GdP Dialisi Peritonale

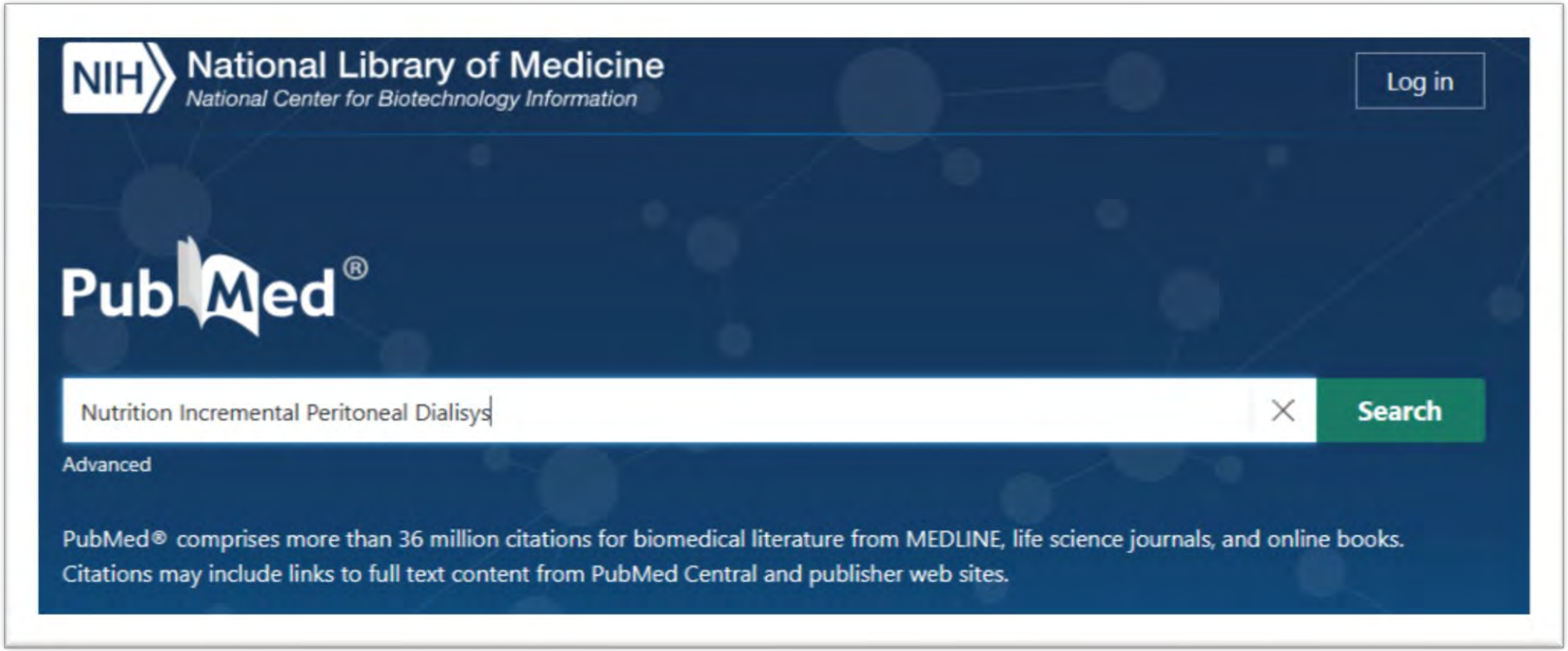
SIN Reni Società Italiana Nefrologia

Laboratorio itinerante di dialisi peritoneale del gruppo di progetto di dialisi peritoneale della Società Italiana di Nefrologia

La terapia nutrizionale nella dialisi peritoneale incrementale e a dose piena

Diana Bertoni

ASST Spedali Civili di Brescia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"While there is evidence that NT may help to prevent and control metabolic alterations in CKD, ***the criteria for implementing a low-protein regimen in CKD are still debated.»***

"There is ***no final consensus*** *on the composition of the diet, nor indications for specific patient settings or different stages of CKD.»*

"This consensus paper is an example of the ***difficulty of demonstrating what is obvious in the clinical practice and the great need for further study*** *in order to improve our understanding and knowledge"*

- Bellizzi V, et al A Delphi consensus panel on nutritional therapy in chronic kidney disease. J Nephrol. 2016 Oct;29(5):593-602. doi: 10.1007/s40620-016-0323-4. Epub 2016 Jun 20.
- Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473. doi: 10.1007/s40620-018-0497-z. Epub 2018 May 24.

Stefano Di Ubaldo

Da qui in avanti, un passo indietro

ALETHEIA EDITORE

Precision Medicine for Nutritional Management in End-Stage Kidney Disease and Transition to Dialysis

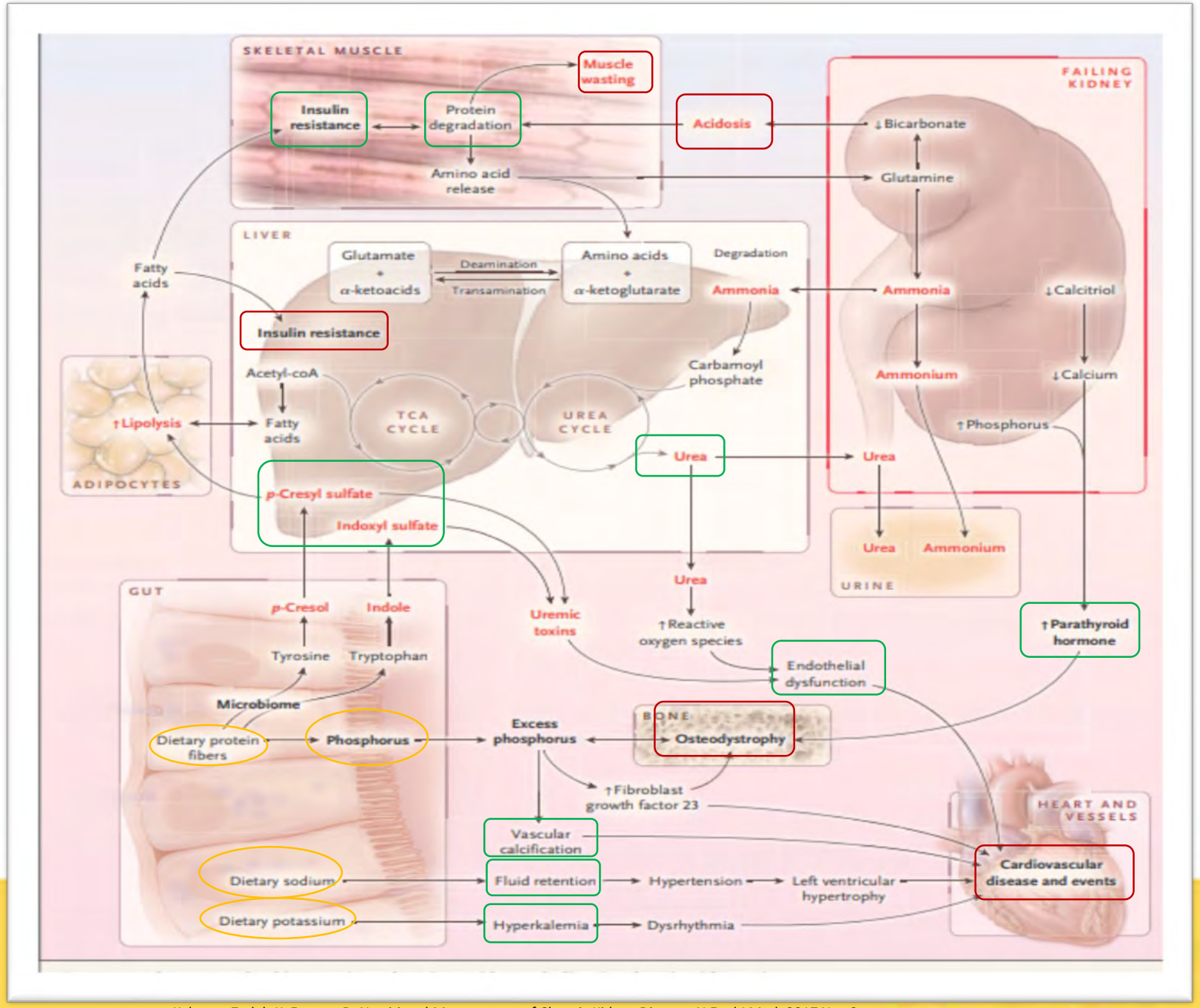
Angela Yee-Moon Wang, MD, PhD, Kamyar Kalantar-Zadeh, MD, MPH, PhD,† Denis Fouque, MD,‡ Pieter T. Wee, MD, PhD,§ Csaba P. Kovesdy, MD,‖ S. Russ Price, PhD,¶ Joel D. Kopple, MD#*

IRC

alterazioni endocrine e metaboliche

comorbidità preesistenti ed infiammazione

«MAL-NUTRIZIONE»



Kalantar-Zadeh K, Fouque D. Nutritional Management of Chronic Kidney Disease. N Engl J Med. 2017 Nov 2

Table 4
Classification of clinical nutrition concepts; i.e. nutrition disorders and nutrition related conditions.

- Clinical nutrition
  - Malnutrition; Synonym: Undernutrition
    - Disease-related malnutrition (DRM) with inflammation
      - Chronic DRM with inflammation; Synonym: Cachexia
        - Cancer cachexia and other disease-specific forms of cachexia
      - Acute disease- or injury-related malnutrition
    - DRM without inflammation. Synonym: Non-cachectic DRM
    - Malnutrition/undernutrition without disease. Synonym: Non-DRM
      - Hunger-related malnutrition
      - Socioeconomic or psychologic related malnutrition
  - Sarcopenia
  - Frailty
  - Over-nutrition
    - Overweight
    - Obesity
      - Sarcopenic obesity
      - Central obesity
  - Micronutrient abnormalities
    - Deficiency
    - Excess
  - Refeeding syndrome

[Consensus, 80% agreement]

Cederholm T,et al. ESPEN guidelines on definitions and terminology of clinical nutrition. Clin Nutr. 2017 Feb;36(1):49-64

Core Curriculum in Nephrology AJKD

Nutrition in Kidney Disease: Core Curriculum 2022

Helen L. MacLaughlin, Allon N. Friedman, and T. Alp Ikizler

Overnutrition, which encompasses the other end of the malnutrition spectrum, includes obesity and (rarely) toxicity from excess micronutrient intake. Though protein-energy malnutrition has historically been the major macronutrient derangement in patients with uremia and kidney failure, obesity is arguably now more common in all stages of CKD, at least in the United States. Obesity is important as a major risk factor for the development and progression of CKD and AKI and as an impediment to optimal care of patients with CKD. Obesity in the CKD population clearly shows a rising trend. In 2011-2014 over 44% of persons with CKD stages 3-5 in the United States

- ESKD (< 20ml/min/1,73m2)→ **riduzione spontanea dell'apporto proteico:**
  - 1,01 g/kg/d con GFR > 50 ml/min
  - 0,85 g/Kg/d con GFR 20-50 ml/min
  - 0,54 g/Kg/d con GFR <20 ml/min

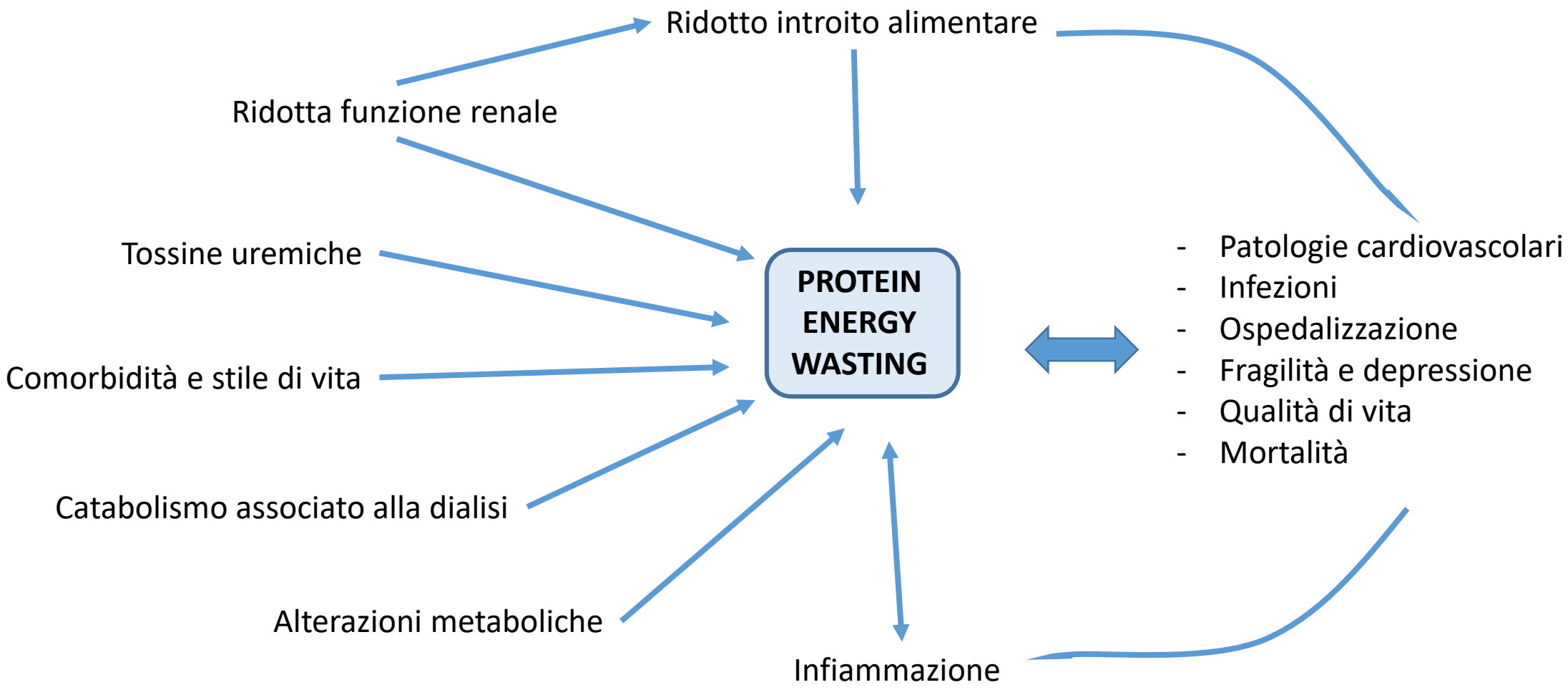
→

- Peggioramento degli indici nutrizionali
- Rischio di sovrastimare GFR basandosi sulla sola creatinina (riduzione massa muscolare)

Aumentato rischio di PEW:

riduzione delle scorte proteiche corporee ed energetiche, associate a una ridotta capacità funzionale in risposta a stress metabolici.

- Prevalenza 10-54% nella CKD stadio 3-5 e 28-54% nei pazienti in dialisi (dato molto variabile)
- > rischio in pz con basso BMI, anziani, donne, pz con demenza/depressione
- Spesso correla con la Fragilità
- Forte predittore di mortalità



Fiaccadori E et al. ESPEN guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease. Clin Nutr. 2021 Apr;40(4):1644-1668.

Causes and mechanisms of Protein energy wasting in CKD patients [17].

1. Reduced protein and energy intake	a. Anorexia: i. *Dysregulation of appetite mediators* ii. *Amino acid stimuli in the hypothalamus* iii. *Uremic toxins* b. Inappropriate dietary restrictions c. Gastrointestinal diseases d. Depression e. Difficulties in food preparation f. Socio-economic difficulties
2. Hypercatabolism	a. Increase in energy expenditure: i. *Chronic inflammation* ii. *Increase in pro-inflammatory cytokines* iii. *Altered metabolism of adiponectin and resistin* b. Hormonal changes: i. *Insulin resistance* ii. *Increased glucocorticoid activity*
3. Metabolic acidosis	Increased protein breakdown, increased BCAA oxidation, insulin and IGF-1 resistance
4. Reduced physical activity	Reduced muscle trophism, reduced self-sufficiency, reduced performance
5. Reduced anabolism	a. Reduced uptake of nutrients b. Resistance to insulin, GH/IGF-1 c. Testosterone deficiency d. Reduced levels of thyroid hormones
6. Comorbidities and life style	a. Comorbidities (diabetes, heart failure, ischemic heart disease, peripheral vascular disease) b. Sedentary lifestyle
7. Dialytic treatment	a. Loss of amino acids and proteins in the dialysate b. Inflammatory processes related to dialysis c. Hypermetabolism related to dialysis d. Loss of residual renal function

CKD, chronic kidney disease; GH, growth hormone; IGF, insulin-like growth factor.

Fiaccadori E et al ESPEN guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease. Clin Nutr. 2021 Apr;40(4):1644-1668.

Impact of nutrition and inflammation indicators on peritoneal dialysis initiation and management

Shunta Hori [1], Mitsuru Tomizawa [1], Kuniaki Inoue [1], Tatsuo Yoneda [1], Akira Tachibana [1],

- Multivariate analysis revealed that the survival index
- nutritional risk index for Japanese hemodialysis patients
- CRP levels

→ Independent indicators of patient survival and cardiovascular disease-free survival

A combination of nutritional indicators (SI) and inflammatory indicators (CRP) may be useful to predict the prognosis more accurately and to improve patient outcome.

Challenging to implement in time sensitive clinical settings

Hori S, Tomizawa M, et al. Impact of nutrition and inflammation indicators on peritoneal dialysis initiation and management. Clin Exp Nephrol. 2023 Nov 23

How to Overcome Anabolic Resistance in Dialysis-Treated Patients?

Giacomo Garibotto [1], Michela Saio [1], Francesca Aimasso [2], Elisa Russo [1 3], Daniela Picciotto [1 3], Francesca Viazzi [1 3], Daniela Verzola [1], Alessandro Laudon [4], Pasquale Esposito [1 3], Giuliano Brunori [4]

Dialysis-treated patients are “anabolic resistant”: blunted muscle protein synthesis (MPS) response to anabolic stimuli

→ muscle wasting and poor physical performance

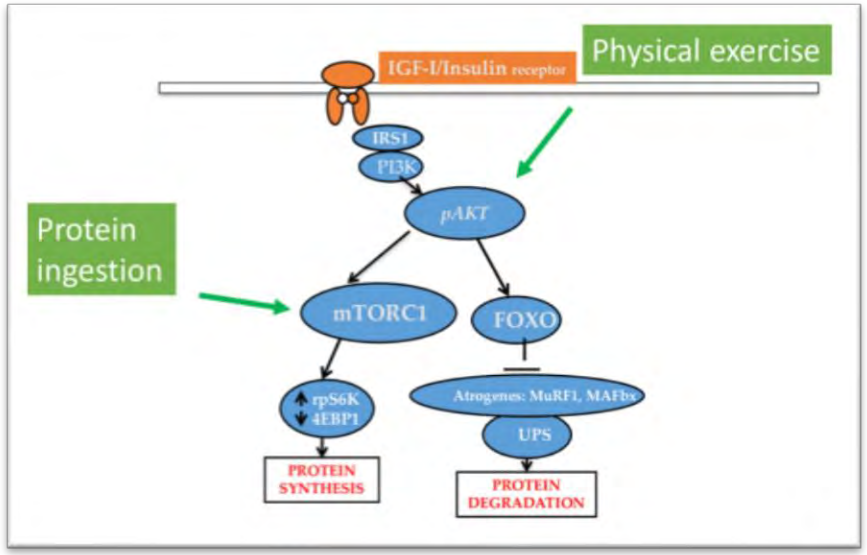
Conditions that impair MPS response to protein and cause “anabolic resistance”

→

- Aging
- Inactivity
- Low energy intake
- DM
- Sepsis
- Hemodialysis procedure (amino acid or protein deprivation)
- Peritoneal dialisys
- Metabolic acidosis

Possible strategies to overcome Anabolic resistence

- Consider amount, quality and timing of ingested protein
- Allow eating during HD
- Intraperitoneal AA+glucose in PD
- Oral nutrition supplements
- Ketoacids and hydoxiacid analogs
- Endurance and resistence training
- Combining nutrition and physical exercise
- Others: beta-hydroxyl-beta- meltil-butyrate, Omega-3 fatty acids, testosterone, growth hormone, denosumab, vitamin D..



The optimal amount and formula of protein/amino acid composition in supplements to maximize MPS is still unknown in dialysis patients

Garibotto G, et al How to Overcome Anabolic Resistance in Dialysis-Treated Patients? Front Nutr. 2021 Aug 12;8:701386

“Regular evaluation of the nutritional and functional status of patients with CKD 4–5 at the start of treatment and during follow up is essential for diet management”

Kistler BM et al. The International Society of Renal Nutrition and Metabolism Commentary on the National Kidney Foundation and Academy of Nutrition and Dietetics KDOQI Clinical Practice Guideline for Nutrition in Chronic Kidney Disease. J Ren Nutr. 2021 Mar;31(2):116-120.e1.

Come capire come sta il nostro paziente…..

Principali manifestazioni cliniche di malnutrizione

Organo	Quadro clinico	Probabile carenza nutrizionale
Condizioni generali	Calo ponderale, aspetto emaciato	Proteine, energia
Cute	Dermatite	Proteine, Zn, Vit.A
Sottocute	Assottigliato Edema	Proteine, energia Proteine, tiamina
Mucose	Pallide	Ferro, Vit.E
Unghie	Coilonichia Fragilità, striature	Ferro, aminoacidi solforati Aspecifica
Capelli	Alterazioni colore e struttura Perdita di capelli	Proteine, energia Zn, AA essenziali, Fe
Labbra	Lesioni angolari bilaterali, cheilosi	Proteine, Fe, Vit.B12 e B6, Ac. folico, niacina, riboflavina
Scheletro	Atrofia muscolare	Proteine, energia

La Valutazione dello Stato Nutrizionale:

strumenti, esami e scale di valutazione

1970 - "Il lungo, il corto e il pacioccone"

Screening dello stato nutrizionale

Test di esecuzione rapida e semplice

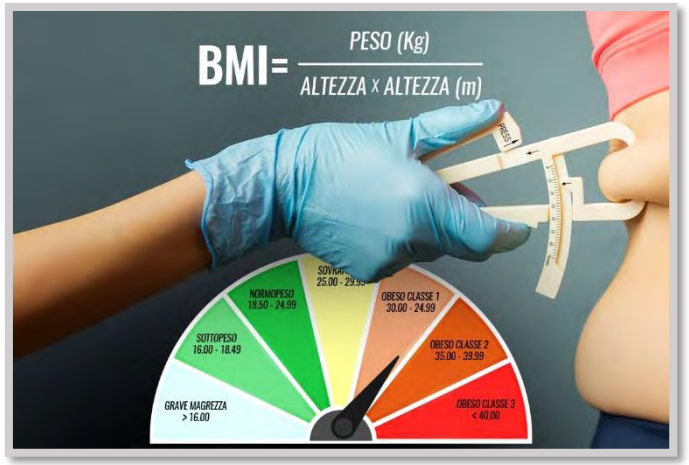
Entro 48h dal primo contatto con il paziente

Obiettivi

- Individuare il paziente a rischio nutrizionale, in considerazione delle condizioni attuali e/o future
- Avviare il paziente ad una valutazione dello stato nutrizionale più approfondita e ad un protocollo di trattamento adeguato

Kondrup J et al. ESPEN Guidelines 2002. *Clin Nutr* 2003
Arends J et al. ESPEN Guidelines 2016. *Clin Nutr; In press*

* **Body mass**: body weight and its variations and body mass index (**BMI**)
Easy but Extremely variable and imprecise



* **Muscle mass and fat mass**: **body circumferences and skinfold thickness**

* **Biochemical data**:

- Albumin
- Prealbumin
- Cholesterol
- Creatinine and clearance
- Urea (plasma and urinary)
- Urinary protein
- Glycemia
- 24h sodium excretion
- Potassium
- Sodium
- Bicharbonate
- Phosphorus
- Transferrin and “iron asset”
- Inflammation

* **Dietary intakes**: **diet history, 24-h recall and food diaries**

Kistler BM et al. The International Society of Renal Nutrition and Metabolism Commentary on the National Kidney Foundation and Academy of Nutrition and Dietetics KDOQI Clinical Practice Guideline for Nutrition in Chronic Kidney Disease. J Ren Nutr. 2021 Mar;31(2):116-120.e1.

Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473

D'Alessandro C, et al "Dietaly": practical issues for the nutritional management of CKD patients in Italy. BMC Nephrol. 2016 Jul 29;17(1):102.

* **Malnutrition Universal Screening Tool (MUST)**

* **Malnutrition Screening Tool (MST)**

* **Subjective Global Assessment (SGA)**

* **Nutritional Risk Screening 2002 (NRS 2002)**

* **Mini Nutritional Assessment Short Form-Revised (MNA-SF)**

* **Subjective Global Assessment (SGA)**

* **Functional and performance evaluations**:
  - Barthel Index
  - Karnowsky Scale
  - handgrip test
  - Sit-ToStand Test
  - 6-min Walking Test
  - Rapid Assessment of Physical Activity (RAPA)
  - pedometers

- Kistler BM et al. The International Society of Renal Nutrition and Metabolism Commentary on the National Kidney Foundation and Academy of Nutrition and Dietetics KDOQI Clinical Practice Guideline for Nutrition in Chronic Kidney Disease. J Ren Nutr. 2021 Mar;31(2):116-120.e1.
- Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473
- Kondrup J et al. ESPEN Guidelines 2002. Clin Nutr 2003
- Arends J et al. ESPEN guidelines 2016. Clin Nutr

* Bio-impedance analysis (BIA)

Semin Dial. 2023 Dec 15. doi: 10.1111/sdi.13190. Online ahead of print.

Incidence of major cardiovascular events at 1, 2, and 5 years and mortality in incident patients on peritoneal dialysis regarding their nutritional status by bioimpedanciometry: A multicenter study in

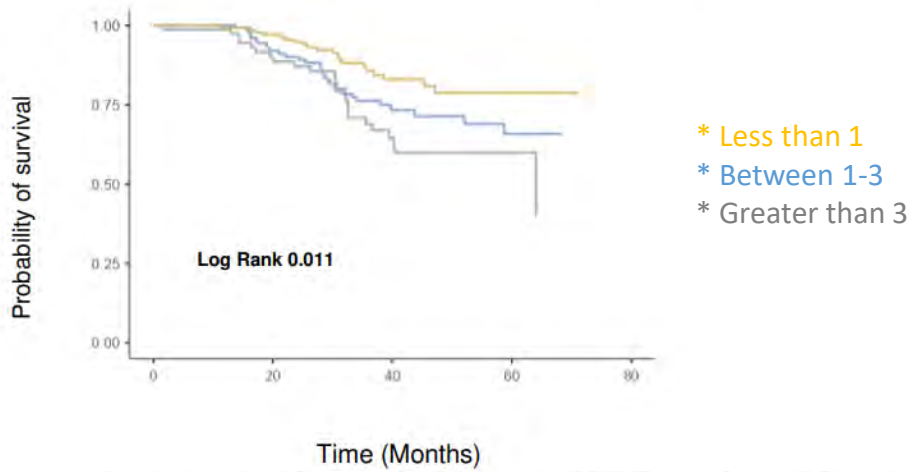
approximately **44% had altered nutritional status:**
- 34% sarcopenia
- 6.7% sarcopenic obesity
- 2.8% in obesity ($p < 0.001$).

- **overhydration (OH) greater than 3 liters** ($p<0.001$)
- **sarcopenia, sarcopenic obesity, and obesity** (p 0.016)

lower survival
(worse in DM – p 0.011)

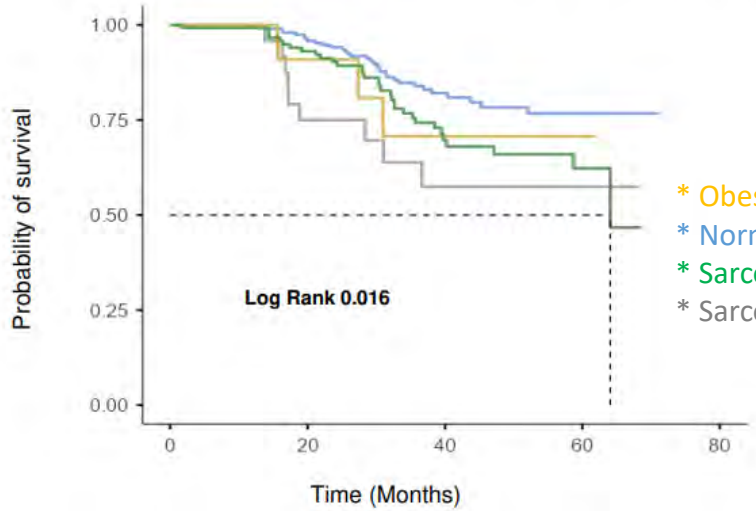
BCM analysis is configured as a highly sensitive and accurate tool to:
- monitor changes in body composition
- make early interventions to adequate risk management and impact on mortality

Figure 2. Survival by OH classification (Overhydration)



* Less than 1
* Between 1-3
* Greater than 3

Figure 3. Survival by Nutritional Classification



* Obese
* Normal nutritional status
* Sarcopenia
* Sarcopenic obesity

Torres R, Reina M, et al. Incidence of major cardiovascular events at 1, 2, and 5 years and mortality in incident patients on peritoneal dialysis regarding their nutritional status by bioimpedanciometry: A multicenter study in Colombia. Semin Dial. 2023 Dec 15.

Pediatr Nephrol. 2023 Nov 16. doi: 10.1007/s00467-023-06219-y. Online ahead of print.

Effect of peritoneal dialysate on bioelectrical impedance analysis variability in pediatric patients receiving peritoneal dialysis

18 patients

A total of 94.1% of BIA parameters exhibited excellent correlations between D + and D- measurements, especially patients older than 10 years. We recommend that BIA measurements be collected from children regardless of the presence of peritoneal dialysate

Correlation of Serum Albumin Levels With Laboratory Parameters in Automated Peritoneal Dialysis and Continuous Ambulatory Peritoneal Dialysis Patients: A Prospective Cohort Study

Rabab M. AlMojalled [1], Reem M. Almabadi [2], Ahlam A. Alghamdi [3], Razan Z. Alnugali [4]

Serum albumin is commonly used as a marker of nutritional status.

Serum albumin levels appeared to be unaffected by the choice of PD modality (85 pt, 71 on APD and 14 on CAPD)

J Ren Nutr. 2023 Oct 31:S1051-2276(23)00192-9. doi: 10.1053/j.jrn.2023.10.009.
Online ahead of print.

Association of Neutrophil and Albumin With Mortality Risk in Patients Receiving Peritoneal Dialysis

Asses the effect of the interaction between neutrophils and albumin on the risk of all-cause mortality and cardiovascular disease (CVD) mortality patients receiving PD.
(1229 PD patients)

Patients with high **neutrophil percentage-to-albumin ratio (NPAR)** showed increased all-cause mortality and CVD mortality, especially when both high neutrophil and low albumin are present.

AlMojalled RM, et al. Correlation of Serum Albumin Levels With Laboratory Parameters in Automated Peritoneal Dialysis and Continuous Ambulatory Peritoneal Dialysis Patients: A Prospective Cohort Study. Cureus. 2023 Oct 20;15(10):e47364.

Gao Y, Han Z, et al. Association of Neutrophil and Albumin With Mortality Risk in Patients Receiving Peritoneal Dialysis. J Ren Nutr. 2023 Oct 31:S1051-2276(23)00192-9.

Nutrients. 2023 Nov 27;15(23):4934. doi: 10.3390/nu15234934.

Dietary Micronutrient Intake and Its Relationship with the Malnutrition–Inflammation–Frailty Complex in Patients Undergoing Peritoneal Dialysis

Malnutrition, inflammation, and frailty interact, often coexist and have a combined effect on patient outcomes.

Address malnutrition and optimize the patient's nutrition status

- nutritional assessment
- medical nutritional therapy

improve outcomes: hospitalization and mortality

* **Semi-quantitative food frequency questionnaire (FFQ)** → Dietary nutrition intake
* **Subjective Global Assessment (SGA)** → Nutrition
* **Malnutrition-Inflammation score (MIS)** → inflammatory burden

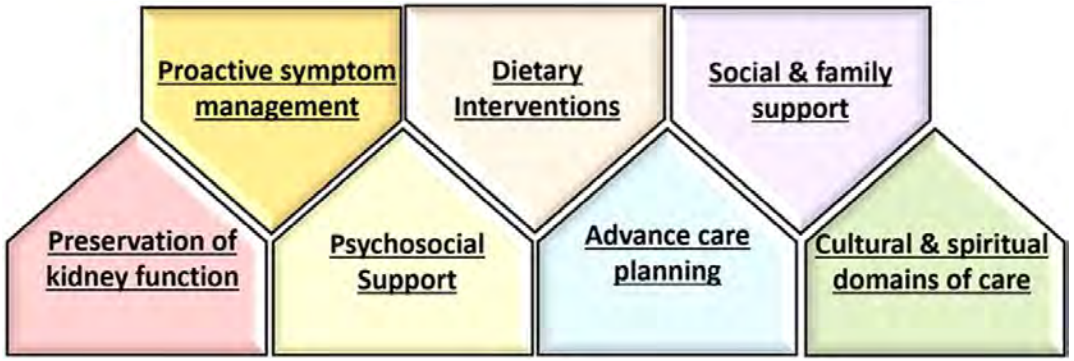
(ten components under four major categories: patients' related medical history; physical exam; body mass index and laboratory parameters)

However, there is *currently no standardized guideline recommending the specific amount of replacement for each nutritional component or micronutrient.*

Forte necessità di una valutazione nutrizionale e di una terapia dietetico-nutrizionale.

OBIETTIVI:

- **Mantenere un buono stato nutrizionale (evitare la PEW)**
- **Anticipare e integrare le terapie farmacologiche (farmaci, dialisi) per ridurre proteinuria e danno renale**
- **Ridurre produzione e accumulo di «tossine uremiche» (urea, acidi, fosfati, P-cresolo, indoxil-solfato…)**
- **Ritardare l'insorgenza di sintomi uremici, l'avvio/ dose del trattamento dialitico (miglioramento qualità di vita)**
- **Ridurre il rischio cardio-metabolico dei pazienti con ESKD**



Multifaceted approach in the conservative and preservative management of kidney disease.

New guidelines:

→ **screen** patients with CKD stages 3-5D for **nutrition status biannually** and address patient to a dietician when needed

→ Prefer **global or composite scores** opposed to single biomarkers

Rhee CM, et al Nutritional and Dietary Management of Chronic Kidney Disease Under Conservative and Preservative Kidney Care Without Dialysis. J Ren Nutr. 2023 Nov;33(6S):S56-S66.

Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473

Kistler BM et al. The International Society of Renal Nutrition and Metabolism Commentary on the National Kidney Foundation and Academy of Nutrition and Dietetics KDOQI Clinical Practice Guideline for Nutrition in Chronic Kidney Disease. J Ren Nutr. 2021 Mar;31(2):116-120.e1.

Practice Guideline > J Nephrol. 2018 Aug;31(4):457-473. doi: 10.1007/s40620-018-0497-z.
Epub 2018 May 24.

Nutritional treatment of advanced CKD: twenty consensus statements

Adherence to a dietary prescription is critical, as with pharmacological therapies

Requirements:

- skilled dietitians (full/ part-time dietitian dedicated to nephrology, in-hospital dietitian)
- individualized dietary programs
- intensive educational programs (informative materials, digital supports)
- regular counseling
- dedicated personnel

- time and money consuming
- rarely available in the common clinical practice

Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473

Quale terapia dietetico – nutrizionale (TDN)?

9. **La terapia dietetica nutrizionale nella MRC 4-5 deve essere gestita con le fasi ed i criteri di una qualsiasi altra terapia farmacologica:**

- **indicazioni**
- **controindicazioni**
- **effetti collaterali**
- **modifiche della posologia**
- **verifica dei risultati**
- **follow-up**

D. Contraindications to a Low-Protein Diet

Absolute

- Protein energy wasting
- Hypercatabolic state (acute or chronic)
- Anorexia and eating disorders
- End of life care management

Relative

- Poor attitude to dietary modifications
- Psychiatric / psychological disorders
- Logistic barriers (economic, cultural, lack of support)
- Poorly controlled diabetes
- Chronic steroid treatment
- Intestinal diseases including chewing disorders
- Short life-expectancy

E. Unwanted Side Effects of LPD

- Weight loss due to reduced energy intake
- Loss of muscle mass due to inadequate protein and energy intake
- Depression, relational problems, psychological discomfort

La TDN nella terapia conservativa della CKD

J Nephrol (2016) 29:593–602
DOI 10.1007/s40620-016-0323-4

POSITION PAPERS AND GUIDELINES

A Delphi consensus panel on nutritional therapy in chronic kidney disease

Vincenzo Bellizzi[1] · Stefano Bianchi[2] · Piergiorgio Bolasco[3] · Giuliano Brunori[4] · Adamasco Cupisti[5] · Giovanni Gambaro[6] · Loreto Gesualdo[7] · Pasquale Polito[8] · Domenico Santoro[9] · Antonio Santoro[10]

Journal of Nephrology
https://doi.org/10.1007/s40620-018-0497-z

POSITION PAPERS AND GUIDELINES

Nutritional treatment of advanced CKD: twenty consensus statements

Adamasco Cupisti[1] · Giuliano Brunori[2] · Biagio Raffaele Di Iorio[3] · Claudia D'Alessandro[1,4] · Franca Pasticci[4,5] · Carmela Cosola[6] · Vincenzo Bellizzi[7] · Piergiorgio Bolasco[8] · Alessandro Capitanini[9] · Anna Laura Fantuzzi[10] · Annalisa Gennari[4,11] · Giorgina Barbara Piccoli[12,13] · Giuseppe Quintaliani[14] · Mario Salomone[15] · Massimo Sandrini[11] · Domenico Santoro[16] · Patrizia Babini[17] · Enrico Fiaccadori[18] · Giovanni Gambaro[19] · Giacomo Garibotto[20] · Mariacristina Gregorini[21] · Marcora Mandreoli[22] · Roberto Minutolo[23] · Giovanni Cancarini[11] · Giuseppe Conte[23] · Francesco Locatelli[24] · Loreto Gesualdo[6]

Received: 5 March 2018 / Accepted: 4 May 2018

Table 1 Dietary composition of low-protein diets for CKD patients

	Normal diet	LPD	Vegan	VLPD
Nutrients				
Energy requirement	normal	high	high	high
Protein, g/Kg/d	0.8	0.6	0.7	0.3-0.4
Prevalent origin of proteins	Mixed	Animal	Plant	Plant
Phosphate, mg/d	700-800	500-600	500-600	300-400
Sodium, mmol/d	100	100	100	100
Supplements				
Free-protein products use	Optional	Yes	No	Yes
EAA + KA	No	Optional	Optional	Yes
Calcium, g/d	Optional	0.5-1.0	0.5-1.0	0.5-1.0
B12 Vitamin	No	Optional	Yes	Yes
Iron	No	Optional	Yes	Yes

EAA essential aminoacids, *KA* ketoacids

Bellizzi *et al. BMC Nephrology* (2016) 17:77
DOI 10.1186/s12882-016-0280-0

BMC Nephrology

CORRESPONDENCE Open Access

Low-protein diets for chronic kidney disease patients: the Italian experience

Vincenzo Bellizzi[1*], Adamasco Cupisti[2], Francesco Locatelli[3], Piergiorgio Bolasco[4], Giuliano Brunori[5], Giovanni Cancarini[6], Stefania Caria[4], Luca De Nicola[7], Biagio R. Di Iorio[8], Lucia Di Micco[8], Enrico Fiaccadori[9], Giacomo Garibotto[10], Marcora Mandreoli[11], Roberto Minutolo[7], Lamberto Oldrizzi[12], Giorgina B. Piccoli[13,14], Giuseppe Quintaliani[15], Domenico Santoro[16], Serena Torraca[1], Battista F. Viola[6] and on behalf of the "Conservative Treatment of CKD" study group of the Italian Society of Nephrology

Indications:

- existence of metabolic and hydroelectrolytic alterations or metabolic acidosis
- protein-energy depletion or obesity
- signs and symptoms of uremic intoxication
- the desire or necessity to delay the start of replacement therapy (dialysis or transplant)

Contraindications:

- patient's refusal or inability to follow dietary rules due to socio-economic or psychological distress, a chewing disorder
- lack of motivation
- deterioration in the quality of life,
- Hypercatabolic conditions etc

Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473

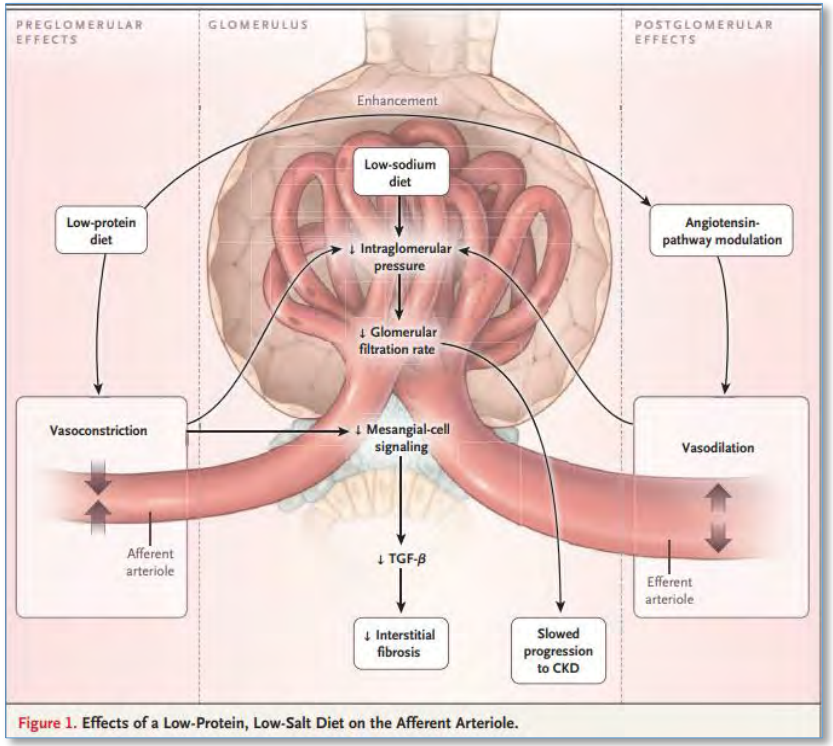


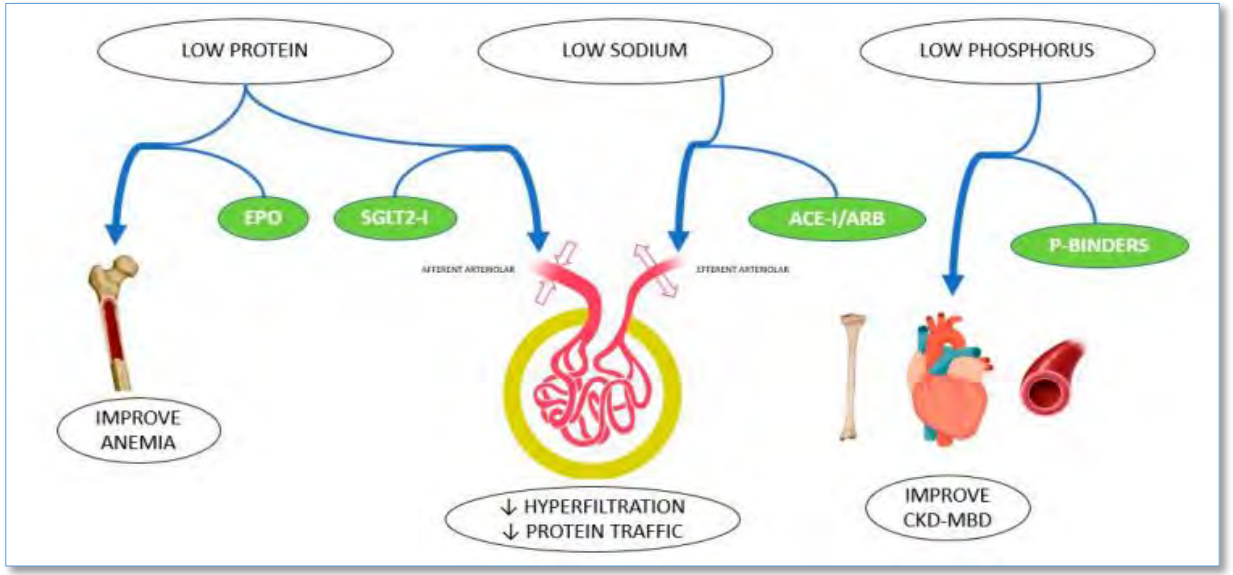
Figure 1. Effects of a Low-Protein, Low-Salt Diet on the Afferent Arteriole.

DIETA IPOSODICA

riduzione proteinuria, potenzia efficacia di RAASi, riduzione PA

ADEGUATO (normale o ridotto) APPORTO DI POTASSIO

ADEGUATO APPORTO CALORICO



DIETA IPOPROTEICA (con adeguato apporto di AA essenziali, +/- ketoanaloghi)

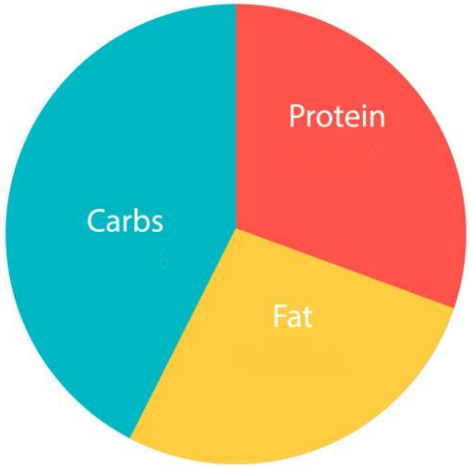
Riduzione di:
- iperfiltrazione glomerulare, infiammazione, progressione del danno renale.
- carico di sodio
- riduce il carico di fosforo → riduce secrezione di FGF-23, miglior controllo PTH
- minor infiammazione → miglior risposta a ESA
- minor generazione di scorie azotate e carico acido
- anche in pazienti proteinurici e diabetici (in assenza di quadri di ipercatabolismo)

Kalantar-Zadeh K, Fouque D. Nutritional Management of Chronic Kidney Disease. N Engl J Med. 2017 Nov 2
Giannese D, D'Alessandro C, Panichi V, Pellegrino N, Cupisti A. Nutritional Treatment as a Synergic Intervention to Pharmacological Therapy in CKD Patients. Nutrients. 2023 Jun 12

Stretta correlazione tra introito proteico e calorico

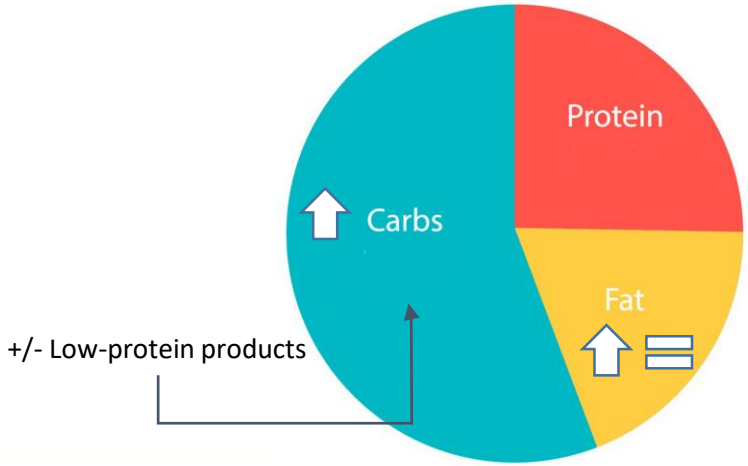
Restrizione proteica → aumentare apporto calorico:

- Evita l'utilizzo proteico a scopo energetico
- Consente l'adattamento metabolico al basso introito proteico
- Previene la perdita di massa muscolare e l'insorgere della PEW



Normal proteic intake

- servono **0,55 g/Kg/die di proteine** per mantenere il bilancio azotato ma solo se l'apporto calorico e almeno di **30 Kcal/Kg/die (35 Kcal/Kg/die** se meno di 60 anni)
- in caso di diete più restrittive è necessario introdurre **supplementi** di **aminoacidi essenziali e/o prodotti aproteici** (ipercalorici) per mantenere il bilancio neutro.



Protein restriction

- Attenta valutazione (multidisciplinare → nefrologo, dietista…)
- Stretto monitoraggio clinico-laboratoristico
- Proposta al paziente «giusto»:
  - compliante («enpowerment» del paziente)
  - assenza di stati di ipercatabolismo
- Personalizzazione: caratteristiche, necessità, gusti del paziente, progressione della sua CKD
- Approccio progressivo e graduale
- Associare a correzione dell'acidosi metabolica e buon controllo glicometabolico
- Garantire adeguato apporto calorico (+/- prodotti aproteici) e aminoacidi essenziali (+/- ketoanaloghi)

Time consuming

Nutritional care management

Surveillance during low-protein diets in CKD

Two main issues set the stage for a successful LPD: prevention of protein-energy wasting and surveillance of adherence to dietary prescriptions. For this reason, patients on LPD require frequent monitoring by skilled personnel (nephrologists and dietitians). Nutritional

Table 1 Main general features of the dietary therapy in patients with chronic renal insufficiency

Energy	30–35 Kcal/kg/day
Protein	0.3–0.7 g/kg/day
Carbohydrates	At least 60 % of total energy intake
Lipids	At least 30 % of total energy intake
Sodium	2.3 g/day (equivalent to 6 g NaCl salt)
Phosphate	<700 mg/day
Supplements	Essential amino acid and ketoacids, calcium carbonate, vitamins, iron

Table 3 Dietary regimens in CKD. The degree of protein and phosphorus restriction is mostly dependent on severity of renal insufficiency, whereas adequacy of energy intake and limitation in salt intake are generally prescribed. As body weight (bw) we refer to the ideal body weight, or to the adjusted weight (when applicable)

Dietary regimen	Main composition features	CKD stages
a) Healthy diet, according to WHO	Protein: 0.8 g/Kg bw/day according to RDA.	I, II, IIIa
	Sodium according to WHO recommendation (2.3 g/day); Phosphorus according to RDA (700 mg/day)	
b) Low Protein Diet (LPD)	Protein: 0.6 g/Kg bw/day, whose 0.4 g/Kg of animal origin; Sodium: 2.3 g/day; Phosphorus < 700 mg/day	IIIb, IV, V
c) Low Protein Vegan Diet	Protein : 0.7 g/Kg bw/die, from grains and legumes;	IIIb, IV
	Sodium : 2.3 g/day; Phosphorus : < 700 mg/day	
d) Supplemented Very Low Protein Diet (sVLPD)	Protein: 0.3-0.4 g/Kg bw/day supplemented with EAAs and KAs	IV, V
	Sodium: 2.3 g/day, Phosphorus : 300–400 mg/day	

D'Alessandro C, et al "Dietaly": practical issues for the nutritional management of CKD patients in Italy. BMC Nephrol. 2016 Jul 29;17(1):102.

Table 1. Recommended Dietary and Nutrient Intake for Different Stages of Kidney Disease in Adults

	Normal kidney function (eGFR >60*) and no proteinuria, but at higher CKD risk, eg, diabetes, hypertension, or solitary kidney†	Mild to moderate CKD (eGFR 30 to <60*) without substantial proteinuria (<0.3 g/d)†	Advanced CKD (eGFR <30*) or any CKD with substantial proteinuria (>0.3 g/d)†	Transitioning to dialysis therapy with good RKF including incremental dialysis preparation†	Prevalent dialysis therapy, or any CKD stage with existing or imminent PEW†
Dietary protein g/kg/d based on IBW†	<1.0 g/kg/d, increase proportion of plant-based proteins	<1.0 g/kg/d (consider 0.6-0.8 if eGFR <45 mL/min/1.73 m^2 and fast progression)	0.6-0.8 g/kg/d including 50% HBV, or <0.6 g/kg/d with addition of EAA/KA	0.6-0.8 g/kg/d on nondialysis days (eg, incremental dialysis) and >1.0 g/kg/d on dialysis days	1.2-1.4 g/kg/d, may require >1.5 g/kg/d if hypercatabolic

Type of Diet	Protein Restriction (g/kg of body weight per day)
Conventional low protein diet	0.55–0.60 g/kg b.w./day; mixed protein
Vegan low protein diet	0.6–0.8 g/kg b.w./day; vegetable protein
Vegan supplemented (moderate restriction) Diet	0.6–0.7 g/kg b.w./day; vegetable protein, supplemented with essential amino- and keto-acids
Very low-protein supplemented vegan diet	0.28–0.43 g/kg b.w./day; vegetable protein only, supplemented, with or without protein-free food
Tailored solutions	Usually 0.6–0.8 g/kg b.w./day, vegetable or mixed

- Cupisti A et al. Medical Nutritional Therapy for Patients with Chronic Kidney Disease not on Dialysis: The Low Protein Diet as a Medication. J Clin Med. 2020 Nov 12
- Wang Ayet al. Precision Medicine for Nutritional Management in End-Stage Kidney Disease and Transition to Dialysis. Semin Nephrol. 2018 Jul
- Kalantar-Zadeh K, Fouque D. Nutritional Management of Chronic Kidney Disease. N Engl J Med. 2017 Nov 2

KDOQI
KIDNEY DISEASE OUTCOMES QUALITY INITIATIVE
National Kidney Foundation

eat right® Academy of Nutrition and Dietetics

KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CKD: 2020 UPDATE

T. Alp Ikizler, Jerrilynn D. Burrowes, Laura D. Byham-Gray, Katrina L. Campbell, Juan-Jesus Carrero, Winnie Chan, Denis Fouque, Allon N. Friedman, Sana Ghaddar, D. Jordi Goldstein-Fuchs, George A. Kaysen, Joel D. Kopple, Daniel Teta, Angela Yee-Moon Wang, and Lilian Cuppari

Guideline 3: Protein and Energy Intake

3.0 Statements on Protein Amount

Protein Restriction, CKD Patients Not on Dialysis and Without Diabetes

3.0.1 In adults with CKD 3-5 who are metabolically stable, we recommend, under close clinical supervision, protein restriction with or without keto acid analogs, to reduce risk for end-stage kidney disease (ESKD)/death (1A) and improve quality of life (QoL) (2C):

	Protein intake	Calories intake
CKD 3-5	0,55 – 0,6 g/prot/kg/day	25-35 Kcal/kg/day
	0,28-0,43 g/prot/kg/day + keto acid/aa analogues (to meet protein requirements)	
CKD 3-5 with diabetes	0,6 – 0,8 g/prot/kg/day	
CKD 5D on MHD or PD (also with diabetes)	1,0-1,2 g/prot/kg/day	

Only in metabolical stability

Ikizler TA et al. KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. Am J Kidney Dis. 2020 Sep;76(3 Suppl 1):S1-S107. doi: 10.1053/j.ajkd.2020.05.006. Erratum in: Am J Kidney Dis. 2021 Feb;77(2):308.

KDOQI guidelines 2020

- Adequate protein and energy intake in the regular diet is critical for patients on HD and PD

- Energy and protein intake is generally lower than that of the recommended → PEW high risk

Strategies for maintaining or improving nutritional status:
- Nutritional indication
- Food and nutritional supplements

ONS (oral nutrition supplements):
- improve nutritional status: serum albumin, BMI, HGS without significant effects on serum phosphorus, potassium, and C-reactive protein levels
- uncertain results on improving clinically relevant outcomes
- Used in malnourished patients
- Easily implementable a minimum 3-month trial of ONS administration to improve nutritional status (CKD 3-5)

No consensus exists on the type, time of initiation, or duration of use of enteral nutrition or nutritional supplementation for patients on MDT (manteinance dialysis treatment)

Liu PJ, Guo J, Zhang Y, Wang F, Yu K. Effects of oral nutritional supplements on the nutritional status and inflammatory markers in patients on maintenance dialysis: a systematic review and meta-analysis of randomized clinical trials. Clin Kidney J. 2023 May 27;16(11):2271-2288.

* Una corretta terapia nutrizionale ipoproteica **non determina malnutrizione o un aumento della mortalità a breve e lungo termine.**

* Una corretta TDN può permettere un **programma integrato, dietetico e dialitico** nell ESRD, riducendo la frequenza delle sedute HD:

- Giovannetti e Locatelli (dieta 0,3 + 1HD/w → alto rischio malnutrizione e scarsa compliance)
- CDDP (programma combinato dietetico dialitico: dieta 0,6 + dieta libera il giorno dell'HD 1giorno a settimana → buoni risultati)

* Una corretta TDN può permettere un **programma integrato di dialisi peritoneale incrementale**

Caria S, Cupisti A, Sau G, Bolasco P. The incremental treatment of ESRD: a low-protein diet combined with weekly hemodialysis may be beneficial for selected patients. BMC Nephrol. 2014 Oct 29;15:172.

Ikizler TA et al. KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. Am J Kidney Dis. 2020 Sep;76(3 Suppl 1):S1-S107. doi: 10.1053/j.ajkd.2020.05.006. Erratum in: Am J Kidney Dis. 2021 Feb;77(2):308.

DIALISI PERITONEALE INCREMENTALE…DEFINIZIONI…

An indefinite Definition….

Best Practice GdS DP SIN

Bertoli SV, Musetti C, Ciurlino D. LA DIALISI PERITONEALE INCREMENTALE: UNA SOLUZIONE COMUNE PER PAZIENTI DIVERSI. Giornale Italiano di Nefrologia, 2010 n. 4, 374-382

CAPD	Dose iniziale	1-2 scambi/die	2 L, solitamente isotonica o icodestrina
	Dose standard	3-5 scambi/die	2-2.5 L, secondo necessità clinica
APD	Dose iniziale	3-5 sedute/sett	8-15 L, solitamente isotonica
	Dose standard	6-7 sedute/sett	10-20 L, secondo necessità clinica

Associated to a low protein diet 0,6g/Kg/day of proteins

PERITONEAL DIALYSIS INTERNATIONAL

Guidelines

Incremental peritoneal dialysis

Peter G Blake[1], Jie Dong[2,3,4,5] and Simon J Davies[6]

SAGE

Table 2. Typical incremental PD prescriptions.

CAPD	APD
3 × 2 L daily	APD with no day dwell
2 × 2 L daily (single or both icodextrin)	APD five nights a week
1 × 2 L icodextrin long dwell daily	APD three nights a week
4 × 1.5 L daily	APD with 1.5 L dwell volumes
CAPD 4–6 days a week	APD for 6 h each night

PD: peritoneal dialysis; APD: automated peritoneal dialysis; CAPD: continuous ambulatory peritoneal dialysis.

Molte definizioni di DP incrementale utilizzano volumi che rientrano nella dose dialitica piena

Journal of Nephrology
https://doi.org/10.1007/s40620-018-00577-9

ORIGINAL ARTICLE

Incremental dialysis in ESRD: systematic review and meta-analysis

Carlo Garofalo[1] · Silvio Borrelli[1] · Toni De Stefano[1] · Michele Provenzano[2] · Michele Andreucci[2] · Gianfranca Cabiddu[3] · Vincenzo La Milia[4] · Valerio Vizzardi[5] · Massimo Sandrini[5] · Giovanni Cancarini[5] · Adamasco Cupisti[6] · Vincenzo Bellizzi[7] · Roberto Russo[8] · Paolo Chiodini[9] · Roberto Minutolo[1] · Giuseppe Conte[1] · Luca De Nicola[1]

Received: 24 November 2018 / Accepted: 18 December 2018

As regards IHD, it is also important to note that this approach may not only include twice-a-week HD schedule but also a once-a-week HD schedule if combined with dietary intervention (low-protein-low-phosphorus-high energy diet) [52, 53]. The dialysis schedule and concomitant dietary

- NON E' UNA DIALISI PRECOCE
- controllo mensile della FRR per adeguare la dose dialitica
- Solo per pazienti «selezionati» (es. diuresi >600ml/die, FRR >3ml/min

VANTAGGI:

- minor velocità di riduzione GFR e della diuresi residua (migliore clearance medie-grandi molecole)
- minor ospedalizzazione
- minor incidenza peritoniti
- minor infiammazione
- minor impatto/miglior qualità di vita del paziente e ambiente

Conclusions Incremental dialysis allows longer preservation of RKF thus deferring full-dose dialysis, by about 1 year in HD and PD, with no increase in mortality risk. Large and adequate studies are needed to confirm these findings.

Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473

Figure 5: Incremental dialysis in 2022. The method of PD used (CAPD and APD) is given in the lateral columns for "incremental" (on the left) and "full dose" patients (right).

Figure 6: percentage of total incident patients who started PD with an incremental prescription (2 or fewer exchanges on CAPD and 4 or fewer sessions on APD).

Indications for DNT are well defined for CKD 5 and for standard PD.
Experiences of association between DNT and incremental hemodialysis are available.
With regard to IPD, there are no specific indications to date.

DNT in IPD could:
- reduce occurrence of uremic symptoms
- improve metabolic control
- contribute to a delay in RRF decline

Problems:
- poor tolerance or adherence to DNT
- risk of worsening nutritional status
- close monitoring of nutritional status and RRF

In Brescia, an IPD experiment began in 2002 → DNT in IPD: daily intake of 0.6–0.8 g protein/kg body weight, 30–35 kcal/kg body weight and 5 g/day of NaCl.

Beyond this experience, controlled studies are necessary in order to confirm that correct DNT in IPD regime.

Cupisti A, Brunori G et al . Nutritional treatment of advanced CKD: twenty consensus statements. J Nephrol. 2018 Aug;31(4):457-473

Esperienze di TDN con dieta ipoproteica in HD incrementale (mono-bisettimanale)

Nel 1994 il gruppo di Locatelli [10], riprendendo lo schema di Giovannetti et al. [9] e le esperienze di Mitch [8] proposero l'integrazione di una dialisi monosettimanale ad una dieta ipoproteica 0,3-0,4 g/Kg/die supplementata con aminoacidi essenziali e chetoanalogi. Questo programma fu denominato *ntegrated Dialysis Diet Program* (IDDP) [10]. La difficile applicabilità di una dieta così severa, l'elevato numero di drop-out e la preoccupazione di indurre malnutrizione portarono alla conclusione che questo trattamento non è da considerare applicabile in larga scala, ma può essere comunque una valida opzione in pazienti attentamente selezionati [27] (full text).

Table 2. List of Studies Relating to Once-Weekly Hemodialysis (OWHD) Combined With Low-Protein Diet

Specific Studies	Study Design	n. Patients on OWHD Plus Diet	Age, y	GFR at Start (mL/min/1.73 sm)	Protein Prescription (g/kg/day) and Supplementation, on Nondialysis Days	Energy Intake Prescription (kcal/kg/day)
Mitch WE et al (1981)	No control group	7	45.0 ± ?	1.86 ± 0.81	0.4 plus EAA	34.3
Morelli E et al (1987)	No control group	17	48.7 ± 11.6	4.09 ± 0.9	0.3 plus EAA + KA	35
Locatelli F et al (1998)	No control group	69	62.9 ± 11.1	2.45 ± 0.94	0.4 plus EAA + KA	40
Caria S et al (2014)	No randomized control group	38	64.5 ± 13.2	7.8 ± 1.9	0.6 without external supplement	30-35

EAA, essential amino acids; GFA, glomerular filtration rate; KA, ketoanalogues; OWHD, once-weekly hemodialysis.

Locatelli F, Andrulli S, Pontoriero G, Di Filippo S, Bigi MC. Integrated diet and dialysis programme. Nephrol Dial Transplant. 1998;13 Suppl 6:132-8.

Esperienze di TDN con dieta ipoproteica in HD incrementale (mono-bisettimanale)

Caria *et al. BMC Nephrology* 2014, **15**:172
http://www.biomedcentral.com/1471-2369/15/172

BMC Nephrology

RESEARCH ARTICLE Open Access

The incremental treatment of ESRD: a low-protein diet combined with weekly hemodialysis may be beneficial for selected patients

Stefania Caria[1*], Adamasco Cupisti[2], Giovanna Sau[3] and Piergiorgio Bolasco[1]

2014

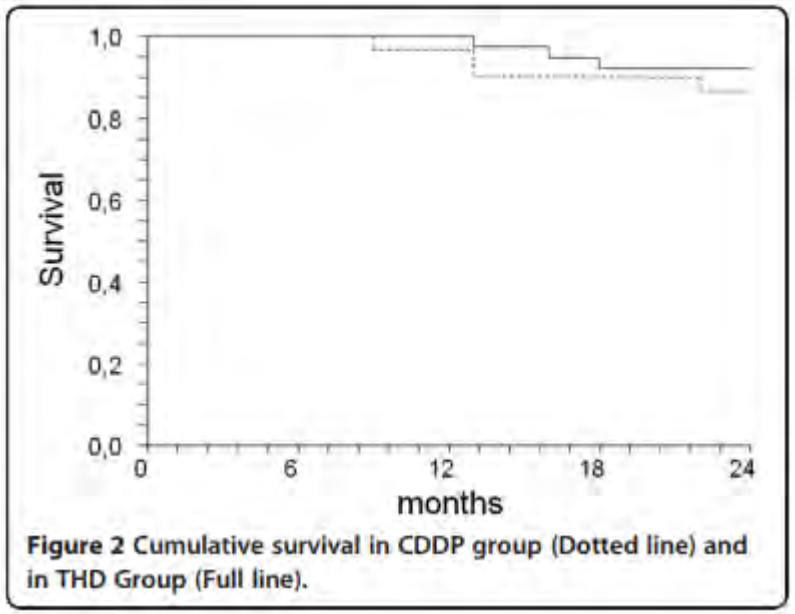


Figure 2 Cumulative survival in CDDP group (Dotted line) and in THD Group (Full line).

CDDP: Combined Diet Dialysis Program

Discussion

This study shows that in selected ESRD patients, a CDDP is able to protect the RRF, to maintain urine volume output, to preserve a good nutritional status, to blunt the rapid β2 microglobulin increase, and to allow better control of anemia and calcium-phosphate abnormalities. CDDP is also associated with a lower rate of hospitalization , reduced need of EPO and drugs used for the CKD-MBD treatment, thus leading to a significant cost-saving. CCDP may be considered as the first step of an incremental approach to hemodialysis treatment of ESRD.

Patients who entered the CDDP showed a better control of phosphatemia, BUN, PTH levels and higher albumin levels despite a lower RRF. It suggests that patients who had maintained consistent adherence to dietary treatment chose the CDDP whereas THD was chosen by patients with poor compliance to dietary prescriptions. In fact, dietary discipline is the first pre-requisite for a safe and successful CDDP.

REVIEW ARTICLE

CPE Dietary Management of Incremental Transition to Dialysis Therapy: Once-Weekly Hemodialysis Combined With Low-Protein Diet

Piergiorgio Bolasco, MD, Adamasco Cupisti, MD,† Francesco Locatelli, MD, PhD,‡ Stefania Caria, MD,* and Kamyar Kalantar-Zadeh, MD, MPH, PhD§*

2016

Table 3. Schematic Differences Between the Combined Diet Dialysis Program (CDDP), the Twice-Weekly, and Three-Weekly Hemodialysis Schedules Relative Level of Impact on the Item: + Low, ++ Middle, +++ High

Properties	CDDP	Twice a Week	Thrice a Week
Nutritional support need	+++	+	+
Protein intake, g/kg/day	0.6	0.8-1.2 (?)	>1.2
Energy intake, kcal/kg/day	30-35	30-35	30-35
vascular access stress	+	++	+++
Protection of residual kidney function	+++	+/++	–
Accommodation of dialysis schedule	+/++	++/+++	+/++
Cost burden	+	++	+++

LPD, low-protein diet.

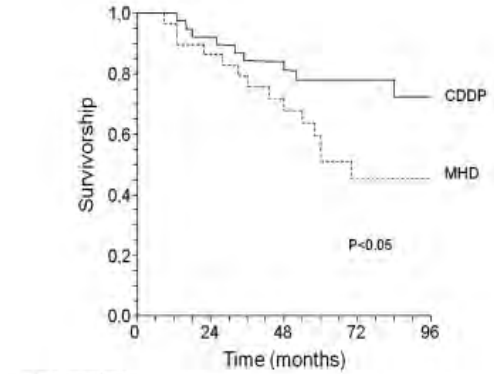


Figure 1. Survival between patients on mainstream thrice weekly hemodialysis and patients on CDDP. CDDP, Combined Diet Dialysis Program.

- ❑ One of the main aims of the incremental dialysis program is the preservation of RKF
- ❑ However, incr. HD is rarely prescribed in Europe (5,2%) and USA (1%), despite many reported advantages (longer RKF preservation, lower patient care burden).
- ❑ Requires a more careful evaluation of clinical status and RKF → preparation should start in the predialysis phase and before transition to dialysis therapy
- ❑ It is important to note that CDDP was only suitable for a highly selected and exceptionally motivated patients

→

- reduced rate of hospitalization
- lower rise in b2-microglobulin levels
- better control of serum phosphorus (and less need for phosphorus binders)
- better anemia management (less need for ESA)

Giornale Italiano di Nefrologia

Dieta

2018

IN DEPTH REVIEW

Approccio incrementale di inizio dialisi: emodialisi bisettimanale, o monosettimanale associata a dieta ipoproteica-ipofosforica?

Piergiorgio Bolasco[1], Stefania Caria[1], Maria Francesca Egidi[2], Adamasco Cupisti[2]

Dialisi Monosettimanale associata a dieta ipoproteica-ipofosforica

La terapia nutrizionale può essere un valido provvedimento per consentire di ridurre la necessità e la frequenza di dose dialitica e quindi per una graduale transizione alla dialisi cronica.

Facendo tesoro delle esperienze precedenti e cercando di correggere alcuni punti di debolezza, abbiamo riproposto un programma denominato *Combined Diet Dialysis Program* (CDDP) [15] (full text). Rispetto agli studi degli anni '80-'90 [9] [10], il CDDP prevede una dieta ipoproteica meno severa (0,6 g/Kg/die), sempre ipofosforica e normocalorica, con dieta libera in proteine il giorno della dialisi per coprire l'aumentato fabbisogno azotato legato alle perdite di proteine e aminoacidi dovute alla seduta di emodialisi [15] (full text).

Per lo più pazienti provenienti dall'ambulatorio di pre-dialisi, stabilizzati da un punto di vista metabolico con un intervento dietetico-nutrizionale e «abituati» alla dieta ipoproteica

- Funzione renale residua: FG 5-10 ml/min e volume di diuresi > 1.0 L/d
- Non segni di ritenzione idrosalina, o responsivi alla terapia diuretica
- Incremento ponderale tra una dialisi e l'altra < 2.5 Kg, o < 5% dell'acqua corporea.
- Aderenza alla terapia nutrizionale: ipoproteica (0.6 g/kg/d), ipofosforica,iposodica, normo/ipercalorica
- Potassiemia controllabile e stabilmente < 5.5 mEq/L
- Assenza di condizioni ipercataboliche e buono stato di nutrizione
- Percezione da parte del paziente di una buona qualità di vita

Nakao et al. BMC Nephrology (2018) 19:151
https://doi.org/10.1186/s12882-018-0941-2

BMC Nephrology

RESEARCH ARTICLE Open Access

Once-weekly hemodialysis combined with low-protein and low-salt dietary treatment as a favorable therapeutic modality for selected patients with end-stage renal failure: a prospective observational study in Japanese patients

Toshiyuki Nakao[1,2,3*], Yoshie Kanazawa[1,2] and Toshimasa Takahashi[1,3] Tokyo Medical University

⇨ - Apporto proteico 0,6 g/kg/die

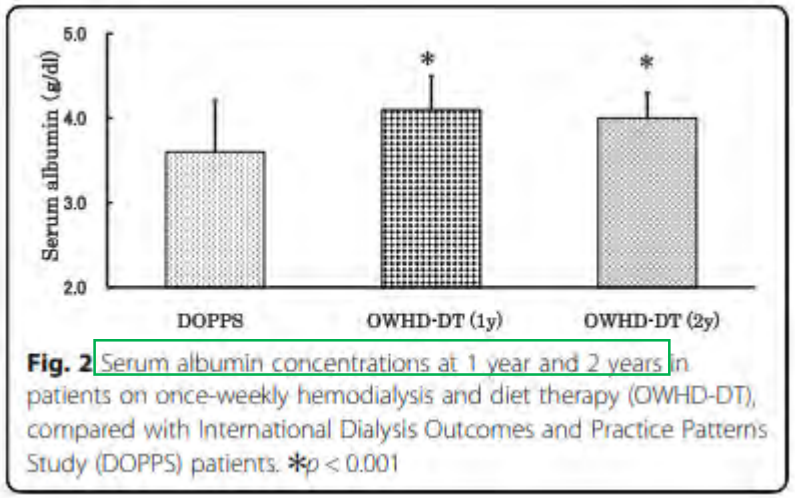


Fig. 2 Serum albumin concentrations at 1 year and 2 years in patients on once-weekly hemodialysis and diet therapy (OWHD-DT), compared with International Dialysis Outcomes and Practice Patterns Study (DOPPS) patients. *$p < 0.001$

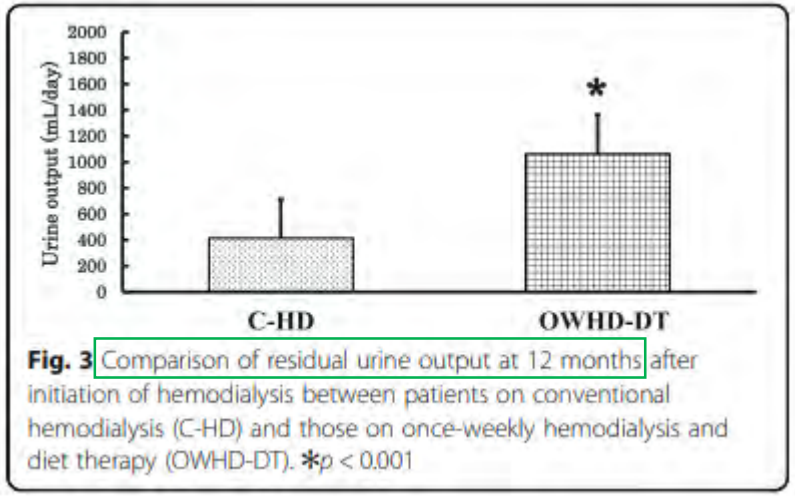


Fig. 3 Comparison of residual urine output at 12 months after initiation of hemodialysis between patients on conventional hemodialysis (C-HD) and those on once-weekly hemodialysis and diet therapy (OWHD-DT). *$p < 0.001$

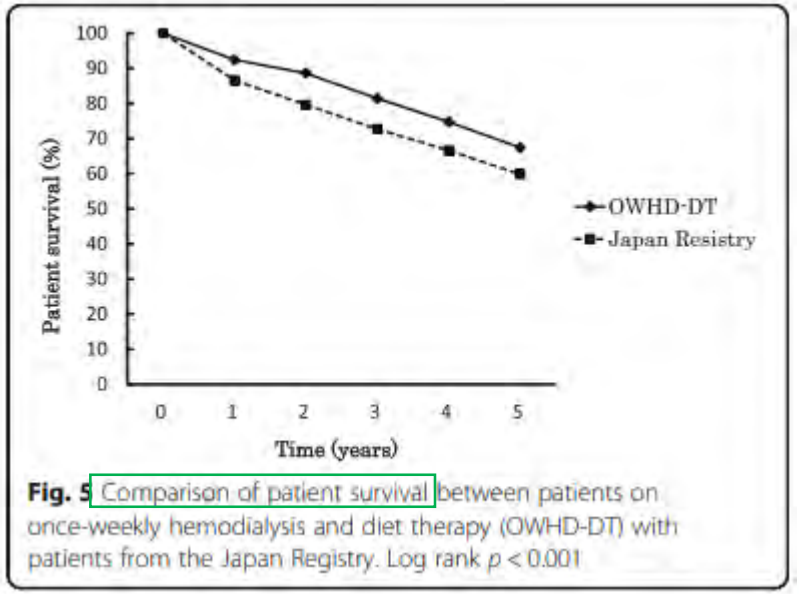


Fig. 5 Comparison of patient survival between patients on once-weekly hemodialysis and diet therapy (OWHD-DT) with patients from the Japan Registry. Log rank $p < 0.001$

Nephrol Dial Transplant (2009) 24: 2551–2558
doi: 10.1093/ndt/gfp085
Advance Access publication 3 March 2009

Shanghai

Better preservation of residual renal function in peritoneal dialysis patients treated with a low-protein diet supplemented with keto acids: a prospective, randomized trial

Na Jiang[1], Jiaqi Qian[1], Weilan Sun[1], Aiwu Lin[1], Liou Cao[1], Qin Wang[1], Zhaohui Ni[1], Yanping Wan[2], Bengt Linholm[3], Jonas Axelsson[3] and Qiang Yao[1]

PD dose (l/day): 6.5 ± 1.5

Methods. To assess the safety of low protein, we first conducted a nitrogen balance study in 34 incident PD patients randomized to receive in-centre diets containing 1.2, 0.9 or 0.6 g of protein/kg ideal body weight (IBW)/day for 10 days. Second, 60 stable PD patients [RRF 4.04 ± 2.30 ml/min/1.73 m^2, urine output 1226 ± 449 ml/day, aged 53.6 ± 12.8 years, PD duration 8.8 (1.5–17.8) months] were randomized to receive either a low- (LP: 0.6–0.8 g/kg IBW/day), keto acid-supplemented low- (sLP: 0.6–0.8 g/kg IBW/day with 0.12 g/kg IBW/day of keto acids) or high-protein (HP: 1.0–1.2 g/kg IBW/day) diet. The groups were followed for 1 year and RRF as well as nutritional status was evaluated serially.

Results. A neutral or positive nitrogen balance was achieved in all three groups. RRF remained stable in group sLP (3.84 ± 2.17 to 3.39 ± 3.23 ml/min/1.73 m^2, P = ns) while it decreased in group LP (4.02 ± 2.49 to 2.29 ± 1.72 ml/min/1.73 m^2, $P < 0.05$) and HP (4.25 ± 2.34 to 2.55 ± 2.29 ml/min/1.73 m^2, $P < 0.05$). There was no change from baseline on nutritional status in any of the groups during follow-up.

Conclusions. A diet containing 0.6–0.8 g of protein/kg IBW/day is safe and, when combined with keto acids, is associated with an improved preservation of RRF in relatively new PD patients without significant malnutrition or inflammation.

Journal of Nephrology
https://doi.org/10.1007/s40620-018-0497-z

POSITION PAPERS AND GUIDELINES

Nutritional treatment of advanced CKD: twenty consensus statements

Adamasco Cupisti[1] · Giuliano Brunori[2] · Biagio Raffaele Di Iorio[3] · Claudia D'Alessandro[1,4] · Franca Pasticci[4,5] · Carmela Cosola[6] · Vincenzo Bellizzi[7] · Piergiorgio Bolasco[8] · Alessandro Capitanini[9] · Anna Laura Fantuzzi[10] · Annalisa Gennari[4,11] · Giorgina Barbara Piccoli[12,13] · Giuseppe Quintaliani[14] · Mario Salomone[15] · Massimo Sandrini[11] · Domenico Santoro[16] · Patrizia Babini[17] · Enrico Fiaccadori[18] · Giovanni Gambaro[19] · Giacomo Garibotto[20] · Mariacristina Gregorini[21] · Marcora Mandreoli[22] · Roberto Minutolo[23] · Giovanni Cancarini[11] · Giuseppe Conte[23] · Francesco Locatelli[24] · Loreto Gesualdo[6]

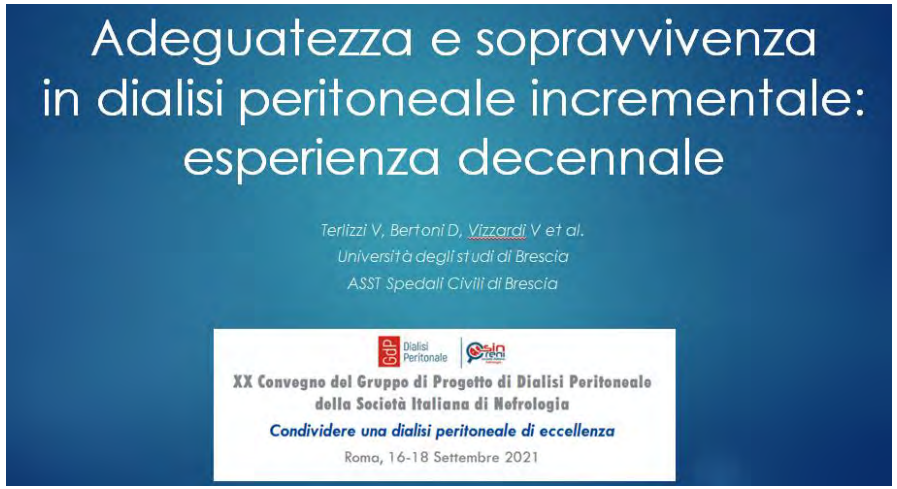
Received: 5 March 2018 / Accepted: 4 May 2018

Indications for DNT are well defined for CKD 5 [43] and for standard PD [114]. Experiences of association between DNT and incremental hemodialysis are available [109]. With regard to IPD, there are no specific indications to date. DNT in IPD could reduce possible occurrence of uremic symptoms, improve metabolic control, and contribute to a delay in RRF decline. The main problems could be poor tolerance or adherence to DNT or risk of worsening nutritional status and it therefore would require periodic metabolic and anthropometric checkups [28]. In Brescia, an IPD experiment began in 2002. To date, more than 50% of patients start with IPD, prevalently with manual methods. In all cases DNT is initiated or continued with a daily intake of 0.6–0.8 g protein/kg body weight, 30–35 kcal/kg body weight and 5 g/day of NaCl.

Beyond this experience, controlled studies are necessary in order to confirm that correct DNT, associated with close monitoring of nutritional status and RRF, allows for optimization of a IPD regime. After all, the importance

Decennio 2008-2018

31 pazienti

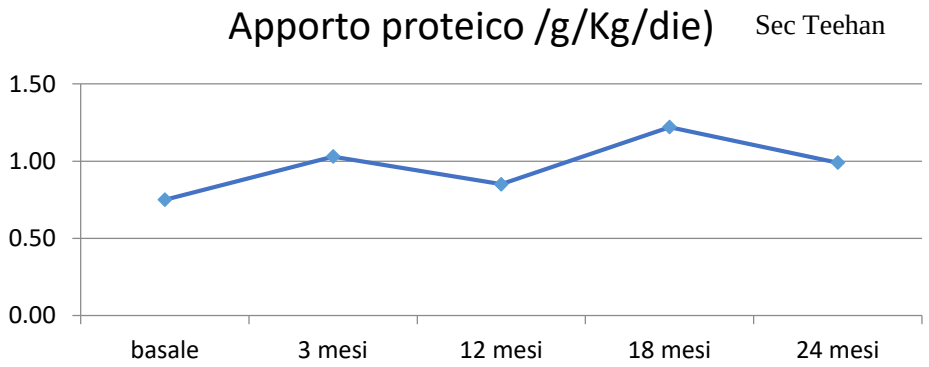


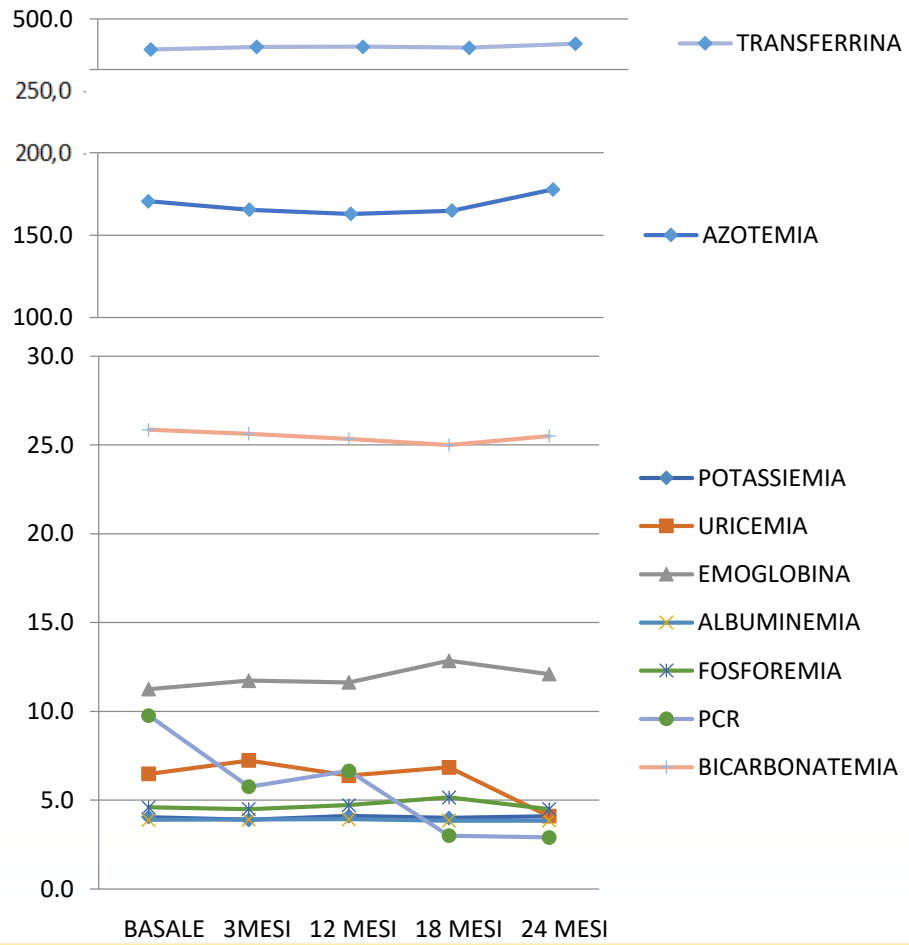
	Incrementale	*Standard*	*p*
Età (anni)	*67.0±13.0*	*64.8±17.4*	*0.32*
wKt/V	*1.75±0.37*	*1.75±0.35*	*0.98*
wClCr (l/sett)	*76.6±17.6*	*60.8±18.7*	*<0.05*
Diuresi (ml/die)	*1509 (1217;1740)*	*798 (373;1277)*	*<0.05*
FRR (ml/min)	*5.4±2.1*	*3.0±2.3*	*<0.05*
PNA (g/kg/die)	*1.02±0.15*	*0.99±0.17*	*0.12*
BMI (Kg/m²)	*23.4±3.8*	*24.3±4.1*	*0.07*

Dal 2002 a Brescia si adotta DPI con TDN 0,6 g/Kg/die di proteine, 30-35 Kcal/Kg/die e 5g/die NaCl

Analisi dati 11/2015- 2/2021: 28 pazienti

Dati personali non pubblicati





VALORI MEDI:

FRR all'avvio DPI: 7,6 ml/min	Apporto proteico: 0,94 g/Kg/die
Albumina: 3,9 g/dl	Bicarbonati: 25,5 mEq/l
Fosforo: 4,7 mg/dl	Urea 168 mg/dl
Perdite DP: 3,6 g/die	Peso e BMI sostanzialmente stabile (non disponibili BIA, DEXA..)

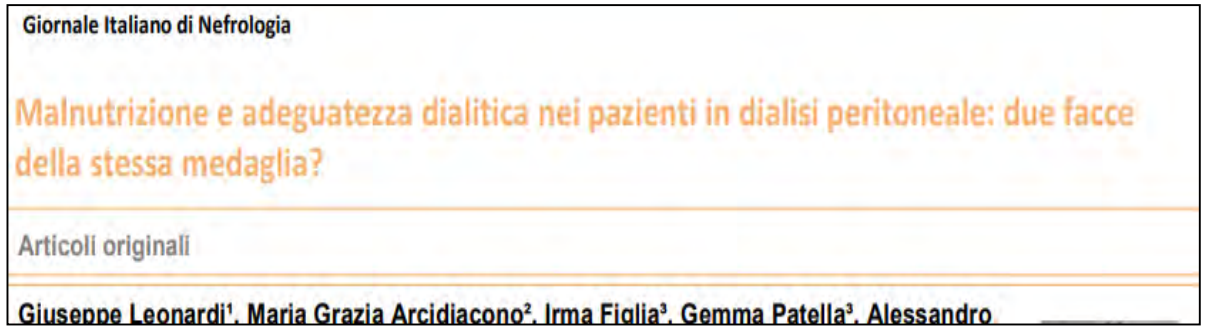
DIALISI PERITONEALE A DOSE PIENA

Con la riduzione della FRR → necessità di passaggio/avvio DP a dose piena, con:

- Aumentata esposizione al glucosio (300-800 Kcal/die)
  - Supplemento calorico (utile per pz malnutriti)
  - Sindrome metabolica
    Dislipidemia
    Aumento massa grassa (> obesità addominale)
    Peggioramento aterosclerosi

- Aumento delle perdite proteiche peritoneali (+)
- Miglioramento del quadro uremico (-)

→ PEW ← Uremia: aumenta apoptosi miociti, catabolismo proteico (indipendentemente dalla DP)



Giornale Italiano di Nefrologia

Malnutrizione e adeguatezza dialitica nei pazienti in dialisi peritoneale: due facce della stessa medaglia?

Articoli originali

Giuseppe Leonardi[1], Maria Grazia Arcidiacono[2], Irma Figlia[3], Gemma Patella[3], Alessandro

Il trattamento dialitico può associarsi allo sviluppo di uno stato di *deplezione proteico-energetica* che può riconoscere diverse cause:

- Perdita di proteine nel dialisato peritoneale
- Distensione addominale
- Anoressia indotta da iperglicemia
- Perdita di proteine nelle urine
- Sintomi gastrointestinali

Adeguatezza dialitica e uno stato di "eunutrizione" sono due elementi essenziali da considerare nella valutazione del paziente in trattamento dialitico sostitutivo. L'inadeguatezza dialitica spesso si associa alla malnutrizione, e la combinazione di questi due fattori ne peggiora significativamente la prognosi.

Peritoneal Dialysis International, Vol. 39, pp. 201–209
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REVIEW

PERITONEAL PROTEIN LOSS, LEAKAGE OR CLEARANCE IN PERITONEAL DIALYSIS, WHERE DO WE STAND?

Anabela Malho Guedes

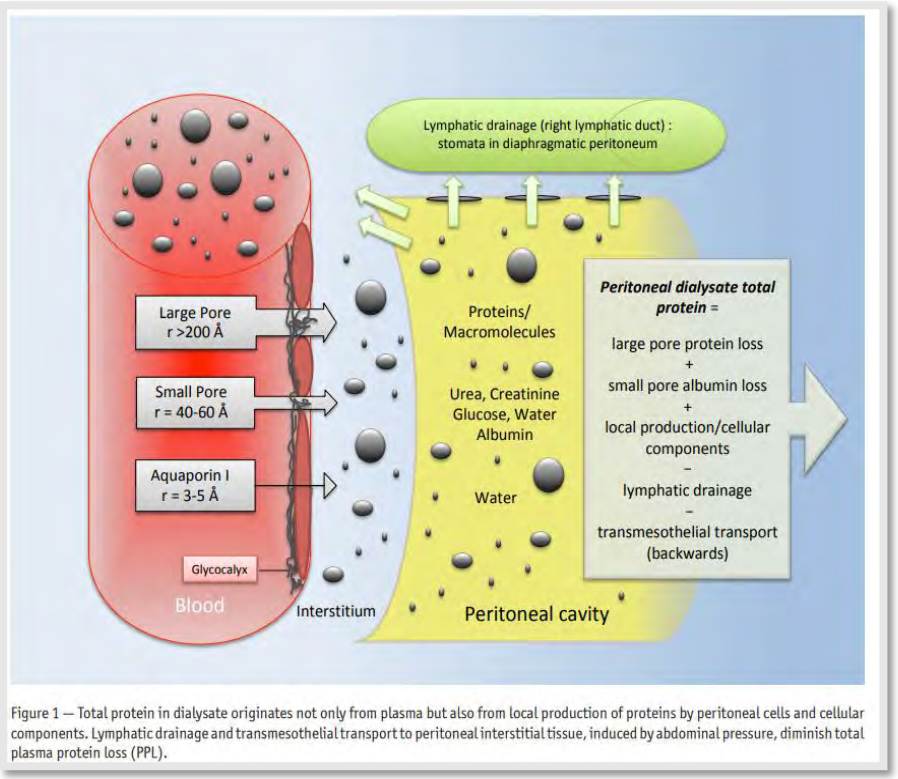

Figure 1 — Total protein in dialysate originates not only from plasma but also from local production of proteins by peritoneal cells and cellular components. Lymphatic drainage and transmesothelial transport to peritoneal interstitial tissue, induced by abdominal pressure, diminish total plasma protein loss (PPL).

The clinical effects of long-term PPL have been a concern for over 40 years

Ever since peritoneal dialysis (PD) was used in the treatment of chronic kidney disease (CKD), high peritoneal protein loss (PPL) has been observed in each PD exchange (1). In adult patients, the loss has been estimated at 5 to 15 g daily (2–4), including 2 – 4 g a day of amino acids (5). This loss of proteins (significantly greater in PD than in hemodialysis) accompanies the removal of both low-molecular-weight uremic metabolites and the so-called middle molecules. The

- **Dati contrastanti sulla correlazione tra perdite proteiche e mortalità, rischio cardiovascolare, danno endoteliale e fallimento della metodica**

- **Dati contrastanti anche sull'impatto delle perdite proteiche sullo stato nutrizionale**:
  - Perdite proteiche e aminoacidiche sono compensate da un aumento della produzione di albumina se vi è un adeguato intake dietetico proteico (1-1,2 g/Kg/die, mai <0,8 g/Kg/die) in assenza di stressors
  - Scarso appetito, stati infiammatori, pregressa malnutrizione possono rendere la correzione dietetica insufficiente
  - La sola perdita proteica peritoneale non è sufficiente a spiegare l'eventuale insorgenza di PEW

- **Interventi per ridurre le perdite proteiche**:
  - Non ci sono differenze sostanziali tra perdite proteiche (g/die) tra CAPD e APD e tra soluzioni iso-ipertoniche
  - Le soluzioni a base di aa compensano le perdite ma non le riducono, possono aumentare urea plasmatica e acidosi (potenziale beneficio se PEW e se associati a glucosio)
  - I RAASi riducono la fibrosi peritoneale con possibile effetto riduttivo delle perdite proteiche (renali e peritoneali)

Garibotto G. et al. Effects of peritoneal dialysis on protein metabolism. Nutr Metab Cardiovasc Dis. 2013 Dec;23 Suppl 1:S25-30. doi: 10.1016/j.numecd.2012.07.005. Epub 2012 Aug 13.

Necessità di attenta valutazione e monitoraggio dello stato nutrizionale e di una corretta prescrizione dietetico nutrizionale

- Nei pazienti in DP c'è maggior rischio di obesità, dislipidemia e diabete de-novo (?) con perdita di massa magra e sviluppo di sindrome metabolica.

- Necessità di un counseling dietistico per adeguare la terapia nutrizionale (corretto apporto proteico e calorico), incentivare l'attività fisica ed incentivare eventuali programmi riabilitativi.

- Va poi effettuato uno stretto monitoraggio dello stato nutrizionale (MIS, SGA, Protein Catabolic Rate (PCR); Protein equivalent of Nitrogen Appearance (PNA o nPNA), DEXA, albumina correlano bene con la prognosi dei pazienti), dell'attività fisica e delle capacità funzionali del paziente

Nutrition and the Kidney: Recommendations for Peritoneal Dialysis

Karthik K. Tennankore and Joanne M. Bargman

Advances in Chronic Kidney Disease, Vol 20, No 2 (March), 2013: pp 190-201

CLINICAL SUMMARY

- Protein energy wasting (PEW) is a common finding in peritoneal dialysis (PD) and is associated with poor outcomes.
- There are many important causes of PEW, including inflammation, loss of residual renal function, and metabolic acidosis.
- A number of tools exist for diagnosing PEW such as Subjective Global Assessment (SGA), analysis of body composition, and body anthropometry.
- Although the evidence is limited, the management of PEW in PD includes dietary support, treatment of metabolic acidosis, optimization of dialysis, and intraperitoneal amino acid supplementation. Novel therapies require validation in future studies.

Although much of this review is focused on PEW, a large proportion of patients undergoing PD are either overweight

Stasi di 6h con AA 1% → riassorbimento di 16g di aa. Sembra avere effetto anabolico soprattutto se associato a una fonte calorica (Glc) ma può dare acidosi, aumento urea, riduzione UF → usare in pazienti malnutriti

DIALISI PERITONEALE A DOSE PIENA: quale «dieta»?!?!

Scarpioni LL, Ballocchi S (eds): Evolution and Trends in Peritoneal Dialysis.
Contrib Nephrol. Basel, Karger, 1990, vol 84, pp 36–44

Nutrition and Metabolism in Continuous Ambulatory Peritoneal Dialysis

Gerhard M. Gahl, Hannelore Hain

KDOQI guidelines 2000

1,2 – 1,3 g/kg/die → difficult to achieve

- APPORTO CALORICO: 35-40 Kcal/Kg/die
  30-35% da carboidrati nel cibo (a cui si aggiungono quelli peritoneali)
  60% del fabbisogno calorico totale

- PROTEINE: 1,2-1,5 g/Kg/die (auspicabile un 50% ad alto valore biologico). Da supplementare con integratori in caso di stati ipercatabolici

- CARBOIDRATI: nella CAPD il 60-80% del glucosio è riassorbito (circa 100-150g/die con 3 scambi/die) → aumenta secrezione insulina ma non sembra aumentare il rischio di intolleranza glucidica e solo pochi pz sviluppano in DM de novo)

- LIPIDI: precoce peggioramento del profilo lipidico per il carico di glucosio.

Peritoneal Dialysis International, Vol. 35, pp. 655–658
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NUTRITION IN OLDER ADULTS ON PERITONEAL DIALYSIS

Lina Johansson

TABLE 1
Examples of Existing Clinical Guidelines on the Recommended Protein and Energy Intakes in Adults on Peritoneal Dialysis and of Older People Free from Renal Disease

	K/DOQI, 2000 (2)	EDTNA/ERCA European Guidelines for the Nutritional Care of Adult Renal Patients, 2002 (3)	UK Renal Association Nutrition in CKD, 2010 (4)	British Dietetic Association, Protein Requirements in Dialysis, 2013 (5)	Position paper from the PROT-AGE Study Group, 2013 (6)
Protein intake	1.2–1.3 g/kg/day with at least 50% of high biological value. At least 1.3 g/kg/day if acutely ill.	1–1.2 g/kg IBW/day for active, non-catabolic patients. 1.5 g/kg IBW/day with peritonitis	1.2 g/kg IBW/day	1.0–1.2 g/kg IBW/day in conjunction with adequate energy intake.	Over 65 years and free from renal disease: 1.0–1.2 g/kg/day Over 65 years, free from renal disease and exercising or active: ≥1.2 g/kg/day.
Energy intake	35 kcal/kg/day for less than 60 years 30–35 kcal/kg/day for more than 60 years. For both, include calories from peritoneal absorption of glucose (estimated at 60%).	35 kcal/kg IBW/day, including calories from peritoneal absorption of glucose (estimated at 60–75%). 30–35 kcal/kg IBW/day in elderly and those with reduced activity.	30–35 kcal/kg IBW/day depending upon age and physical activity.		

K/DOQI = Kidney Disease Outcomes Quality Initiatives; EDTNA/ERCA = European Dialysis and Transplant Nurses Association/European Renal Care Association; UK = United Kingdom; CKD = chronic kidney disease; IBW = ideal body weight.

lead to PEW.[69] Perhaps a more attainable and clinically relevant DPI target may be closer to 1 g/kg/day. In an observational cohort study of 305 incident patients undergoing PD, those in the highest tertile of baseline DPI (≥0.94g/kg/day) had a lower risk for all-cause mortality and first-episode peritonitis compared with patients with a DPI ≤0.73 g/kg/day.[70]

- Protein intake in older people on PD is suboptimal, at 0.95 ± 0.29 g/kg/day, without taking into account this protein loss (exacerbate during peritonitis).
- Older people may be more → PEW is more prevalent
- Supplementing protein through commercial preparations, through home-made preparations (2 large egg whites) or Nutrineal (Baxter, Compton, UK) (1.1% amino acid containing dialysate), a bag designed to improve protein balance
- Calories from the dialysate can positively enhance the energy intake
- Being overweight may mask the presence of malnutrition (sarcopenic overweight or obesity)

nutrients 2020 MDPI

Review

Nutritional Status in Peritoneal Dialysis: Nutritional Guidelines, Adequacy and the Management of Malnutrition

Thomas Kiebalo [1], Jacqueline Holotka [1], Ireneusz Habura [2] and Krzysztof Pawlaczyk [1,*]

"In light of **inconsistent recommendations that vary between each respective society**, as well as a **general lack of concise information**, it is our intention to call for further research regarding nutritional recommendations in peritoneal dialysis (PD)"

Table 1. Daily macro- and micro-nutrient intake.

	Protein	Calcium	Phosphorus	Sodium	Potassium
PDK	1.2–1.4 g/kg	1000 mg	≥1200 mg	2000–3000 mg	None
KDIGO	None	1000–1200 mg	<4000 mg	None	
Europe	≥1.2 g/kg		None		
Canada			None		

KDIGO—Kidney Disease Improving Global Outcome, UTL—Upper tolerable limit, PKD—Polycystic Kidney Disease Foundation.

Table 2. Global Nutritional Recommendation in PD.

Society	Recommendation
KDIGO [7,8]	Restriction of dietary calcium binders in all stages of chronic kidney disease without limitations Phytate consumption: anti-oxidant and anti-cancer properties, ability to hinder nutrient absorption Importance of minimizing hyperphosphatemia in patients through the ingestion of food additives to an upper tolerable limit of 4000 mg (3000 in those >70 years of age) Lack of data which associates dietary restrictions to improved outcomes in patients with stage G3A-G4 chronic renal disease
PKD Foundation [7]	Maintaining blood calcium levels between 8.4 and 9.5 mg/dL Phosphorus in the diet may be restricted if blood levels reach greater than 5.0 mg/dL
National Kidney Foundation [8]	Phosphorus in the diet may be restricted if blood levels reach greater than 5.0 mg/dL
Canadian Guidelines [9]	Reduce levels of sodium, phosphorus and fluids Increase intake of potassium and protein Patient's following a potassium restricted diet should limit their intake to 2000 milligrams per day, in constant to the standard recommendation of 3500 to 4500 milligrams daily for healthy patients

National Kidney Foundation®

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CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CHRONIC KIDNEY DISEASE: 2019 UPDATE

Public Review DRAFT
October 2019

Dietary Protein Intake, Maintenance Hemodialysis and Peritoneal Dialysis

3.1.2 In adults with **CKD on MHD (1C)** and **PD (OPINION) who are metabolically stable**, we recommend prescribing a dietary protein intake of 1.0 -1.2 g /kg ideal body weight per day to maintain a stable nutritional status.

Dietary Protein Intake, Diabetes Mellitus

3.1.3 In the adult with **CKD 3-5 and who have diabetes**, it is reasonable to prescribe a dietary protein intake of 0.8 – 0.9 g /kg ideal body weight per day to maintain a stable nutritional status and optimize glycemic control (OPINION).

3.1.4 In adults with **CKD on MHD and PD and who have diabetes**, it is reasonable to prescribe a dietary protein intake of 1.0 -1.2 g /kg ideal body weight per day to maintain a stable nutritional status. For patients at risk of hyper and/or hypoglycemia, higher levels of dietary protein intake may need to be considered to maintain glycemic control (OPINION).

KDOQI KIDNEY DISEASE OUTCOMES QUALITY INITIATIVE
National Kidney Foundation

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KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CKD: 2020 UPDATE

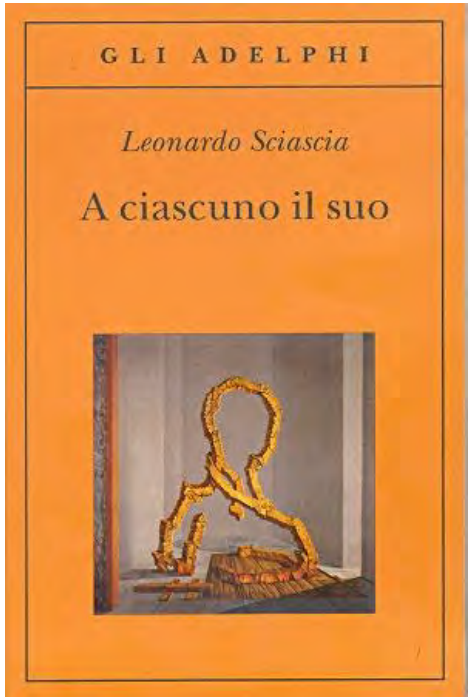
T. Alp Ikizler, Jerrilynn D. Burrowes, Laura D. Byham-Gray, Katrina L. Campbell, Juan-Jesus Carrero, Winnie Chan, Denis Fouque, Allon N. Friedman, Sana Ghaddar, D. Jordi Goldstein-Fuchs, George A. Kaysen, Joel D. Kopple, Daniel Teta, Angela Yee-Moon Wang, and Lilian Cuppari

* 25-35 Kcal/kg/die

CKD 5D on MHD or PD (also with diabetes) 1,0-1,2 g/prot/kg/day

1) Includere la valutazione dell'assetto nutrizionale nella pratica quotidiana e rivalutarla periodicamente.
(Time consuming)

2) In base al grado di CKD e alle condizioni cliniche va prescritta e personalizzata la terapia dietetica più adeguata, pur in assenza di forti evidenze per quanto riguarda la terapia nutrizionale in corso di DPI.
(Necessità di un team multidisciplinare)



3) Escludere la presenza di PEW e adottare la strategia nutrizionale più adatta per prevenirla o trattarla. (Time consuming + team multidisciplinare)


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
рахмат
Баярлалаа
спасибо
gracias
merci
obrigado
bedankt
dziękuję
go raibh maith agat
mochchakkeram
sukriya
kop khun krap
terima kasih
tapadh leat
dank je
grazie
arigatô
dakujem
takk
sagolun
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mauruuru
감사합니다
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sulpáy
taiku
djiere dieuf
asante
manana
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trugarez
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dekuji
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