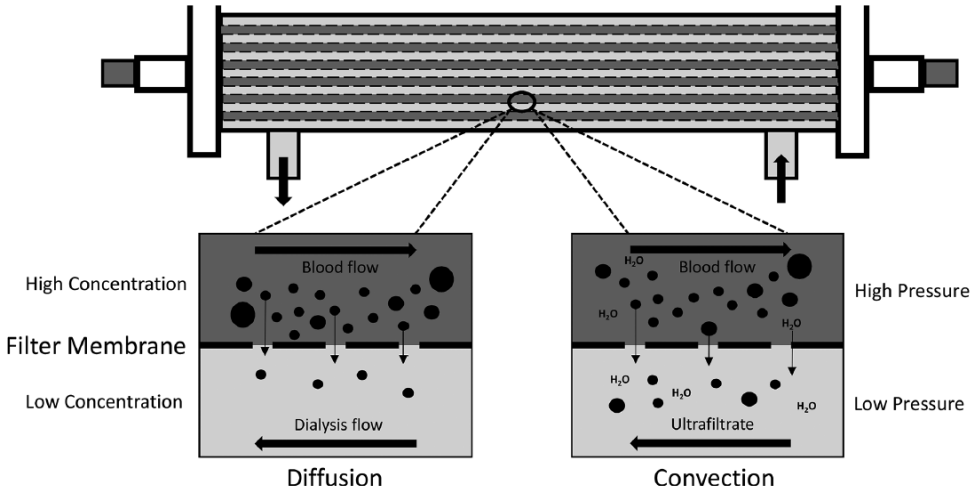
Ikizler, T A; Wingard, R L; Sun, M; Harvell, J; Parker, R A; Hakim, R M

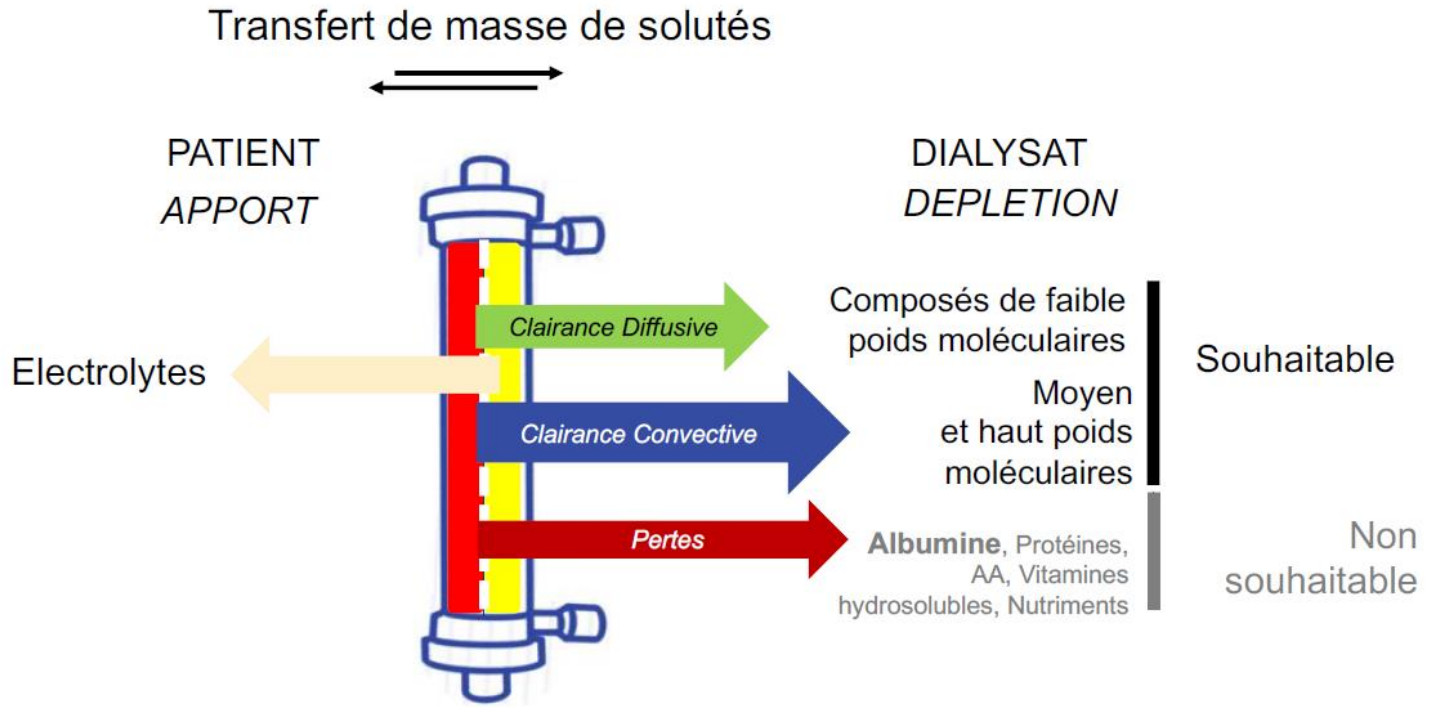
Ikizler TA, JASN, 1996



Metabolic Support of the Patient on Continuous Renal Replacement Therapy

Erin M. Nystrom, PharmD, BCNSP; and Andrea M. Nei, PharmD, BCPS, BCCCP

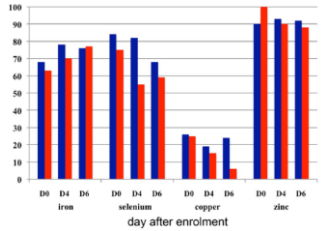


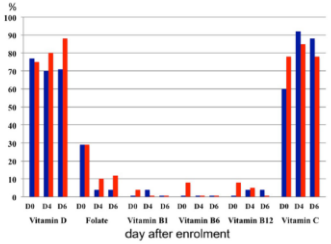


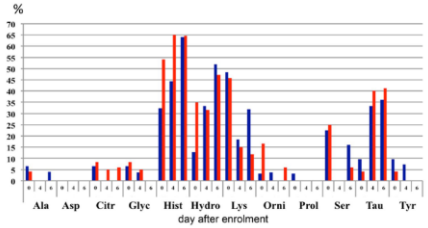
SCIENTIFIC REPORTS | (2020) 10:1505

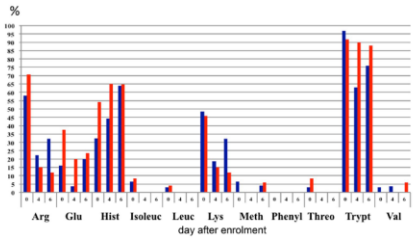
Micronutrients in critically ill patients with severe acute kidney injury – a prospective study

Marlies Ostermann[1*], Jennifer Summers[2], Katie Lei[3], David Card[4], Dominic J. Harrington[4], Roy Sherwood[5], Charles Turner[6], Neil Dalton[6], Janet Peacock[2] & Danielle E. Bear[1]





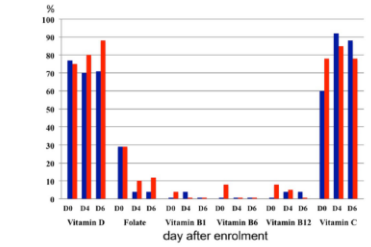


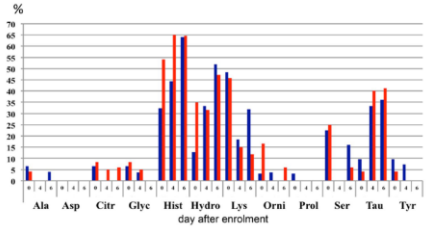


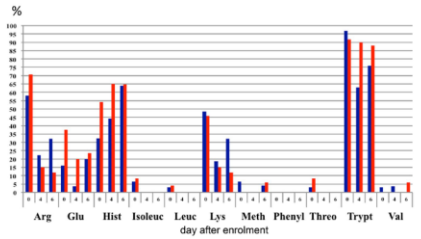
SCIENTIFIC REPORTS | (2020) 10:1505

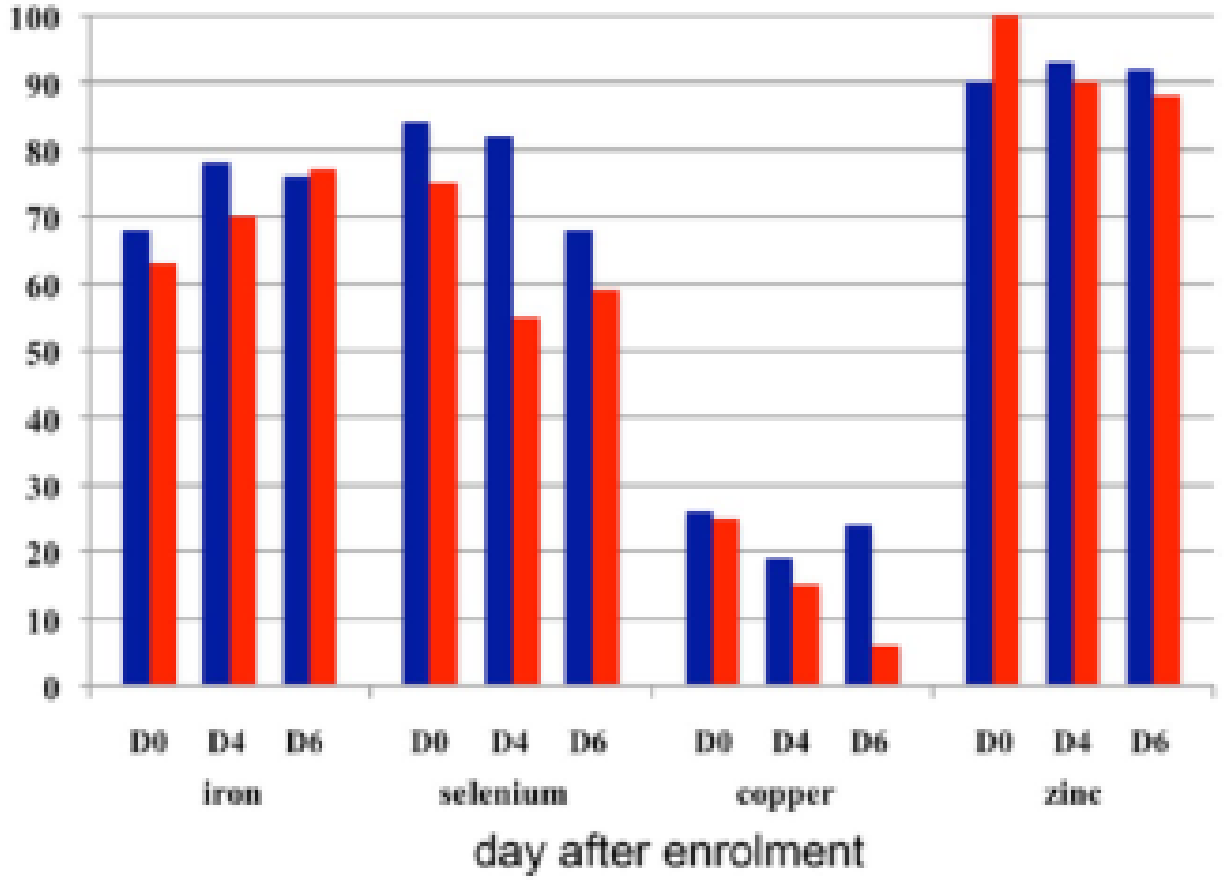
Micronutrients in critically ill patients with severe acute kidney injury – a prospective study

Marlies Ostermann[1*], Jennifer Summers[2], Katie Lei[3], David Card[4], Dominic J. Harrington[4], Roy Sherwood[5], Charles Turner[6], Neil Dalton[6], Janet Peacock[2] & Danielle E. Bear[1]







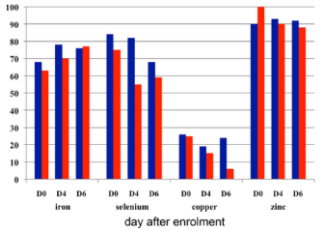


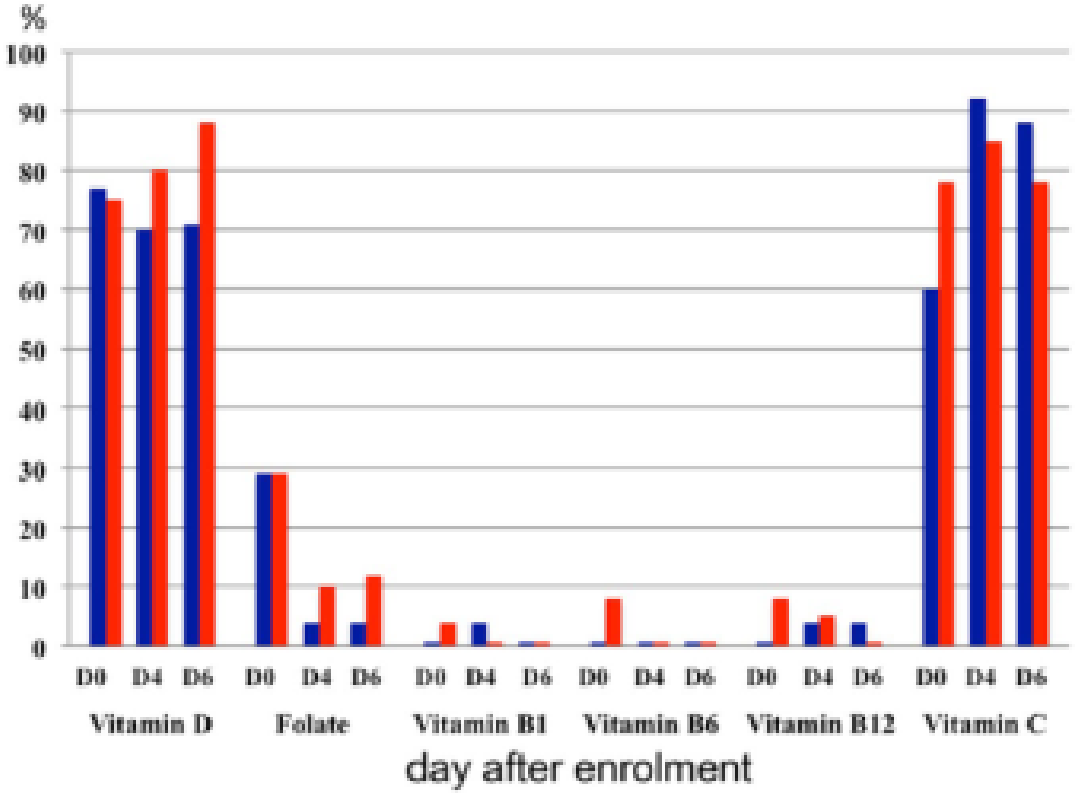
Oligo-éléments

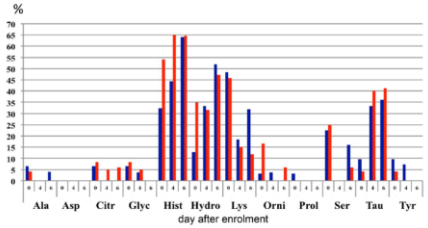
SCIENTIFIC REPORTS | (2020) 10:1505

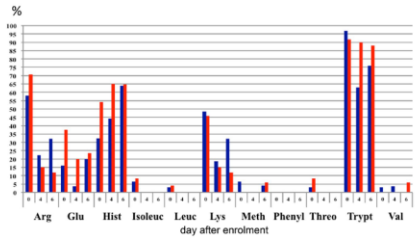
Micronutrients in critically ill patients with severe acute kidney injury – a prospective study

Marlies Ostermann[1*], Jennifer Summers[2], Katie Lei[3], David Card[4], Dominic J. Harrington[4], Roy Sherwood[5], Charles Turner[6], Neil Dalton[6], Janet Peacock[2] & Danielle E. Bear[1]







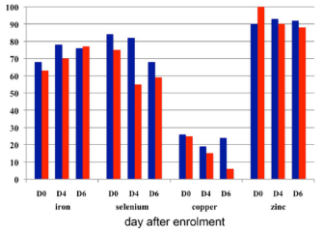


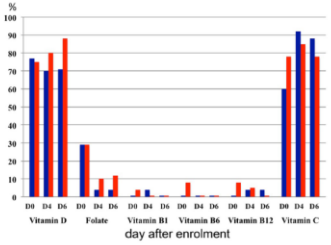
Vitamines

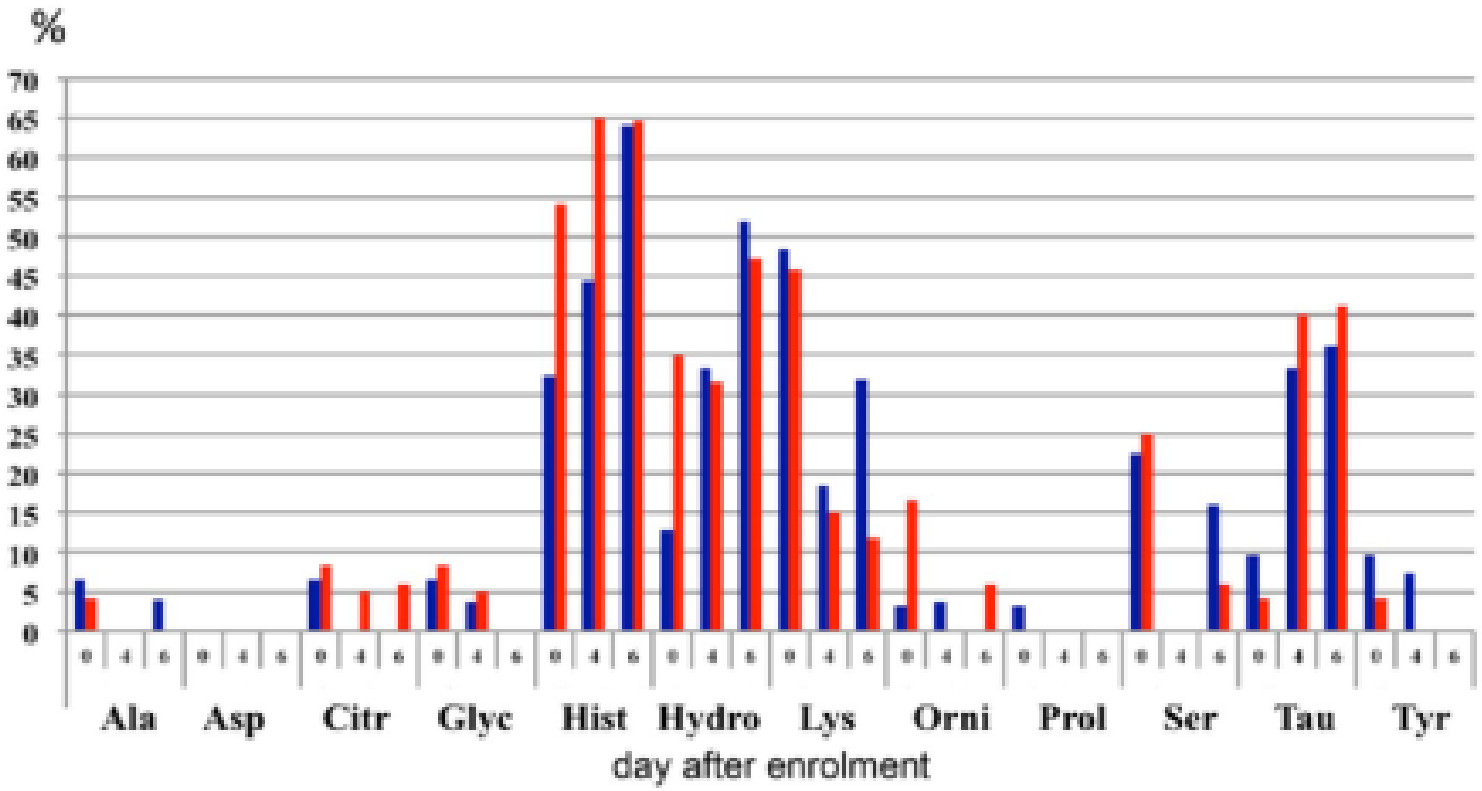
SCIENTIFIC REPORTS | (2020) 10:1505

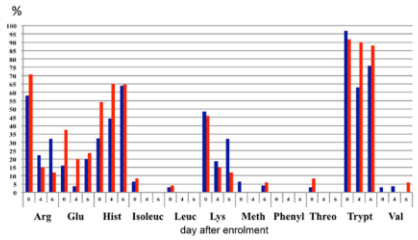
Micronutrients in critically ill patients with severe acute kidney injury – a prospective study

Marlies Ostermann[1*], Jennifer Summers[2], Katie Lei[3], David Card[4], Dominic J. Harrington[4], Roy Sherwood[5], Charles Turner[6], Neil Dalton[6], Janet Peacock[2] & Danielle E. Bear[1]







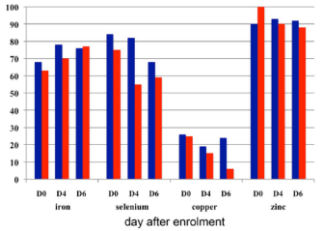


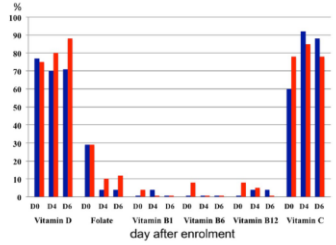
Acides Aminés Essentiels (Indispensables)

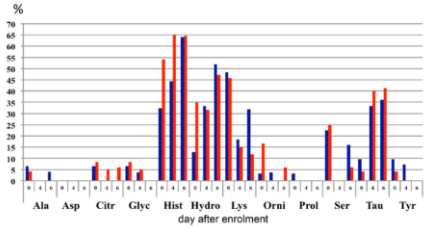
SCIENTIFIC REPORTS | (2020) 10:1505

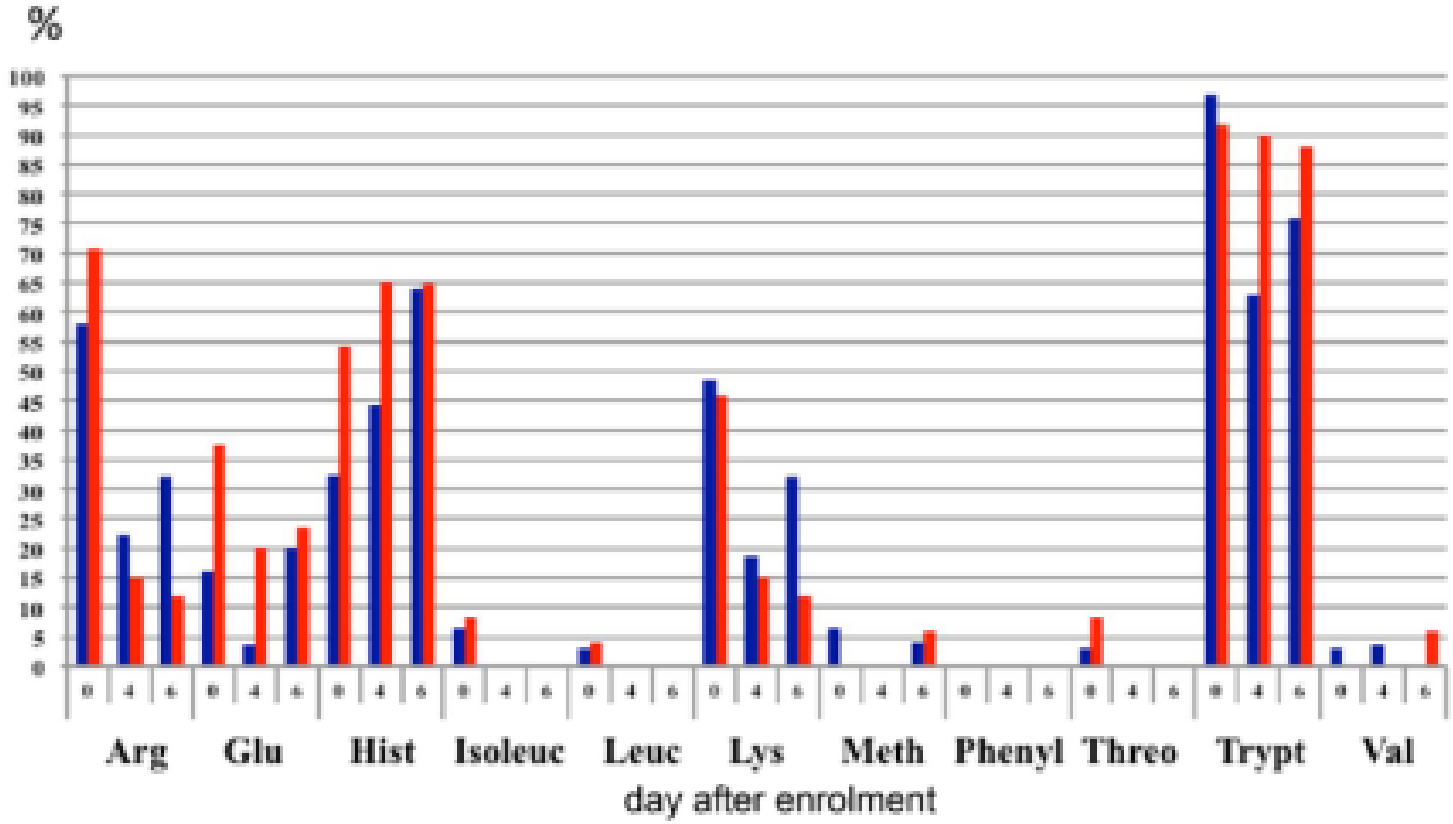
Micronutrients in critically ill patients with severe acute kidney injury – a prospective study

Marlies Ostermann[1*], Jennifer Summers[2], Katie Lei[3], David Card[4], Dominic J. Harrington[4], Roy Sherwood[5], Charles Turner[6], Neil Dalton[6], Janet Peacock[2] & Danielle E. Bear[1]









Acides Aminés Non Essentiels

Micronutrient deficiencies in critically ill patients receiving continuous renal replacement therapy

Megan Fah [a], Laura E. Van Althuis [b], Tetsu Ohnuma [a], Hilary M. Winthrop [b], Krista L. Haines [c], David G.A. Williams [a], Vijay Krishnamoorthy [a], Karthik Raghunathan [a], Paul E. Wischmeyer [a, *]

Clinical Nutrition ESPEN 50 (2022) 247–254

Results: 106 ICU patients met inclusion criteria and 46% were exposed to CRRT. At least one micronutrient deficiency was reported in 90% of CRRT patients compared to 61% patients unexposed to CRRT ($p = 0.002$). A greater percentage of copper ($p < 0.001$) and carnitine ($p < 0.001$) deficiencies were found among patients exposed to CRRT, while more zinc deficiencies were noted among non-CRRT patients ($p = 0.001$).

Nutrients and micronutrients at risk during renal replacement therapy: a scoping review

Mette M. Berger[a], *Marcus Broman*[b], *Lui Forni*[c], *Marlies Ostermann*[d], *Elisabeth De Waele*[e] *and Paul E. Wischmeyer*[f]

Curr Opin Crit Care 2021, 27:367–377

Despite sparse data, this scoping review showed a real risk of micronutrient deficiency in case of prolonged CRRT (beyond 7–10 days) due to effluent losses of the hydrosoluble vitamins (especially B1 and C), copper and selenium.

Observation of low blood levels of some micronutrients in several studies points to depletion: monitoring blood levels of Cu, Se, B1 is encouraged from the second week on.

Blood Purif 2019;48:321–329

Amino Acid Loss during Continuous Venovenous Hemofiltration in Critically Ill Patients

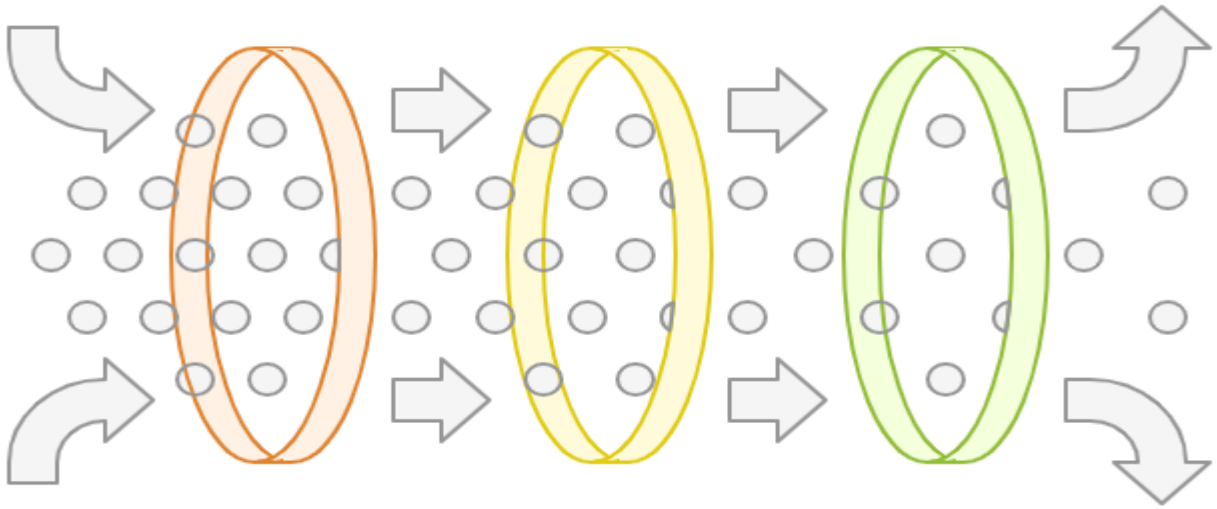
24-h study period. ***Conclusion:*** During CVVH with a modern polysulfone membrane, the estimated AA loss was 13.4 g/day, which corresponds to a loss of about 11.2 g of protein per day. Adsorption did not play a major role. However, individual AA behaved differently, suggesting complex interactions and processes at the filter membrane or peripheral AA production.

SCIENTIFIC REPORTS | (2020) 10:1505 |

Clearance of micronutrients during continuous renal replacement therapy

Nuttha Lumlertgul[1,2,3], Danielle E. Bear[1,4] and Marlies Ostermann[1*]

Facteurs Affectant la Perte de Nutriments en Dialyse



Coefficient de Tamisage

La capacité du nutriment à passer à travers le filtre de dialyse.

Intensité de la Dialyse

Le débit du dialysat ou de l'ultrafiltrat.

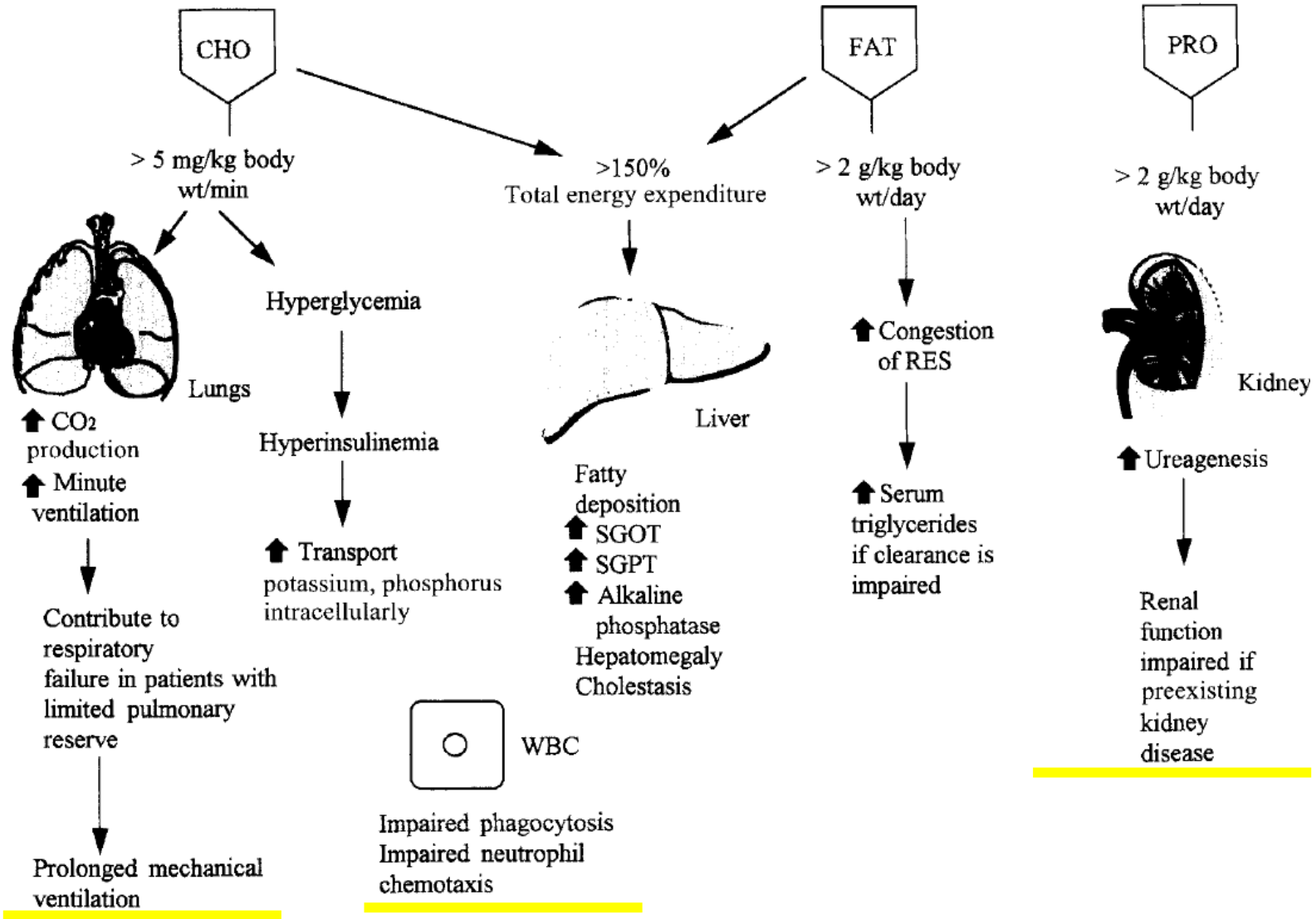
Durée

La durée de la session de dialyse.

JOURNAL OF THE AMERICAN DIETETIC ASSOCIATION

Overfeeding macronutrients to critically ill adults: Metabolic complications

CATHERINE J. KLEIN, MS, RD; GENA S. STANEK, MS, RN, CCRN; CHARLES E. WILES III, MD;



Continuous renal replacement therapy: a potential source of calories in the critically ill[1,2]

Andrea M New,[3] Erin M Nystrom,[3] Erin Frazee,[3] John J Dillon,[4] Kianoush B Kashani,[4,5] and John M Miles[6,7]*

American Society for Nutrition

Am J Clin Nutr 2017;105:1559–63

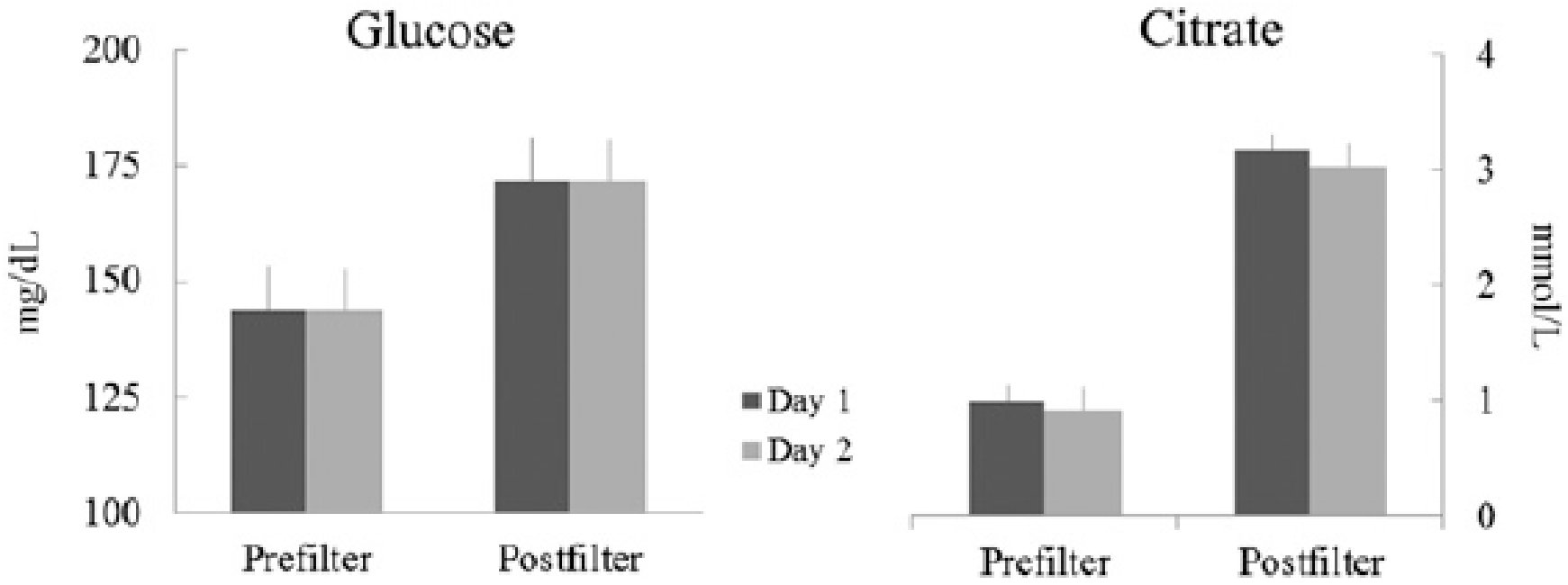


FIGURE 3 Comparison of glucose and citrate concentrations on days 1 and 2 ($n = 8$).

Continuous renal replacement therapy: a potential source of calories in the critically ill[1,2]

Andrea M New,[3] Erin M Nystrom,[3] Erin Frazee,[3] John J Dillon,[4] Kianoush B Kashani,[4,5] and John M Miles[6,7]*

American Society for Nutrition

Am J Clin Nutr 2017;105:1559–63

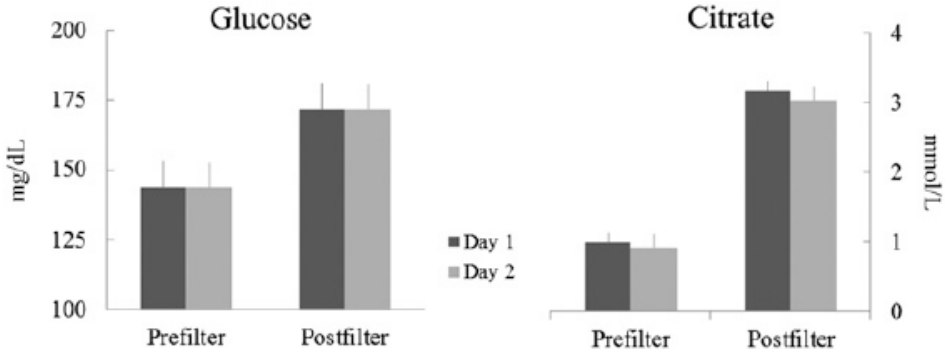


FIGURE 3 Comparison of glucose and citrate concentrations on days 1 and 2 (n = 8).

Conclusions: During CVVH there was a substantial net uptake of both glucose and citrate that delivered exogenous energy and provided ~512 kcal/d. Failure to account for this source of calories in critically ill patients receiving nutrition on CVVH may result in overfeeding. *Am J Clin Nutr* 2017;105:1559–63.

Management of Nutrition in Acute Kidney Injury and Renal Replacement Therapy

Alice Sabatino, Riccardo Antoniotti, and Enrico Fiaccadori

Calorie Equivalent of Carbohydrate Metabolism Substrates in Dialysis/Hemofiltration Fluids

SUBSTRATE	MOLECULAR WEIGHT	kcal/mmol	kJ/mmol	kcal/g
Glucose	198[a]	0.73	3.06	4 (3.4 if monohydrate)
Citrate	192[b]	0.59	3.07	3
Lactate	89	0.33	1.37	3.7

Journal of the Intensive Care Society
2021, Vol. 22(3) 183–186

Calorie provision from citrate anticoagulation in continuous renal replacement therapy in critical care

Alice R Rogers and Bethan Jenkins

Conclusions: Continuous veno-venous haemofiltration with tri-sodium citrate provided an additional 196 ± 69 kcal/day. The calorie load from citrate continuous veno-venous haemofiltration should be calculated regularly as changes in filter settings, in particular citrate dose and blood flow can have a significant impact on calorie provision.

Citrate calories entering blood stream/min =

((flow rate/1000) X citrate dose) x (1-(filtration fraction/100)) x 0.59

Flow rate = ml/min, citrate dose = mmol/L, filtration fraction = %

Clinical Nutrition 43 (2024) 2238–2254

Contents lists available at ScienceDirect

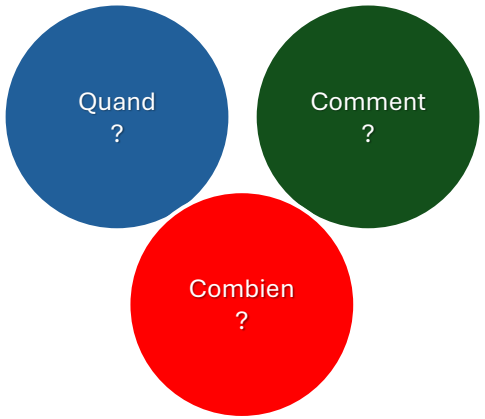
Clinical Nutrition

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

ESPEN Guideline

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Alice Sabatino [a, *], Enrico Fiaccadori [b], Rocco Barazzoni [c], Juan Jesus Carrero [d, e], Adamasco Cupisti [f], Elisabeth De Waele [g], Joop Jonckheer [h, i], Cristina Cuerda [j, k], Stephan C. Bischoff [l]



Clinical Nutrition 43 (2024) 2238–2254

Contents lists available at ScienceDirect

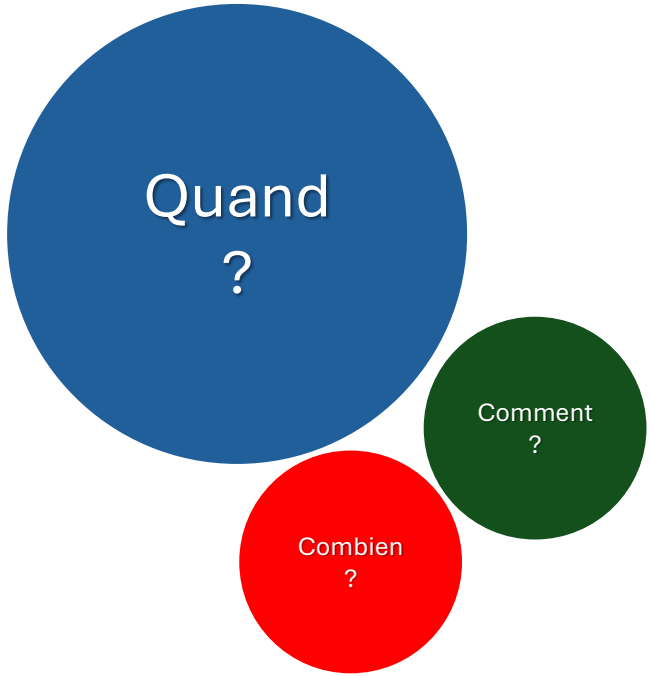
Clinical Nutrition

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

ESPEN Guideline

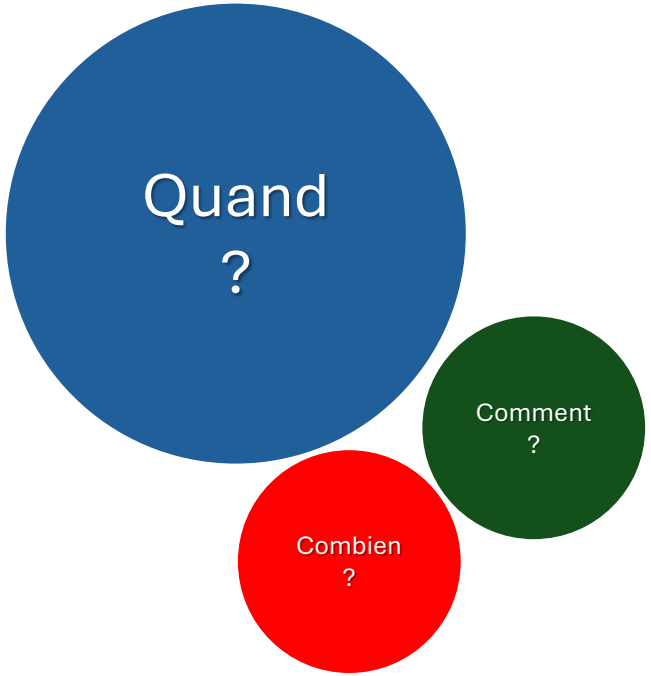
ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Alice Sabatino [a, *], Enrico Fiaccadori [b], Rocco Barazzoni [c], Juan Jesus Carrero [d, e], Adamasco Cupisti [f], Elisabeth De Waele [g], Joop Jonckheer [h, i], Cristina Cuerda [j, k], Stephan C. Bischoff [l]



Clinical nutrition in patients with Acute Kidney Injury: Traditional approaches and emerging perspectives

Clinical Nutrition ESPEN 65 (2025) 348–356



début **précoce** du soutien nutritionnel **(dans les premières 48 heures)** est **recommandé** chez tous les patients qui ne sont pas en mesure de satisfaire au moins **70%** de leurs besoins quotidiens par voie orale

ESPEN Guideline

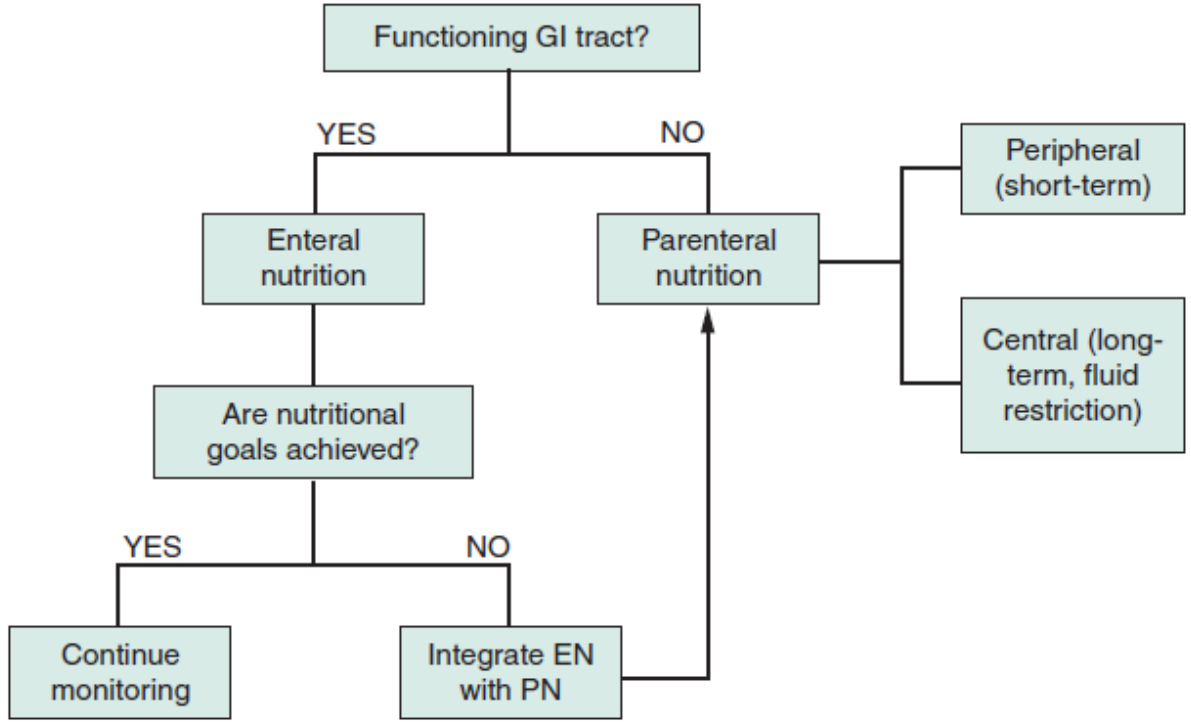
Management of Nutrition in Acute Kidney Injury and Renal Replacement Therapy

Alice Sabatino, Riccardo Antoniotti, and Enrico Fiaccadori

Quand ?

Comment ?

Combien ?



EN, PN, or EN and PN shall be given to critically and non-critically ill hospitalized patients with AKI/AKD, CKD, CKD with KF unable to achieve at least 70% of macronutrient requirements with oral nutrition.

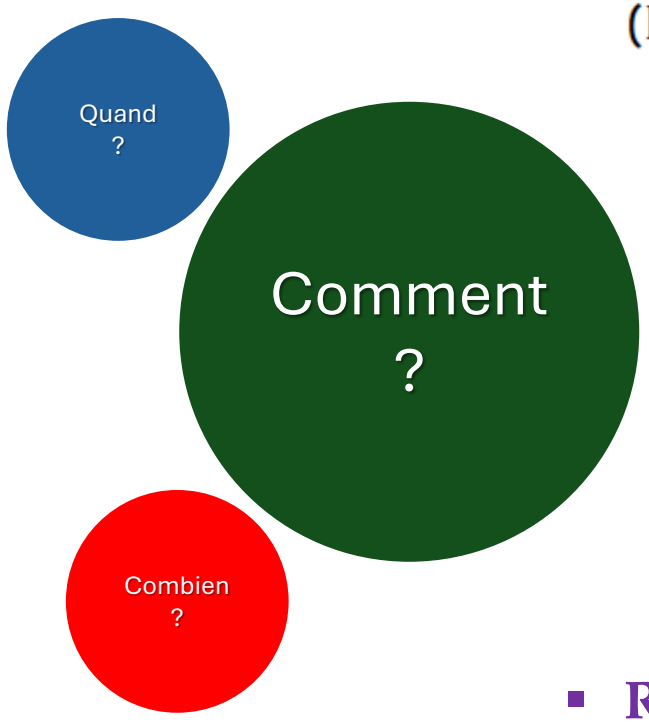
Grade of recommendation A – Strong consensus (95.7% agreement)

ESPEN Guideline

Clinical Nutrition 43 (2024) 2238–2254

9) Any hospitalized patient with AKI/AKD and/or CKD with or without KF, and especially those staying for more than 48 h in the ICU, should be screened for malnutrition.
(R6, Grade GPP, strong consensus).

ESPEN Guideline



- **MUST (Malnutrition Universal Screening Tool) ±**
- **NRS (Nutritional Risk Screening)**

- **Renal iNUT (renal inpatient nutritional screening tool)**

A new Renal Inpatient Nutrition Screening Tool (renal iNUT): A multicenter validation study

Helena S. Jackson [a, *], Helen L. MacLaughlin [b], Alberto Vidal-Diez [c], Debasish Banerjee [d]

Point-counterpoint: Indirect calorimetry Is essential for optimal nutrition therapy in the intensive care unit

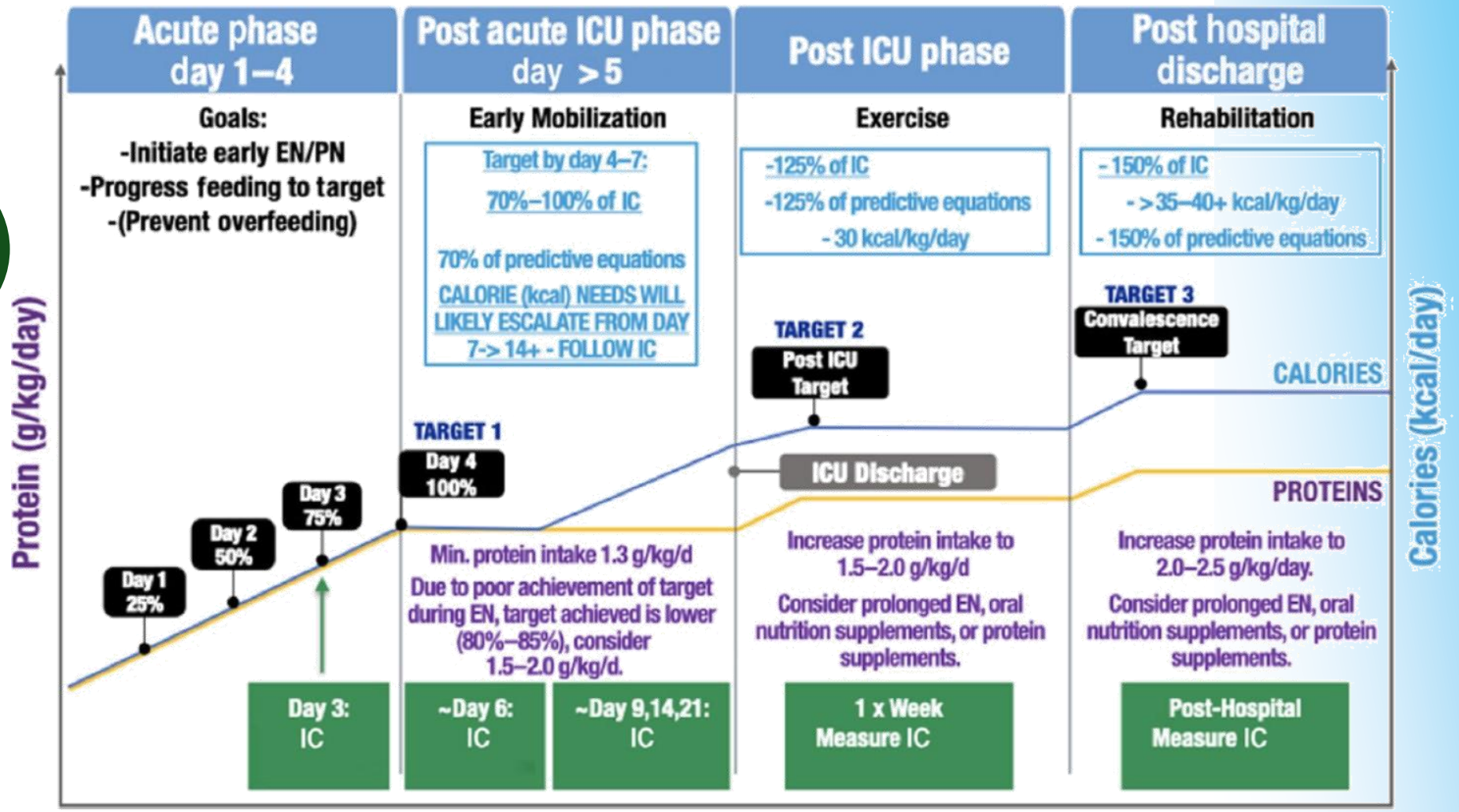
Paul E. Wischmeyer, MD, EDIC[1], Jeroen Molinger, MSc[2], Krista Haines, MA, DO[3]

Support nutritionnel personnalisé

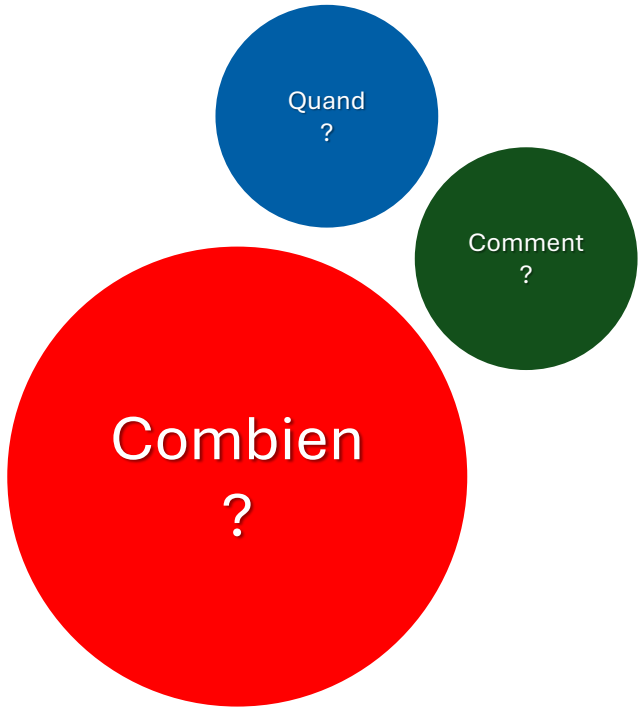
Quand ?

Comment ?

Combien ?



Évaluation des Besoins Énergétiques chez les patients en hémodiafiltration/HDI ?



La calorimétrie indirecte ?

Jonckheer *et al. BMC Nephrology* (2019) 20:222

CO_2 and O_2 removal during continuous veno-venous hemofiltration: a pilot study

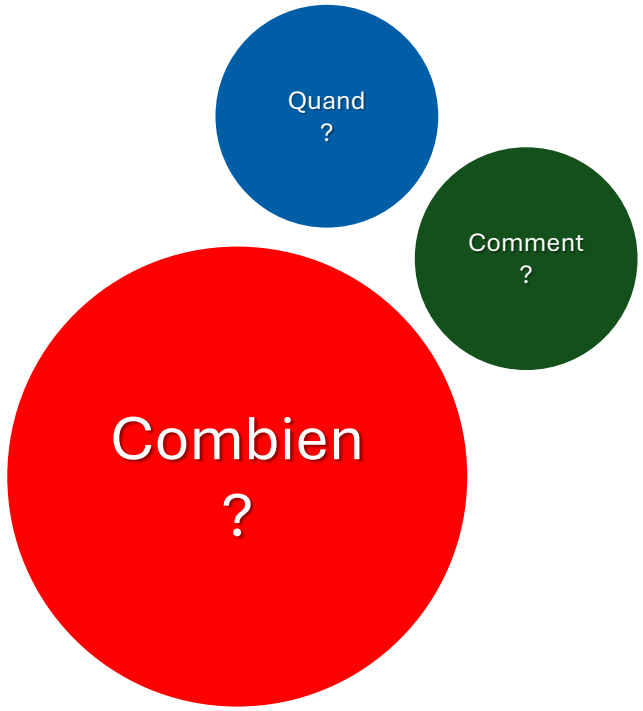
Joop Jonckheer[1*], Herbert Spapen[1], Aziz Debain[2], Joy Demol[3], Marc Diltoer[1], Olivier Costa[4], Katrien Lanckmans[4], Taku Oshima[5], Patrick M. Honoré[6], Manu Malbrain[1] and Elisabeth De Waele[1,3]

La circulation extracorporelle peut entraîner **l'élimination** d'une quantité significative de CO2 (**26 mL/min,** soit **14%** du VCO2 expiré) dans **le liquide d'effluent** pendant la procédure.

Clinical Nutrition 39 (2020) 3797–3803

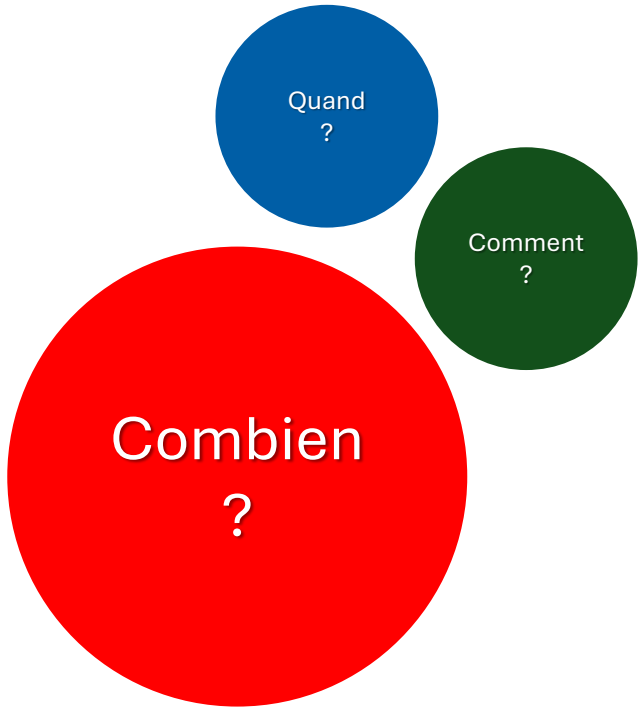
MECCIAS trial: Metabolic consequences of continuous veno-venous hemofiltration on indirect calorimetry

J. Jonckheer [a, *], J. Demol [a, b], K. Lanckmans [c], M.L.N.G. Malbrain [a, d], H. Spapen [a, d], E. De Waele [a, b, d]



It is feasible to perform IC during CVVH. CO_2 removal by CVVH needs to be accounted for although our investigations showed that this led to a change in REE of only 3% which makes a correction factor unnecessary when prescribing caloric targets for ICU patients undergoing CVVH. When the settings of CVVH are changed this leads to a different REE. This suggests that in clinical practice when CRRT settings are changed, IC should be repeated if caloric prescriptions are based on this REE. Whether or not citrate is a

Évaluation des Besoins Énergétiques chez les patients en hémodiafiltration/HDI ?



- La calorimétrie indirecte ?

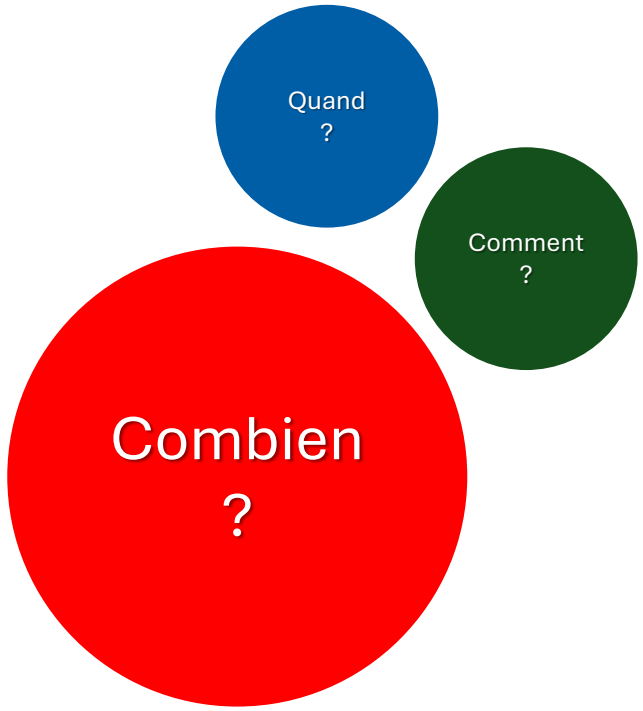
- **les équations prédictives pour estimer la déperdition énergétique ?**

Limites :

- ✓ une sous-estimation ou une surestimation des besoins énergétiques
- ✓ basées sur le poids corporel

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

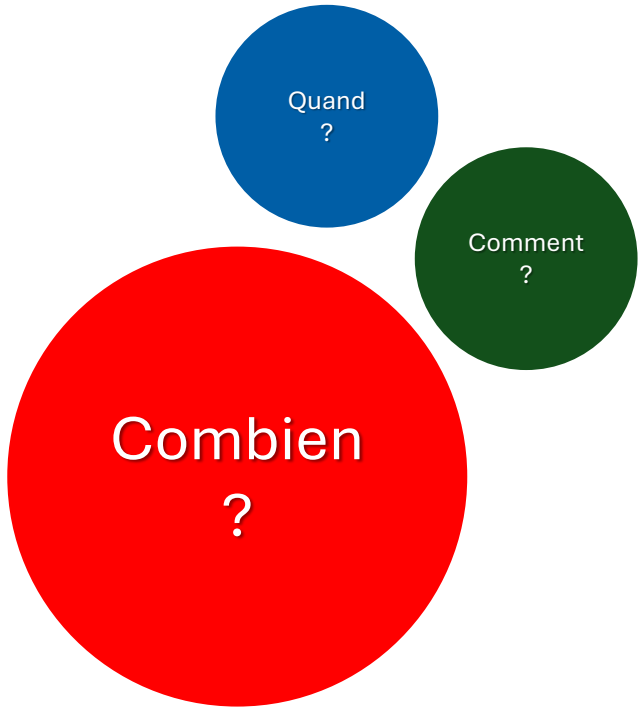
Clinical Nutrition 43 (2024) 2238–2254



20) In hospitalized patients with AKI/AKD and/or CKD or CKD with KF needing medical nutrition therapy, indirect calorimetry should be used to assess energy expenditure to guide nutritional therapy (caloric dosing) and avoid under- or overfeeding.
(R10, grade B, strong consensus 96%)

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Clinical Nutrition 43 (2024) 2238–2254

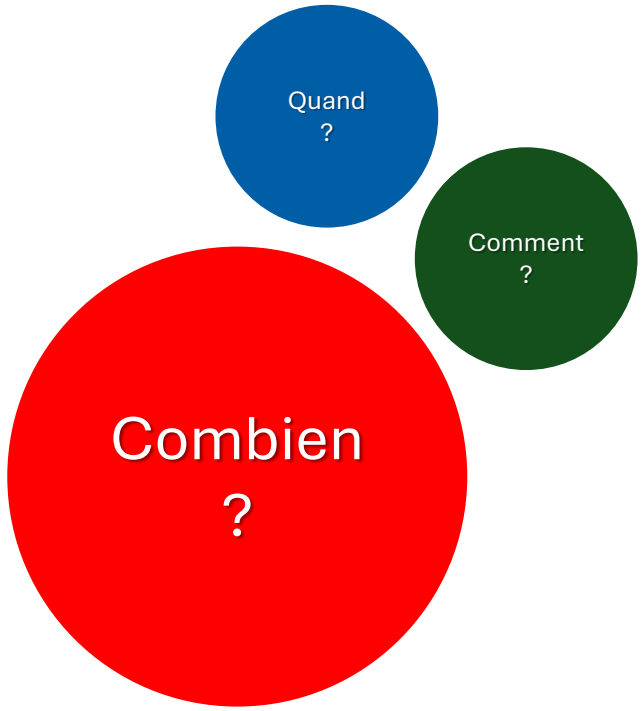


20) In hospitalized patients with AKI/AKD and/or CKD or CKD with KF needing medical nutrition therapy, indirect calorimetry should be used to assess energy expenditure to guide nutritional therapy (caloric dosing) and avoid under- or overfeeding.
(R10, grade B, strong consensus 96%)

21) Indirect calorimetry can be performed during CKRT, bearing in mind the intrinsic limitations of the method. A minimum interval of 2 h after an intermittent dialysis session should be preferred to improve the precision of the measurement.

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Clinical Nutrition 43 (2024) 2238–2254



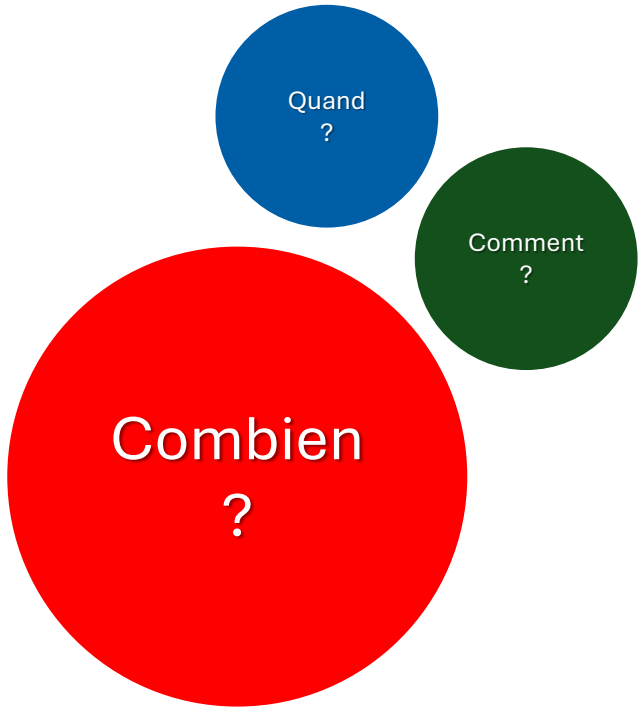
20) In hospitalized patients with AKI/AKD and/or CKD or CKD with KF needing medical nutrition therapy, indirect calorimetry should be used to assess energy expenditure to guide nutritional therapy (caloric dosing) and avoid under- or overfeeding.
(R10, grade B, strong consensus 96%)

21) Indirect calorimetry can be performed during CKRT, bearing in mind the intrinsic limitations of the method. A minimum interval of 2 h after an intermittent dialysis session should be preferred to improve the precision of the measurement.

22) Whenever the clinical condition of the patient is changing, indirect calorimetry shall be repeated.
(R12, grade GPP, strong consensus 100%)

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Clinical Nutrition 43 (2024) 2238–2254



20) In hospitalized patients with AKI/AKD and/or CKD or CKD with KF needing medical nutrition therapy, indirect calorimetry should be used to assess energy expenditure to guide nutritional therapy (caloric dosing) and avoid under- or overfeeding.
(R10, grade B, strong consensus 96%)

21) Indirect calorimetry can be performed during CKRT, bearing in mind the intrinsic limitations of the method. A minimum interval of 2 h after an intermittent dialysis session should be preferred to improve the precision of the measurement.

22) Whenever the clinical condition of the patient is changing, indirect calorimetry shall be repeated.
(R12, grade GPP, strong consensus 100%)

23) If calorimetry is not available, using VO2 (oxygen consumption) from pulmonary arterial catheter or VCO2 (carbon dioxide production) derived from the ventilator will give a better evaluation on energy expenditure than predictive equations.

Clinical Nutrition ESPEN 65 (2025) 348–356

Nutritional targets in patients with AKI.

Variables	Recommended values
Energy intake	20-30 kcal/Kg/day
Carbohydrates	3–5 (maximum 7) g/Kg/day
Lipids	0.8–1 g/Kg/day
Glycemic target, mg/dL	110–180 mg/dL

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Clinical Nutrition 43 (2024) 2238–2254

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Protéines

Hospitalized patient with AKI, AKI on CKD, CKD, with acute/critical illness, not on KRT: start with 1 g/kg BW/day, and gradually increase up to 1.3 g/kg BW/d if tolerated.

Critically ill patients with AKI or AKI on CKD or CKD with KF on conventional intermittent KRT: 1.3–1.5 g/kg/d.

Critically ill patients with AKI or AKI on CKD or CKD with KF on CKRT or PIKRT: 1.5 g/kg/d up to 1.7 g/kg/d.

If available, the pre-hospitalization body weight or usual body weight may be preferred over the ideal BW. Actual BW should not be considered for a protein prescription.

(R18, grade 0, consensus 83%)

Clinical Nutrition 43 (2024) 2238–2254

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

42) Because of increased requirements during KF and critical illness, and large effluent losses during KRT, trace elements should be monitored and supplemented. Increased attention should be given to selenium, zinc, and copper.

43) Because of increased requirements during KF and critical illness, and large effluent losses during KRT, water-soluble vitamins should be monitored and supplemented. Special attention should be given to vitamin C, folate, and thiamine.

44) Electrolytes abnormalities are common in patients with AKI, AKI on CKD, or CKD with KF receiving KRT and shall be closely monitored.

Clinical Nutrition 43 (2024) 2238–2254

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

46) No disease-specific enteral nor parenteral formula oriented for patients with reduced kidney function should be routinely utilized in every patient with AKI, AKI on CKD, or CKD with KF in comparison to conventional formulas. Instead, their use is to be individualized (see recommendation 26).

(R24, grade B, consensus 88%)

48) In selected patients with electrolyte and fluid imbalances, concentrated "renal" EN or PN formulas with lower electrolyte content may be preferred over standard formulas.

Nutr. Clin. Pract. 2025;40:35–53.

CE Nutrition support for patients with renal dysfunction in the intensive care unit: A narrative review

Joanna L. Otis MS, RDN[1] | Nicholas M. Parker PharmD, RPh[2]
Rebecca A. Busch MD[3]

Energy[31–37]

AKI or AKI on CKD: 20–30 kcal/kg/day

- Catabolic phase ± RRT: 20–25 kcal/kg/day
- Anabolic phase ± RRT: 25–30 kcal/kg/day

CKD ± RRT: 30–35 kcal/kg/day

Protein[31–36,38,39] AKI or AKI on CKD receiving iHD: 1.5 g/kg/day; or receiving CRRT: 1.5–2.5 g/kg/day

Vitamins

Thiamine[31,32,40–42,46–48]	AKI or CKD ± iHD: no specific recommendations CRRT: 100 mg/day • High-protein renal-specific enteral formulas contain 2–4 mg thiamine per liter • Adult parenteral MVI often contain 6 mg thiamine per dose; additional thiamine may be added to the PN formula • TPP is the preferred assay to assess for deficiency because it is unaffected by the acute phase response
Pyridoxine[32,37,40–42,46,47,49]	AKI or CKD ± iHD: no specific recommendations CRRT: 100 mg/day • High-protein renal-specific enteral formulas contain ~8 mg pyridoxine per liter • Adult parenteral MVI often contain 6 mg pyridoxine per dose; additional pyridoxine may be added to the PN formula • Red cell PLP most reliable assay during the acute phase response
Folic acid[31,32,40–42,46]	AKI or CKD on RRT (iHD or CRRT): 1 mg/day High-protein renal-specific enteral formulas contain 750–1000 mcg folic acid per liter • Parenteral MVI often contains 600 mcg folic acid per dose; additional folic acid may be added to PN formula • RBC folate and homocysteine levels are the preferred assays
Ascorbic acid[32,40–42,46,50,51]	AKI or CKD on iHD: 75–100 mg/day CRRT: 250 mg/day

aspen CELEBRATING 50 YEARS AMERICAN SOCIETY FOR PARENTERAL AND ENTERAL NUTRITION

Minerals	
Copper[31,40–42,46,53,54]	AKI or CKD ± iHD: no specific recommendations
	CRRT: 3 mg/day if receiving CRRT for ≥2 weeks
Selenium[40–42,46,47,51,54,55]	AKI or CKD: no specific recommendation
	CRRT: 50–200 mg/day

Intensive Care Med (2019) 45:1006–1008

WHAT'S NEW IN INTENSIVE CARE

How to feed a patient with acute kidney injury

M. Ostermann[1*], E. Macedo[2] and H. Oudemans-van Straaten[3,4]

Unmet needs and future research

Nutrition in AKI is an under-researched area. There are no RCTs on nutrition in patients with AKI. The exact role of routine micronutrient supplementation in patients receiving CRRT remains unknown. More well-designed RCTs are urgently required, in particular to investigate whether different protein targets in combination with hypocaloric nutrition and the supplementation of micronutrients improves outcomes in AKI.

Merci pour votre attention

DEUXIÈME JOURNÉES
FRANCOPHONE
DE RÉANIMATION

mh Hached icu

FACULTÉ DE MÉDECINE DE SOUSSE
كلية الطب "ابن الجزار" بسوسة

ATR
الجمعية التونسية لطب الانعاش
ASSOCIATION TUNISIENNE DE REANIMATION

srlf
SOCIÉTÉ
DE RÉANIMATION
DE LANGUE FRANÇAISE