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The effects of oral protein supplementation on nutritional status in malnourished hemodialysis patients. A retrospective study

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Abstract

Background: Malnutrition is common in chronic hemodialysis (CHD) patients due to lower dietary protein and energy intake than normal. Morbidity and mortality rates are unacceptably high in end-stage renal disease (ESRD) patients and correlate with malnutrition status in these patients. This retrospective study aims to evaluate the nutritional effects of oral nutrition supplements (ONS) on various nutritional parameter outcomes in maintenance hemodialysis (MHD) patients based on the hypothesis that daily provision of ONS would improve or prevent further deterioration of the nutrition status of MHD patients.

Methodology: For 34 patients who received ONS for two months, laboratory and anthropometric measurements were taken before the start of ONS intake and after two months of continuous consumption. Biochemical markers (albumin, ferritin, and uric acid), anthropometric measurement, body mass index (BMI), dry weight (DW), and inter-dialysis weight changes were statistically analyzed using SPSS software and paired-t test was used for comparison the changes in these values.

Result: After the provision of ONS during hemodialysis there was a significant increase in serum albumin concentration from 30.6 (± 3.5) gm/L at baseline to 31.9 (± 4.1) gm/L after 2 months (P = 0.038) and inter dialysis weight change from 2.2 (± 0.91) kg at baseline to 2.6 (± 1.2) kg (P = 0.033). The other biochemical markers such as ferritin, uric acid, and anthropometric measurements (Body Mass Index (BMI) and dry weight) had no significant changes during the study.

Conclusion: In conclusion, our findings suggest that the treatment strategy of providing ONS could be an effective therapy for malnourished patients in MHD and might have a beneficial effect against muscle loss due to catabolism during hemodialysis (HD) treatment.

Keywords: Hemodialysis; Malnutrition; Oral nutrition supplement; Nutritional status and dry weight

1. Introduction

Malnutrition is common in patients with chronic kidney disease (CKD) undergoing HD treatment due to lower-than-normal dietary protein and energy intake resulting in negative effects on their prognosis (1–3). Morbidity and mortality rates are unacceptably high in end-stage renal disease (ESRD) patients, especially in patients who undergo HD therapy (4). Managing malnutrition, serum nutritional parameters, and anthropometric measurement in HD patients is an important factor, as it is the main cause of morbidity, mortality, and hospitalization (5,6). Protein-energy wasting is a

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state of metabolic and nutritional derangements in CKD and common comorbidity in 75% of patients undergoing MHD therapy (7–9). This condition is a progressive depletion of protein and energy stores and is associated with poor quality of life, complications, and an increased risk of mortality in HD patients.

The nutritional guidelines of the Kidney Disease Outcomes Quality Initiative (KDOQI) have recommended HD patients with 30–35 kcal/kg/day of energy and 1.2g protein /kg/day intake (10,11). Due to dietary restrictions, socioeconomic limitations, and anorexia, many patients fail to comply with these recommendations. Hence, additional nutritional intervention is needed to support MHD patients to achieve nutritional protein and energy goals (12,13).

ONS may provide benefits over protein and carbohydrate-dense supplements for patients undergoing HD to compensate for the adverse metabolic outcomes (14). However, few studies have considered the effects of ONS, which can contain proteins, energy, and electrolytes on malnourished HD patients (15–17). Therefore, this retrospective study aims to evaluate the effects of ONS on various nutritional parameter outcomes in maintenance hemodialysis (MHD) patients based on the hypothesis that daily ONS consumption could improve or prevent further deterioration of the nutrition status of these patients. The present study was designed to determine the effects of ONS on biochemical and anthropometric nutrition markers in malnourished patients undergoing HD therapy.

2. Study methodology

2.1. Sample size

This study was conducted on patients treated in the HD unit of Hazm Mebeirek General Hospital (HMGH), State of Qatar. During the monthly nutrition assessment of the 64 patients receiving MHD therapy, many patients who were diagnosed as malnourished (serum albumin concentration <35 gm/L and/or a loss of ≥5% DW over the past 3 months) were followed up for 2 months between September and November 2022. The clinical dietitian recommended that the assigned physician prescribe a high-protein ONS for patients who met the inclusion criteria. The inclusion criteria were age >18 years old, serum albumin concentration of <35 gm/L and/or a loss of ≥5% dry weight over the past 3 months. The exclusion criteria were patients who have liver disease, active inflammation, death during follow-up, and who are undergoing peritoneal dialysis.

2.2. Study methodology

Laboratory and anthropometric measurements were taken before the beginning of ONS intake and after two months of continuous consumption of the patients who received ONS for two months. Biochemical markers (albumin, ferritin, uric acid, body), anthropometric measurement (BMI and DW) and inter-dialysis weight change data were extracted from the electronic medical record (EMR) after getting approval from the Medical Research Center of Hamad Medical Corporation (HMC) for two readings.

Renilon, an approved ONS by HMC, has been used as a complementary oral food source for MHD patients in all HD units and is manufactured by Nutricia Company in prepackaged bottles. The eligible patients have received 7 bottles (125ml each bottle) per week for two months. Each bottle contains 249 calories, 9.1-gram whey protein instead of animal protein because whey protein has a lower content of electrolytes, and 2.5mg Fe.

Eligible patients were visited during dialysis sessions and were encouraged to consume the ONS provided. Statistical analysis using SPSS software and the paired-t test were utilized in assessing the changes in biochemical markers and anthropometric measurements during the consumption of ONS for comparison of the changes in these values before and after the ONS was taken. Analysis of the covariance using (ANOVA) model to assess the effect of providing supplements and the baseline parameters as covariance. The p-value of < 0.05 will be considered statistically significant.

2.3. Anthropometric measurements and biochemical markers

DW and intradialytic weight gain were measured and recorded before and after the provision of ONS. BMI was calculated at the beginning and end of the follow-up period. The concentrations of serum albumin, ferritin and uric acid were extracted from EMR before and after ONS provision.

2.4. Statistical analysis

Descriptive statistics were utilized to summarize and determine the sample characteristics and distribution of various considered parameters related to demographic, biochemical markers, anthropometric measurement (BMI and dry

weight), albumin, ferritin, uric acid, inter dialysis weight change data, and other related features of this cohort participants.

The normally distributed data and results were reported with mean and standard deviation (SD) with corresponding 95% CI, and the remaining results were reported with median and interquartile range (IQR). Categorical data were summarized using frequencies and percentages. Associations between two or more qualitative variables were examined and assessed using Pearson Chi-square and Fisher Exact tests as appropriate.

Quantitative outcomes (biochemical marker and anthropometric measurement) measured between the two-time points were analyzed using paired t-test or Wilcoxon signed ranked test as appropriate. The relationship between two quantitative variables was examined using Pearson's or Spearman's correlation coefficients. Linear or non-linear regression was performed to explore and assess the impact of potential factors and predictors affecting the biochemical marker and anthropometric measurement by adjusting potential predictors and confounders.

Repeated measure analysis of variance (ANOVA) was used to analyze quantitative outcome measures recorded at various time points. Pictorial presentations of the key results, biochemical markers and anthropometric measurements were made using statistical graph box plots. All Statistical analyses were done using statistical packages SPSS 27.0 (SPSS Inc. Chicago, IL) software.

3. Result

Table 1 Demographic characteristics of the study patients (*N*= 34)

Gender		**Height**	**Age**	**Percentage %**
male		28	28	82.4
	Mean	167.5357	52.6071	
	Std. Deviation	7.63754	12.58553	
	Minimum	149.00	25.00	
	Maximum	180.00	71.00	
female		6	6	17.6
	Mean	157.5000	53.3333	
	Std. Deviation	5.04975	15.56492	
	Minimum	152.00	38.00	
	Maximum	166.00	77.00	

A total of 34 patients in the HMGH dialysis unit were recruited for this study. The inclusion criteria included age >18 years old, serum albumin concentration of <35 gm/L and/or a loss of ≥5% dry weight. Patients who have liver disease, active inflammation, death during follow-up, and undergoing peritoneal dialysis were not included in the study.

The demographic characteristics of the study population at baseline are shown in Table 1. The mean SD for the age of the male patients were 52.6 (±12.5) years old ranging between 25 to 71 years while the mean age for the female patients was 53.3 (±15.5) years between 38 to 77 years. Approximately 82.4% were male and 17.6% of the participants were female.

Table 2 Study variables (mean SD) at baseline (*N* =34)

		Albumin	**Ferritin**	**Uric acid**	**BMI**	**Dry weight**	**Inter dialysis Weight change**
N	Valid	34	34	34	34	34	34
	Missing	0	0	0	0	0	0

Mean	30.6471	666.2353	371.6765	25.8279	71.4500	2.2735
Std. Deviation	3.54950	355.66524	73.31903	5.84100	18.81681	.91131
Minimum	22.00	118.00	236.00	19.00	43.50	.50
Maximum	34.00	1919.00	581.00	39.79	120.00	3.90

Table 3 Study variables (mean SD) at follow-up time after 2 months of ONS provision (*N* =34)

		Albumin 2	**Ferritin 2**	**Uric acid 2**	**BMI 2**	**Dry weight 2**	**Inter dialysis Weight change 2**
N	Valid	34	34	34	34	34	34
	Missing	0	0	0	0	0	0
Mean		31.9118	609.1471	367.5588	25.7500	71.1618	2.6471
Std. Deviation		4.10002	303.35199	48.61736	5.93630	18.89720	1.23269
Minimum		13.00	208.00	242.00	18.60	43.50	.20
Maximum		38.00	1437.00	473.00	39.79	121.00	5.20

Table 4 Paired sample test

		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	AL1 - AL2	-1.26471	3.40507	.58396	-2.45279	-.07662	-2.166	33	.038
Pair 2	Fe1- Fe2	57.08824	238.59429	40.91858	-26.16125	140.33772	1.395	33	.172
Pair 3	Ur1 - Ur2	4.11765	62.00477	10.63373	-17.51684	25.75213	.387	33	.701
Pair 4	BMI1 - BMI2	.07794	.56602	.09707	-.11955	.27543	.803	33	.428
Pair 5	Dr1 - Dr2	.28824	1.63369	.28018	-.28179	.85826	1.029	33	.311
Pair 6	Inte1 - Inter2	-.37353	.97648	.16747	-.71424	-.03282	-2.230	33	.033

3.1. Biochemical and anthropometrical measurement findings

The mean (SD) levels of serum albumin were significantly increased from 30.6 (±3.5) gm/L at baseline to 31.9 (±4.1) gm/L after 2 months of ONS provision (P = 0.038) as in table 2,3, and 4, while the significant increase in the male group is shown in table 5. The mean changed after 2 months from 30.3 (±3.7) gm/L to 32.0 (±4.4) gm/L compared with the female group mean before and after the follow-up period is 31.8 (±2.2) gm/L and 31.5 (±2.2) gm/L respectively.

The other biochemical markers, ferritin, and uric acid, the mean and SD were 666.2 (±355.6) ug/L vs 609.1 (± 303.3) (ug/L) (P = 0.172) after, and 371.6 (±73.3) umol/L vs 367.5 (±48.6) umol/L, (P = 0.701) for uric acid respectively. However, the changes in mean value are considered statistically insignificant in these indicators.

At baseline, the inter-dialysis weight change mean (SD) was 2.2 (± 0.91) kg and was significantly higher after 2 months of ONS provision with a mean (SD) of 2.6 (±1.2) kg (P = 0.033). BMI and dry weight mean (SD) before and after ONS consumption were 25.8 (±5.8) kg/m2 and 71.4 (±18.8) kg vs 25.7 (±5.9) kg/m2 (p= 0.428) and 71.1(±18.8) kg (p=0.311) respectively which showed no significant difference before and after ONS consumption.

Table 5 Mean SD at follow-up time for the two genders after 2 months of ONS provision (*N* =34).

gender		Albumin 1	Albumin 2
Male N	Valid	28	
	Missing	0	
Mean		30.3929	32.0000
Std. Deviation		3.75489	4.42217
Minimum		22.00	13.00
Maximum		34.00	38.00
Female N	Valid	6	
	Missing	0	
Mean		31.8333	31.5000
Std. Deviation		2.22860	2.25832
Minimum		29.00	28.00
Maximum		34.00	35.00

4. Discussion

Studies for evaluating the effectiveness and the importance of high protein supplements in malnourished HD patients are limited. In this retrospective observational study, we were able to illustrate that ONS given during HD therapy, for 2 months, could significantly improve some nutritional parameters in malnourished HD patients. Protein calorie malnutrition in HD patients is related to multiple factors such as decreased protein and energy intake. Several studies indicated that in HD patients, the protein and energy intake are less than the recommended value (1-5). Decreased nutrient intake and malnutrition in these patients can be related to several factors, including metabolic abnormalities, low appetite, and certain co-morbidities (6-8).

Nutrition counselling generally has little effect on improving nutrient intake and reaching the recommended levels in HD patients. ONS has been a suggested dietary intervention method to overcome this problem. However, the results of the studies have been mixed. There is a constant challenge for ONS compliance with intake when given at home. This study indicates that ONS supplementation given during HD therapy showed nutritional benefits in malnourished HD patients.

There are limited numbers of studies evaluating the efficacy of oral nutritional supplementation in HD patients. Some studies showed various degrees of improvement in nutritional parameters in HD, while others showed no improvement (10-13). In a recent systematic review and meta-analysis of randomized clinical trials study by Liu et al., it was reported that there is a beneficial effect of ONS on the study participants (10). Our results also are consistent with these reports, though the design of our study was not randomized and only observational.

This beneficial improvement appeared to have occurred in the absence of an increase in daily dietary intake for HD patients outside the dialysis facility. In addition to inadequate oral dietary nutrient intake, the HD procedure has been considered a catabolic process and resulted in the development of malnutrition in protein and calories. The HD procedure is associated with certain catabolic consequences (16). Other certain characteristics during HD procedure still predispose to catabolism, particularly the lack of free access to food during HD sessions and the inevitable loss of nutrients in the dialysate. The hemodialysis procedure treatment leads to increased catabolism of whole-body and muscle protein resulting in loss of protein stores and increased energy expenditure (18).

It is estimated that 6 to 8 grams of amino acids are lost in the dialysate, and 200 kcal of extra energy is utilized during hemodialysis (19). The protein and energy losses are caused by significant muscle loss and catabolism to compensate for plasma amino acid and protein pool. Moreover, these studies indicate a lack of adequate compensatory protein anabolism, leading to a net increase in protein catabolism during 3 to 4 hours of HD procedure. The consumption of ONS was encouraged during HD sessions when catabolism was at its peak and the amino acid loss in the dialysate. Our results

suggest that the oral nutritional supplementation during this time resulted in significant improvement in malnutrition in these patients.

Better compliance is the rationale for the provision of supplementation during HD. When provided for intake at home, compliance cannot be guaranteed and can be an issue in the evaluation of the benefits of ONS. Financial advantages are another important aspect of oral nutritional supplementation compared with the high cost of intradialytic parenteral nutrition (IDPN) (20).

In a retrospective study, Capelli et al. showed a modest increase in survival in HD patients who received IDPN for 9 months (20). In another retrospective study, Chertow et al. analyzed a large group of HD patients who received IDPN and compared them with those patients who did not receive IDPN (21). The authors reported a significant reduction in the risk of death in the group of malnourished patients, with low albumin levels who were given IDPN.

The present study demonstrated a significant increase in inter-dialysis weight change following the consumption of ONS. Currently, there is a lack of available studies addressing the underlying reasons for this observation. The study of Yang et al. suggested that this increase may be attributed to higher fluid intake post-dialysis procedure potentially driven by thirst and xerostomia (22). However, additional studies are needed before ONS can be recommended for general use for malnourished HD patients to approve their efficacy especially compared to IDPN.

While our study showed a significant improvement in malnourished HD patients, one of the limitations of this study is the design was a retrospective study, there is no controlled group, and the total daily protein and calorie intake of participants were not assessed.

Abbreviations and Acronyms

- ESRD: End-stage renal disease
- HD: Hemodialysis dialysis
- PD: Peritoneal dialysis
- EMR: Electronic medical record
- MRC: Medical research center
- HMC: Hamad medical corporation
- ONS: Oral nutritional supplement.
- HMGH: Hazm Mebaireek General Hospital
- SD: standard deviation
- MHD: maintenance hemodialysis
- DW: dry weight.
- BMI: body mass index

5. Conclusion

In conclusion, our study illustrates that the treatment strategy of providing ONS could be an effective therapy for malnourished patients in MHD patients and have a beneficial effect on muscle loss retention which might be caused by catabolism during HD treatment.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interests.

Statement of ethical approval

The study design and operationalization adhered to the principles of respect, justice and confidentiality stipulated in the 2013 Declaration of Helsinki Good Clinical Practice. Also, in line with the laws and regulations of the Ministry of Public Health in Qatar, the study protocol was approved by HMC's Medical Research Center (MRC).

Statement of informed consent

The researchers will maintain anonymity of the participants by not including their personal details on the data collection tool.

References

[1] Caglar K, Fedje L, Dimmitt R, Hakim RM, Shyr Y, Ikizler TA. Therapeutic effects of oral nutritional supplementation during hemodialysis. Kidney Int. 2002 Sep;62(3):1054–9.

[2] Sezer S, Bal Z, Tutal E, Uyar ME, Acar NO. Long-term oral nutrition supplementation improves outcomes in malnourished patients with chronic kidney disease on hemodialysis. JPEN J Parenter Enteral Nutr. 2014 Nov;38(8):960–5.

[3] Sohrabi Z, Eftekhari MH, Akbarzadeh M. Effect of Protein Supplementation on Serum Electrolytes in Hemodialysis Patients. International Journal of Nutrition Sciences [Internet]. 2019 Mar [cited 2024 Aug 30];4(1). Available from: https://doi.org/10.30476/ijns.2019.81532.1008

[4] Nieves-Anaya I, Várgas MB, García OP, Biruete A, Kistler B, Atilano-Carsi X. Effect of oral nutritional supplementation combined with impedance vectors for dry weight adjustment on the nutritional status, hydration status and quality of life in patients on chronic hemodialysis: A pilot study. Clin Nutr ESPEN. 2023 Apr;54:23–33.

[5] Ko GJ, Obi Y, Tortorici AR, Kalantar-Zadeh K. Dietary protein intake and chronic kidney disease. Curr Opin Clin Nutr Metab Care. 2017 Jan;20(1):77–85.

[6] Moretti HD, Johnson AM, Keeling-Hathaway TJ. Effects of protein supplementation in chronic hemodialysis and peritoneal dialysis patients. J Ren Nutr. 2009 Jul;19(4):298–303.

[7] Liu PJ, Ma F, Wang QY, He SL. The effects of oral nutritional supplements in patients with maintenance dialysis therapy: A systematic review and meta-analysis of randomized clinical trials. PLoS One. 2018;13(9):e0203706.

[8] Qin A, Tan J, Hu W, Liu Y, Chen L, Tang Y, et al. Oral energy supplementation improves nutritional status in hemodialysis patients with protein-energy wasting: A pilot study. Front Pharmacol. 2022;13:839803.

[9] Yang Y, Qin X, Li Y, Yang S, Chen J, He Y, et al. Relationship between Serum Uric Acid and Mortality Risk in Hemodialysis Patients: A Multicenter Prospective Cohort Study. Am J Nephrol. 2020;51(10):823–32.

[10] Leon JB, Albert JM, Gilchrist G, Kushner I, Lerner E, Mach S, et al. Improving albumin levels among hemodialysis patients: a community-based randomized controlled trial. Am J Kidney Dis. 2006 Jul;48(1):28–36.

[11] Panjkota Krbavčić I, Vrdoljak I, Bituh M, Rumora Samarin I, Vukomanović A, Duvnjak M. Nutritional status of hemodialysis patients. Hrvat čas prehrambenu tehnol biotehnol nutr (Online). 2018 Dec 20;13(3–4):86–94.

[12] Gharib MS, Nazeih MS, El Said TW. Effect of intradialytic oral nutritional supplementation on nutritional markers in malnourished chronic hemodialysis patients: prospective randomized trial. BMC Nephrol. 2023May 4;24(1):125.

[13] Kalantar-Zadeh K, Rodriguez RA, Humphreys MH. Association between serum ferritin and measures of inflammation, nutrition and iron in hemodialysis patients. Nephrol Dial Transplant. 2004 Jan;19(1):141–9.

[14] Li J, Hou G, Sun X, Chen A, Chai Y. A Low-Cost, Intradialytic, Protein-Rich Meal Improves the Nutritional Status in Chinese Hemodialysis Patients. J Ren Nutr. 2020 Mar;30(2):e27–34.

[15] Beciragic A, Resic H, Prohic N, Karamehic J, Smajlovic A, Masnic F, et al. Correlation Between C-reactive Protein and Non-enzymatic Antioxidants (Albumin, Ferritin, Uric Acid and Bilirubin) in Hemodialysis Patients. Mater Sociomed. 2015 Apr;27(2):87–90.

[16] Jackson L, Cohen J, Sully B, Julious S. NOURISH, Nutritional OUtcomes from a Randomised Investigation of Intradialytic oral nutritional Supplements in patients receiving Haemodialysis: a pilot randomised controlled trial. Pilot Feasibility Study. 2015;1:11.

[17] Pifer TB, McCullough KP, Port FK, Goodkin DA, Maroni BJ, Held PJ, et al. Mortality risk in hemodialysis patients and changes in nutritional indicators: DOPPS. Kidney Int. 2002 Dec;62(6):2238–45.

[18] Lim VS, Bier DM, Flanigan MJ, Sum-Ping ST. The effect of hemodialysis on protein metabolism. A leucine kinetic study. The Journal of clinical investigation. 1993 Jun 1;91(6):2429-36.

[19] Wolfson M, Jones MR, Kopple JD. Amino acid losses during hemodialysis with infusion of amino acids and glucose. Kidney International. 1982 Mar 1;21(3):500-6.

[20] Capelli JP, Kushner H, Camiscioli TC, Chen SM, Torres MA. Effect of intradialytic parenteral nutrition on mortality rates in end-stage renal disease care. American journal of kidney diseases. 1994 Jun 1;23(6):808-16.

[21] Chertow GM, Ling J, Lew NL, Lazarus JM, Lowrie EG. The association of intradialytic parenteral nutrition administration with survival in hemodialysis patients. American journal of kidney diseases. 1994 Dec 1;24(6):912-20.

[22] Yang SC, Chiang CK, Hsu SP, Hung KY. Relationship between interdialytic weight gain and nutritional markers in younger and older hemodialysis patients. Journal of Renal Nutrition. 2008 Mar 1;18(2):210-22.