



Inflammation in Chronic Kidney Disease (CKD)

Vishal Bagchi, MBA RD LD
October 12, 2022



1

Disclosure




- Vishal Bagchi is employed by Nutricia North America
- Slides are scientific and based on information and research evidence available during the time of the lecture
- Non-biased and Non-Promotional

No conflict of interest for this presentation

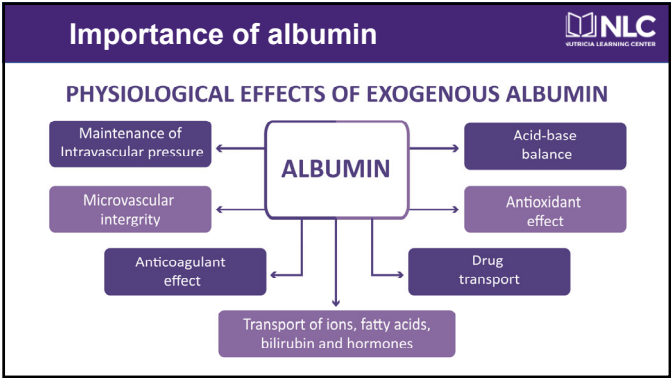
2

Objectives

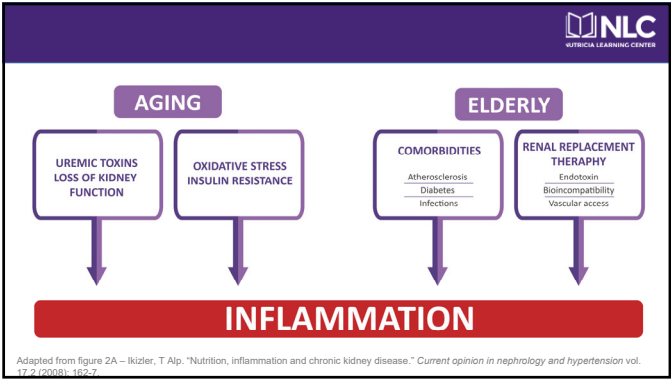


- Participants will be able to
 - Discuss the markers of inflammation in CKD
 - Identify causes of inflammation in CKD
 - Discuss current recommendations for management of inflammation in CKD

3



4



5

Malnutrition-Inflammation Complex Syndrome (MICS)

NLC


NUTRICIA LEARNING CENTER

- Protein-energy malnutrition and inflammation that occur concurrently and coexist in individuals with CKD
- Malnutrition-inflammation-atherosclerosis syndrome (MIA) is also used to describe the combination of malnutrition, inflammation and atherosclerosis
- Changes in acute-phase serum proteins
- Hypercatabolic state
- Diminished appetite/anorexia
- Erythropoietin hyporesponse

Yamada, Shunsuke et al. "Emerging cross-talks between chronic kidney disease-mineral and bone disorder (CKD-MBD) and malnutrition-inflammation complex syndrome (MICS) in patients receiving dialysis." *Clinical and experimental nephrology* vol. 26 7 (2022): 813-826. doi:10.1007/s10157-022-02216-x

6

Acute-phase protein



□ "Positive" acute-phase proteins:

■ C-reactive protein

■ Ferritin and others

□ "Negative" acute-phase proteins

■ Decreases during inflammation


■ Albumin

■ Transferrin and others

■ Physiological role of decreased synthesis of such proteins is generally to save **amino acids** for producing "positive" acute-phase proteins more efficiently.

7

Role of C-reactive protein in CKD



□ Acute phase reactant


□ Rises during inflammatory processes

□ Early defense against infections

□ Secreted in liver

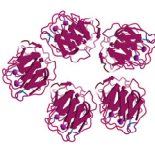
□ Associated with low Hgb and/ or EPO resistance

□ CRP was an independent predictor for higher all-cause mortality and increased risk of developing major adverse cardiovascular events

□ Serum C-reactive protein to albumin ratio(CAR)  all-cause mortality in PD.

□ Normal: Less than 10 mg/L


□ High: Equal to or greater than 10 mg/L



Liu, Siyi et al. "Serum C-reactive protein to albumin ratio and mortality associated with peritoneal dialysis." Renal failure vol. 42,1 (2020): 600-606. doi:10.1080/0886022X.2020.1783680

8

CRP elevated in peritoneal dialysis (PD)




□ Studies have shown an inverse relationship between serum albumin and CRP levels in hemodialysis patients.

□ CRP has been found to be elevated in PD patients with chronic infection

□ CRP values become significantl elevated during peritonitis

□ Poor adequacy increases inflammation




Muga, Francisco et al. "Inflammation and hemodialysis adequacy: Are C-reactive están los niveles de proteína C reactiva inflados por la dosis de diálisis recibida?" Nefrología, 50(211-499521)00112-0. 5 Jul. 2021

Castro-Marciano, Alfonso M et al. "Systemic inflammation May limit the effect of protein supplement on nutritional status in peritoneal dialysis." Clinical nutrition ESPEN vol. 49 (2022): 307-313.

9

CRP in peritoneal dialysis




- 34 malnourished patients(SGA)
- 6 months nutrition counselling + protein supplements (Egg albumin)
- Two groups based on C-reactive protein (hsCRP)
 - Inflammation (>3 mg/L)
 - 70% improved, 25% no change and 5% worsened
 - Albumin 3.0 →3.4 (g/dL)
 - BMI 20.3 →21.6 kg/m2
 - No-inflammation (≤3 mg/L)
 - 50% improved, 36% no change and 14% worsened
 - Albumin 2.8 →3.0 g/dL
 - 21.9 ± 3.0 vs 22.5 kg/m2

Cueto-Manzano AM, et al. Systemic inflammation may limit the effect of protein supplement on nutritional status in peritoneal dialysis. Clin Nutr ESPEN. 2022;49:307-113.

10

CRP




- 50% of pts with a GFR 15-60 have a CRP>2.1mg/L
- Europe – median CRP for dialysis 5mg/L
- Americans – slightly higher (~6.8)
- Asians – substantially lower
- Why isn't it used more?
 - Cheap
 - Reliable
 - No trials to show usefulness (dialysis setting)
- Higher in Covid-19 patients

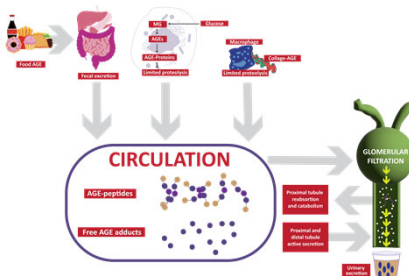
Romão JE Jr, et al. Positive acute-phase inflammatory markers in different stages of chronic kidney disease. Am J Nephrol. 2006;26(1):59-66.

11

Advanced Glycation End Products (AGE)




- Compounds produced when sugars combine with proteins, fats and other ingredients in food (Maillard, 1912)
- Increase oxidation and inflammation
- AGE's can modify LDL cholesterol to make it easier to oxidize and easier to deposit in blood vessels
- The older you get the harder it is for your body to get rid of AGEs
- Kidneys clear AGE



Sergi D, Bouillon H, Campbell FM, Williams LM. The Role of Dietary Advanced Glycation End Products in Metabolic Dysfunction. Mol Nutr Food Res. 2021;65(1):1900934.

12

Role of diet and AGE levels




Restriction of AGE in diet to prevent DM, CKD and atherosclerosis is **extrapolated**.

- Cross sectional with 2-year F/U of healthy adults and CKD-3 patients
- 325 healthy adults and 66 CKD-3 patients
- Diet modifications
- Results:
 - Reducing dietary AGE intake significantly decreases oxidative stress in both healthy participants and CKD-3

Viassara H, et al. Protection against loss of innate defenses in adulthood by low advanced glycation end products (AGE) intake: role of the anti-inflammatory AGE receptor-1. J Clin Endocrinol Metab. 2009;94(11):4483-4491


13

AGE content of foods




- Poached or steamed chicken had half the AGE of roasted or broiled
- Scrambled eggs prepared with cooking spray, margarine or oil had ~50% to 75% less AGE than if cooked with butter

Unibarrí, Jaime et al. "Advanced glycation end products in foods and a practical guide to their reduction in the diet." Journal of the American Dietetic Association vol. 110,6 (2010): 911-16.



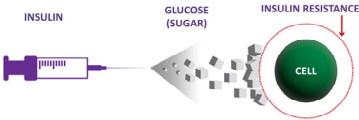
14

AGE and insulin resistance



- NHANES III – found that GFR was lower in pts who were insulin resistant
- Which came first? Insulin resistance or inflammation?

GLUCOSE DOES NOT GO INTO CELL



Foley RN, Wang C, Ishani A, Collins AJ. NHANES III: influence of race on GFR thresholds and detection of metabolic abnormalities. J Am Soc Nephrol. 2007;18(9):2575-2582. doi:10.1681/ASN.2006121411

15

Role of diet in AGE




- Found naturally in animal-derived foods before cooking
- Cooking forms new AGEs in these foods




Uribami J, Woodruff S, Goodman S, Cai W, Chen X, Pyzik R, Yong A, Striker GE, Viassara H. Advanced glycation end products in foods and a practical guide to their reduction in the diet. J Am Diet Assoc 2010;110:911-6.


16


The take home on AGE



- AGEs play an indirect role in CKD and its progression
- Reducing exposure to AGEs may become an important disease prevention strategy
- The message: eat more whole foods, avoid processed foods, increase fruits and vegetables




 Avoid frying, grilling, roasting and broiling!


 Use boiling, poaching, steaming or stewing

17

Abdominal obesity




- More fat = more inflammation
- More muscle = less inflammation
- Associated higher prevalence of malnutrition and inflammation
- Lower muscle mass and strength
- Waist circumference better indicator vs. BMI



Brooks GC, Blaha MJ, Blumenthal RS. Relation of C-reactive protein to abdominal adiposity. Am J Cardiol. 2010;106(1):56-61

18

The advent of discussions about nitrogen balance




- Borah et al – study on nitrogen balance(1978)
 - High (1.44 g/kg/d) and low protein diets (0.5 g/kg/d)
 - Low, always negative nitrogen balance
 - High in negative nitrogen balance on dialysis days only
- The process of dialysis increases CRP and IL-6
 - ▣ Inflammatory acute phase reactants markers


Borah MF, et al. Nitrogen balance during intermittent dialysis therapy of uremia. *Kidney Int.* 1978;14(5):491-500.

19

That is a LOT of protein




90 kg Male eating 1.44 g protein/kg BW/d
= 130 g protein/d
= 6 3-oz servings of steak
= 9 1-fl oz of a LQ Protein



1 fl oz = 15 g protein
x9


Recommendation for PD:
1.2-1.3 g protein/kg/BW/d
= 108 g protein/d
= 5 3-oz servings of steak
= 7 1-fl oz of a LQ Protein




1 fl oz = 15 g protein
x7

20

Hemodialysis



- Hemodialysis is associated with the activation of an “inflammatory cascade”
 - ▣ Exposure of blood to dialysis membranes
 - ▣ Less than sterile dialysate
 - ▣ Ultra pure dialysate has shown improvements in inflammatory markers, response to EPO and slower loss of residual renal function



Cao H, Ye H, Sun Z, Et al., Circulatory mitochondrial DNA is a pro-inflammatory agent in maintenance hemodialysis patients. *PLoS One.* 2014;9(12):e13179


21

Peritoneal dialysis

❑ Protein loss in dialysate

❑ Feeling of fullness due to PD Fluids

❑ Protein energy wasting



Stuart MMQ, Furuso ACT, Veiga JPR, Rodrigues ME, Gomes LO, Moraes CF. Impact of different automated peritoneal dialysis modalities on the inflammatory profile of elderly patients with chronic kidney disease [published online ahead of print, 2022 Jun 13]. J Bras Nefrol. 2022;50(101-28002022005032401.

22

Does the dialysis solution play a role in inflammation?

❑ Glucose Degradation Products (GDP) in dialysate lead to inflammation and then fibrosis

❑ GDP's in the dialysis solution and the reactive carbonyl compounds in uremia lead to AGE

❑ Authors suggest adequate nutrition support and screening for “persistent inflammation”

Lai KN, Leung JC. Inflammation in peritoneal dialysis. Nephron Clin Pract. 2010;116(1):c11-c19

23

Protein Energy Wasting

CAUSES OF PEW

Dietary nutrient intake

↑

Loss of kidney function

Uremic toxins

Comorbid conditions (HK, diabetes, CVD depression)

Dialysis-associated catabolism

Metabolic derangements (HPT, metabolic acidosis, hypogonadism, GH resistance)

Inflammation

PROTEIN ENERGY WASTING

CONSEQUENCES OF PEW

Infection

↓

Cardiovascular disease

↓


Frailty, depression

24

© 2022 Nutricia North America

8

Protein Energy Wasting (PEW) is common in CKD



- PEW is found in 20-50% of patients with advanced kidney disease
- PEW sharply increases mortality risk and frequency of hospitalizations
- One study found that in the first 48 hours of hospitalization pts met only 7% of protein needs and 14% of calorie needs

Bizler TA, et al. Prevention and treatment of protein energy wasting in chronic kidney disease patients: a consensus statement by the International Society of Renal Nutrition and Metabolism. *Kidney Int.* 2013;84(6):1096-1107

25

2014334
RU125


How does inflammation effect appetite?





26

Anorexia



- A metabolic effect of inflammation
- Animal studies have shown that cytokines have a direct effect on the satiety center
- Animal studies have also shown an increase in skeletal muscle breakdown in response to TNF- α administration
- Diminished appetite (anorexia) is associated with higher concentration of proinflammatory cytokines, higher levels of **EPO hyporesponsiveness** and poor clinical outcome.

Giardi A, Pasetti E, De Nicola L, Maczafeno S, Russo R, Cazzullo M. Renal anaemia and EPO hyporesponsiveness associated with vitamin D deficiency: the potential role of inflammation. *Nephrol Dial Transplant*. 2013 Jul 28;28(7):1672-9

27

Slide 26


RU124 Lloyd will buy image once deck is approved.

REICHERT Ulrike, 7/22/2022

RU125 [@PRUDENTE Lloyd] slide deck is final, can you please buy the images?

REICHERT Ulrike, 8/3/2022

Anemia and nutritional status




- Improving nutritional state in dialysis patients may also improve anemia and lead to lower required EPO dose.
- 2019 González-Ortiz et al, 61 HD PEW is an incremental predictor of poor responsiveness to EPO in HD patients

González-Ortiz, Alena et al. "Relationship between protein-energy wasting in adults with chronic hemodialysis and the response to treatment with erythropoietin." BMC nephrology vol. 20,1 316. 14 Aug. 2019. doi:10.1186/s12882-019-1447-0

28


Albumin management and ESA use



- There is an inverse relationship between ESA dose and appetite
 - Locatelli F, et al. Nutritional-inflammation status and resistance to erythropoietin therapy in haemodialysis patients. *Nephrol Dial Transplant*. 2006;21(4):991-998
- Increase in serum albumin concentration is associated with rapid improvement in anemia.
Such a rate of anemia correction can only be realized by tripling the dose of ESAs
 - Agarwal R, Davis JL, Smith L. Serum albumin is strongly associated with erythropoietin sensitivity in hemodialysis patients. *Clin J Am Soc Nephrol*. 2008;3(1):98-104

29

How do RD's effect EPO usage?



- Better nutrition status = better EPO responsiveness
- Our responsibility for addressing inflammation

30

Hidden inflammation

Dental inflammation


Bed sores

Foot sores

Uncontrolled diabetes

Lack of exercise

Stress



31

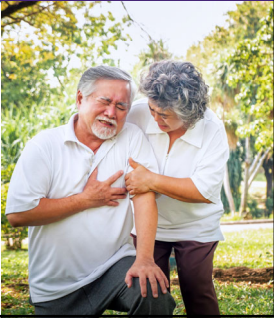
What do CKD patients die of?

Cardiovascular mortality

Uremic dyslipidemia

Infection

Malnutrition and failure to thrive



32

What can be done to reduce inflammation and increase qol?

Vitamin D

Omega's


Exercise

Diet counseling

Enteral nutrition

33

Vitamin D




- Starts decreasing in Stage III
- In Stage VI the median is 15-20 ng/ml
- Vitamin D is an acute phase reactant – levels decrease with inflammation
- Which came first?
 - Inflammation = low Vit D
 - Low vit D = Inflammation

Waldron, Jenna Louise et al. "Vitamin D: a negative acute phase reactant." *Journal of clinical pathology* vol. 66,7 (2013): 620-2. doi:10.1136/jclinpath-2012-201301.

34

Oral cholecalciferol in dialysis patients with vitamin D deficiency




- 56 patients' baseline 25OHD₃ level <20 ng/mL
- 100 IU of cholecalciferol per kg body weight once weekly orally for 26 weeks
- 25OHD₃ 9.9 →26.1 ng/mL
- Cinacalcet therapy was positively associated
- iPTH level significantly decreased from median 362 pg/mL to 297 pg/mL

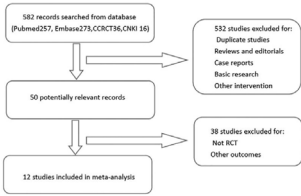
ZB, Emmanuel et al. "Efficacy and safety of body weight-adapted oral cholecalciferol substitution in dialysis patients with vitamin D deficiency." *BMC nephrology* vol. 16 128. 4 Aug. 2015. doi:10.1186/s12882-015-0116-3.

35

Omega-3 A meta-analysis, Hu et. al 2017




- Inflammatory biomarkers
 - C-reactive protein (CRP),
 - interleukin-6 (IL-6)
 - tumor necrosis factor- α (TNF- α)
- Insufficient evidence



Hu, Chao et al. "Effects of Omega-3 Fatty Acids on Markers of Inflammation in Patients With Chronic Kidney Disease: A Systematic Review and Meta-analysis." *Journal of Clinical Medicine* vol. 9,2 (2020): 1-14. doi:10.3390/jcm9021144. 2020.11444. Official peer-reviewed journal of the International Society for Advancing Health Sciences. Published online for Dietitians. *Thrombosis* vol. 29,2 (2019): 1-14. doi:10.3390/thromb29020144. 2019.144. Official peer-reviewed journal of the International Society for Advancing Health Sciences. Published online for Dietitians.

36

Dietary Omega-3 vs Omega-6




- Mortality in long-term hemodialysis patients is high, mostly attributed to cardiovascular events, and may be related to chronic inflammation. We hypothesized that the anti-inflammatory benefits of higher dietary intake of omega-3 compared with omega-6 polyunsaturated fatty acids may modulate the inflammatory processes and decrease death risk.
- 145 hemodialysis patients from 8 DaVita dialysis clinics in Southern California in 2001-2007.
- Intake of dietary omega-3 and ratio of omega-6 to omega-3 using 3-day food record supplemented by dietary interview.
- 1-year change in serum C-reactive protein (CRP) level and 6-year survival.
- 3-day food record may underestimate actual dietary fat intake at an individual level.
- Higher dietary omega-6 to omega-3 ratio appears to be associated with both worsening inflammation over time and a trend toward higher death risk in hemodialysis patients. Additional studies including interventional trials are needed to examine the association of dietary fatty acids with clinical outcomes in these patients


Noori N, et al. Dietary omega-3 fatty acid, ratio of omega-6 to omega-3 intake, inflammation, and survival in long-term hemodialysis patients. *Am J Kidney Dis.* 2011;58(2):248-256

37

Resistance training vs cachexia and sarcopenia




- Resistive exercise (RE) with or without nutritional interventions is a valuable and underutilized tool for improving muscle mass, muscle strength, and physical function in CKD
- Adding high-protein ONS or vitamin D to RE have possible added benefits




Hoor, Harasa et al. "Resistance exercise and nutritional interventions for augmenting sarcopenia outcomes in chronic kidney disease: a narrative review." *Journal of cachexia, sarcopenia and muscle* vol. 12.8 (2021): 1541-1560. doi:10.1002/jcsm.12791

38

Diet counseling



- First Era: Potassium
 - Dialysis Efficiency
 - Less frequent deaths
- Second Era: Phosphate
 - Calcification
- Third Era: Malnutrition
 - Eating more may not be enough



Piccoli, Giorgia Barbara et al. "The Diet and Hemodialysis Dyad: Three Eras, Four Open Questions and Four Paradoxes: A Narrative Review, Towards a Personalized, Patient-Centered Approach." *Nutrients* vol. 9.4 372. 10 Apr. 2017. doi:10.3390/nu9040372


39

PO supplements

Initial intervention

Readily available and convenient

Adherence to oral supplements is variable and low



40

PO supplements: Cochrane review

22 studies and 1278 participants, 79%HD, 21%PD

The rise in serum albumin was more evident in participants who were on HD compared to PD, and those who were malnourished

Cost outcomes were associated with clinically relevant benefits such as improved quality of life, reduced infections, reduced minor post-operative complications, reduced falls, and functional limitations

41

K/DOQI 2020 implementation considerations:
Oral nutrition supplements

ONS should be prescribed as needed to maximize calorie and/or protein intake to meet daily energy needs.

Tailor prescription to patient needs: on MHD days or up to 1-x/day

Patients should be advised to take ONS 1 hour after meals rather than as a meal replacement to maximize benefit.

ONS prescription should take into account patient preference and available resources to allow them to purchase products that fit their needs.

Energy-dense or low-electrolyte renal-specific ON may be necessary to increase protein and energy intake and avoid fluid overload and electrolyte derangements.


Monitored provision of high-protein meals or ONS during MHD may be a useful strategy to increase total protein and energy intake.

42

© 2022 Nutricia North America

14


Conclusion



- Inflammation is multifactorial and virtually inevitable in CKD and Dialysis
- First, treat underlying inflammation and comorbidities
- Personalize patient's nutrition:
 - Adjust type of cooking (AGE)
 - Recommend boiling, poaching, steaming or stewing
 - Consider concentrated liquid protein medical foods
 - Suggest recipes with ONS/medical foods to increase variety and fight flavor fatigue
 - Consider micronutrients
- Involve family

43

Bibliography



Ikizer, T Alp. "Nutrition, inflammation and chronic kidney disease." *Current opinion in nephrology and hypertension* vol. 17.2 (2008): 162-7.

Yamada, Shunsuke et al. "Emerging cross-talks between chronic kidney disease-mineral and bone disorder (CKD-MBD) and malnutrition-inflammation complex syndrome (MICS) in patients receiving dialysis." *Clinical and experimental nephrology* vol. 26.7 (2022): 613-629.

Liu, Siyi et al. "Serum C-reactive protein to albumin ratio and mortality associated with peritoneal dialysis." *Renal failure* vol. 42.1 (2020): 600-606.

Valga, Francisco et al. "Inflammation and hemodialysis adequacy: Are C-reactive protein levels influenced by dialysis dose?" "Inflamación y adecuación de la hemodíalisis: ¿están los niveles de proteína C-reactiva influidos por la dosis de diálisis recibida?" *Nefrología*. 2021;1:6995(2)109112.0. 5 Jul. 2021.

Cueto-Manzano, Alfonso M et al. "Systemic inflammation May limit the effect of protein supplement on nutritional status in peritoneal dialysis." *Clinical nutrition ESPEN* vol. 49 (2022): 307-313.

Romão JE Jr, et al. Positive acute-phase inflammatory markers in different stages of chronic kidney disease. *Am J Nephrol*. 2006;26(1):59-66.

Sergi D, Bouletis H, Campbell FM, Williams LM. The Role of Dietary Advanced Glycation End Products in Metabolic Dysfunction. *Mol Nutr Food Res*. 2021;65(1):e1900934.

Vlassara H, et al. Protection against loss of innate defenses in adulthood by low advanced glycation end products (AGE) (take: role of the anti-inflammatory AGE receptor-1. *J Clin Endocrinol Metab*. 2009;94(1):4483-4491

Urban, Jamie et al. "Advanced glycation end products in foods and a practical guide to their reduction in the diet." *Journal of the American Dietetic Association* vol. 110.6 (2010): 911-16.

Foley RN, Wang G, Ishani A, Collins AJ, NHANES III: Influence of race on GFR thresholds and detection of metabolic abnormalities. *J Am Soc Nephrol*. 2007;18(9):2575-2582. doi:10.1093/ajkn.2006.12.411

Brooks GC, Blaha MJ, Blumenthal RS. Relation of C-reactive protein to abdominal adiposity. *Am J Cardiol*. 2010;106(1):56-61

Borah MF, et al. Nitrogen balance during intermittent dialysis therapy of uremia. *Kidney Int*. 1978;14(5):491-500

Cao H, Ye H, Sun Z, Et al., Circulatory mitochondrial DNA is a pro-inflammatory agent in maintenance hemodialysis patients. *PLoS One*. 2014;9(12):e113179


Studart MMQ, Furioso ACT, Veiga JPR, Rodrigues ME, Gomes LO, Moraes CF. Impact of different automated peritoneal dialysis modalities on the inflammatory profile of elderly patients with chronic kidney disease [published online ahead of print, 2022 Jun 13]. *J Bras Nefrol*. 2022;50(1):28002022005034901.

Clin, M et al. "A systematic review of the cost and cost effectiveness of using standard oral nutritional supplements in community and care home settings." *Clinical nutrition (Edinburgh, Scotland)* vol. 35.1 (2016): 125-137. doi:10.1016/j.clnu.2015.07.012

Ikizer, T Alp et al. "KDIGO Clinical Practice Guideline for Nutrition in CKD: 2020 Update." *American journal of kidney diseases : the official journal of the National Kidney Foundation* vol. 76.3 Suppl 1 (2020): S1-S107.

44

Bibliography



Lai KN, Leung JC. Inflammation in peritoneal dialysis. *Nephron Clin Pract*. 2010;116(1):c11-c18

Ikizer TA, et al. Prevention and treatment of protein energy wasting in chronic kidney disease patients: a consensus statement by the International Society of Renal Nutrition and Metabolism. *Kidney Int*. 2013;94(6):1096-1107

Icardi A, Paoletti E, De Nicola L, Maczaffero S, Russo R, Cuzzolino M. Renal anaemia and EPO hyporesponsiveness associated with vitamin D deficiency: the potential role of inflammation. *Nephrol Dial Transplant*. 2013 Jul;28(7):1672-9.

González-Ortiz, Alema et al. "Relationship between protein-energy wasting in adults with chronic hemodialysis and the response to treatment with erythropoietin." *BMC nephrology* vol. 20.1 316. 14 Aug. 2019

Locatelli F, et al. Nutritional-inflammation status and resistance to erythropoietin therapy in haemodialysis patients. *Nephrol Dial Transplant*. 2006;21(4):991-998

Agarwal R, Davis JL, Smith L. Serum albumin is strongly associated with erythropoietin sensitivity in hemodialysis patients. *Clin J Am Soc Nephrol*. 2008;3(1):98-104

Waldron, Jenna Louise et al. "Vitamin D: a negative acute phase reactant." *Journal of clinical pathology* vol. 66.7 (2013): 620-2. doi:10.1136/jclinpath-2012-201301

Zia, Esmat et al. "Efficacy and safety of body weight-adapted oral cholecalciferol substitution in dialysis patients with vitamin D deficiency." *BMC nephrology* vol. 16 128. 4 Aug. 2015. doi:10.1186/s12882-015-0116-3

Hu, Chun et al. "Effects of Omega-3 Fatty Acids on Markers of Inflammation in Patients With Chronic Kidney Disease: A Controversial Issue." *Therapeutic apheresis and dialysis : official peer-reviewed journal of the International Society for Apheresis, the Japanese Society for Apheresis, the Japanese Society for Dialysis Therapy* vol. 22.2 (2018): 124-132. doi:10.1111/1744-0057.12511


Noor N, et al. Dietary omega-3 fatty acid, ratio of omega-6 to omega-3 intake, inflammation, and survival in long-term hemodialysis patients. *Am J Kidney Dis*. 2011;58(2):248-256


Noor, Hanan et al. "Resistance exercise and nutritional interventions for augmenting sarcopenia outcomes in chronic kidney disease: a narrative review." *Journal of cachexia, sarcopenia and muscle* vol. 12.6 (2021): 1621-1640

Probst, Georgia Barbara et al. "The Diet and Hemodialysis Dyad: Three Eras, Four Open Questions and Four Paradoxes. A Narrative Review. Towards a Personalized, Patient-Centered Approach." *Nutrients* vol. 8.4 372. 10 Apr. 2017

Mah, Jia Yee et al. "Oral protein-based supplements versus placebo or no treatment for people with chronic kidney disease requiring dialysis." *The Cochrane database of systematic reviews* vol. 5.9 CD012616. 11 May. 2020

45






Thank you!

Type your questions in the
Q&A panel


Make sure you select 'All Panelists'

Nutricia Learning Center
is provided by
Nutricia North America



© 2022 Nutricia North America


46



Feedback and certificate of attendance

Please provide your feedback (2 options):

Aim your smartphone camera at this → QR code



OR

After this event: Fill out the survey in post-event email and pop up when you exit.

To receive your certificate of attendance (2 options):


Take the survey and find the event code at end of survey
Visit www.NutriciaLearningCenter.com
Enter event code into your NLC Dashboard. The Certificate of Attendance will be added to your NLC profile!

OR

Take the survey
Once you finished the survey, a pop-up page will provide you the certificate of attendance for immediate download.

PLEASE FEEL
FREE TO STAY
FOR A
MESSAGE
AFTER THE
EDUCATIONAL
EVENT

47



This ends the
educational part of our webinar.

The following short message is about
Nutricia's product offerings related to the
discussed topic. Please feel free to join us.

48

Pro-Stat: Concentrated Liquid Protein



When your patients need protein, **Pro-Stat** offers a convenient, concentrated protein source in a ready-to-drink format



Pro-Stat

- 15 g protein/fl oz
- Hydrolyzed collagen
- **Coming Soon:** Reformulated without phosphorus



Pro-Stat AWC

- 17 g protein/fl oz
- Hydrolyzed collagen with added nutrients for wound healing




Pro-Stat MAX

- 11 g protein/fl oz
- Hydrolyzed whey- and collagen
- 100% PDCAAS


Pro-Stat is a medical food for the management of pressure injuries, wounds, and other conditions requiring increased protein needs in low volume such as protein-energy malnutrition, unintentional muscle loss, low serum proteins, electrolyte disorders, & fluid restrictions.

49



If you like more information, please leave your name and contact information at the end of the webinar survey.

Thank you for joining us today.



50
