Open Access

Original Article

Effect Of Predialytic and Intradialytic Oral Nutritional Supplementation On Adequacy of Hemodialysis: A Quasi-experimental Analysis

Fahad Riaz, Abdul Rehman Arshad*, Zubair Ahmed, Muhammad Iqbal, Muhammad Zulqurnain Saleem, Rabia Parveen

Department of General Medicine, Pak Emirates Military Hospital/National University of Medical Sciences (NUMS), Rawalpindi Pakistan,
*Department of Nephrology, Pak Emirates Military Hospital/National University of Medical Sciences (NUMS), Rawalpindi Pakistan

ABSTRACT

Objective: To compare effects of predialytic and intradialytic oral nutritional supplementation on adequacy of hemodialysis.
Study Design: Quasi-experimental study.
Place and Duration of Study: Pak Emirates Military Hospital, Rawalpindi, Pakistan, from Jun to Aug 2023.
Methodology: Patients on hemodialysis were consecutively recruited. In the first arm (two sessions), patients were given 200ml of oral NOVASOURCE® Renal two hours into dialysis sessions, whereas in the second arm (another two sessions), this was given an hour before starting the session. Serum urea levels were checked at the start and end of each dialysis session. Ultrafiltration volumes were recorded, and post-dialysis weight was noted. All patients were monitored for intradialytic hypotension. Kt/V by Daugirdas equation and urea reduction ratios were calculated.
Results: Twenty patients with a median age of 57.50 years (interquartile range 35.00- 64.25 years) underwent 80 hemodialysis sessions. Mean Kt/V was 1.42± 0.38 and 1.40± 0.34 with predialytic and intradialytic nutritional supplementation (p=0.852), with targets being achieved in 27 (67.50%) and 28 (70.00%) sessions, respectively (p=0.418). Urea reduction ratios were 66.43± 16.59% and 65.82± 17.22% with predialytic and intradialytic nutritional supplementation (p=0.869), with targets being achieved in 23 (57.50%) and 26 (65.00%) sessions, respectively (p=0.973). Intradialytic hypotension was seen in 1 (0.03%) and 3 (0.08%) sessions with predialytic and intradialytic nutritional supplementation (p =0.999).
Conclusion: Timing of nutritional supplementation does not affect adequacy of hemodialysis.

Keywords: Hemodialysis, High Protein Diet, Nutritional Support, Protein Energy Malnutrition, Renal Replacement Therapy.

How to Cite This Article: *Riaz F, Arshad AR, Ahmed Z, Iqbal M, Saleem MZ, Parveen R. Effect Of Predialytic and Intradialytic Oral Nutritional Supplementation On Adequacy of Hemodialysis: A Quasi-experimental Analysis. Pak Armed Forces Med J 2026; 76(Suppl-6): S864-S868.*
DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-6.11000

INTRODUCTION

Hemodialysis is the most prevalent form of renal replacement therapy in developing countries like Pakistan. With an increasing prevalence of end-stage renal disease (ESRD), more and more people require this treatment to sustain life. Hemodialysis has consistently been shown to improve symptoms, quality of life, and life expectancy in such patients.[1] This treatment modality is expensive and beyond the reach of majority of patients in this part of the world. Whereas the Government has taken special incentives in the form of comprehensive health insurance (Sehat Sahulat Program) and many hemodialysis units are being run by philanthropists all over the country, a significant proportion of patients are still unable to get adequately dialyzed because of logistical issues.[2] Facilities for such treatment are also not infinite, especially in smaller cities, thus putting an extra burden on resources. Limited slots and greater workload on hemodialysis units also mean that they are at times unable to accommodate all patients for a weekly hemodialysis schedule. It is thus not uncommon to find underdialyzed patients.[3]

Malnutrition is a major issue among patients on maintenance hemodialysis. In a previous study at our hospital, one in four patients had malnutrition.[4] As with underdialysis, malnutrition is associated with increased mortality risk in ESRD.[5] It is imperative to both improve nutritional status and deliver an adequate dose of hemodialysis to ensure longevity for these patients. Building up these patients' nutrition is challenging for multiple reasons.[6] Administering sufficient calories is associated with an excess of certain electrolytes, such as phosphate and potassium. Patients also have poor appetite, limiting intake of food as well as prescribed nutritional supplements.[7] Intradialytic administration of nutritional supplements improves compliance and nutritional status, but it is associated with a greater risk of intradialytic hypotension and an increased service delivery-related burden on dialysis room staff.[8]

Correspondence: Dr Fahad Riaz, Department of General Medicine, Pak Emirates Military Hospital, Rawalpindi Pakistan
Received: 06 Oct 2023; revision received: 22 Mar 2024; accepted: 25 Mar 2024

Predialytic nutritional supplementation, on the other hand, seems more practical from healthcare providers' perspective. It remains to be seen whether that strategy affects the dose of hemodialysis delivered to patients and whether it has the same long-term effects on nutritional status and well-being.[9] Such data from Pakistan have not been published before, and we therefore planned this study to compare the effect of predialytic nutritional supplementation on hemodialysis adequacy with intradialytic administration. The results would help formulate local policies for improving nutritional status in patients with end-stage renal disease.

METHODOLOGY

This quasi-experimental crossover study was carried out at the Department of Nephrology, Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jun to Aug 2023. After obtaining approval from the Ethics Review Committee of the hospital, vide reference number A/28/EC/451/23, the recruitment of participants was conducted. A minimum sample size of 36 hemodialysis sessions (including 18 sessions in each arm of the study) was calculated with Epitools Sample Size Calculator, assuming a mean spKt/V of 1.41 and 1.26 (with a standard deviation of 0.016) in the two groups.[6]

Inclusion Criteria: Patients of either gender, aged 40 to 65 yrs, who were on maintenance hemodialysis for at least three months, having a good record of compliance to hemodialysis sessions, were included in the study.

Exclusion Criteria: Patients who were admitted preceding screening for eligibility, patients with temporary vascular access, heart failure, recurrent intradialytic hypotension, shortening of hemodialysis sessions irrespective of cause, missed hemodialysis sessions, and unwillingness expressed by the patients were excluded.

All individuals were consecutively recruited for the study. The purpose of the study was explained, and relevant instructions were given during the week preceding start of this study.

NOVASOURCE® Renal was used as a nutritional supplement in this study. This is a protein-rich liquid supplement, with each 200ml serving containing 18.2 grams of protein and providing 402 kcal of energy.[10] All hemodialysis sessions carried out as a part of this study started at 1000hrs. In the first phase of this study, patients were asked not to take anything by mouth during the three hours before start of the hemodialysis session (0700hrs onwards). This was confirmed by direct questioning each time. At the start of hemodialysis session, a blood sample for estimation of serum urea was obtained from arterial port of the dialysis tubing using standard protocol. NOVASOURCE® Renal 200ml was given orally two hours after the start of hemodialysis session, and the patients did not eat anything else throughout the hemodialysis session. Blood pressure was measured every 30 minutes during these sessions. At the end of hemodialysis sessions, blood sampling was done again to determine post- dialysis serum urea levels, ultrafiltration volume was recorded, and body weight was noted down. Patients were given instructions for the next hemodialysis session as well. After two sessions, patients were shifted to the other arm, wherein NOVASOURCE® Renal was given ONE hour before initiation of hemodialysis session. The rest of the methodology, including blood sampling and patient monitoring, remained the same during this phase (Figure) Kt/V urea for each hemodialysis was calculated using the following equation of Daugirdas formula:

*Kt/V= -LN(R - 0.008 * Duration) + (4-3.5 * R) * UF/Post-dialysis weight*

where, R= Post-dialysis Urea/ Pre-dialysis Urea

Urea reduction ratio (URR) was calculated using the following equation:

*URR= (Pre-dialysis Urea - Post-dialysis Urea) / Pre-dialysis Urea *100*

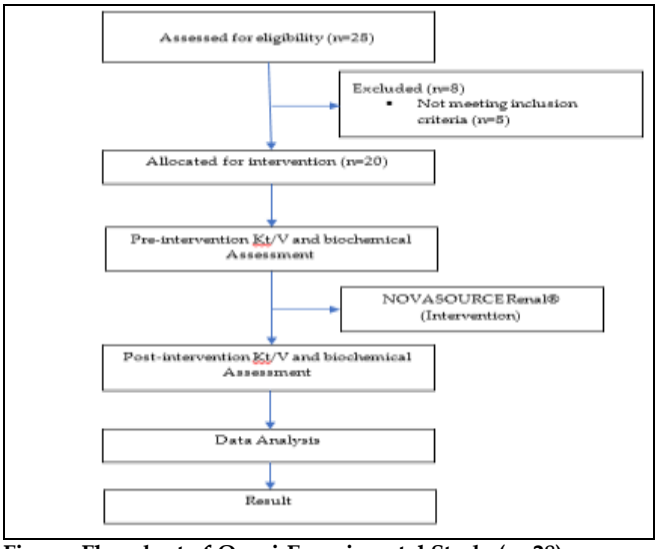

Figure: Flowchart of Quasi-Experimental Study (n=28)

Data analysis was done with Statistical Package Statistical Sciences version 20. Hemodialysis adequacy was defined as Kt/V ≥1.2 or urea reduction ratio ≥65%. Intradialytic hypotension was defined as a 30%

reduction in systolic blood pressure from baseline or an absolute value of <90 mmHg. All parameters with normal distribution were described as Mean±SD. Median and interquartile range were used for parameters with skewed distribution. Proportions of patients achieving Kt/V and URR targets in the two arms were compared using Chi-square test. Kt/V and URR values in the two arms were compared using a Paired Samples t-test. Significance level was set at ≤0.05 for both these tests.

RESULTS

Twenty patients included in this study had a median age of 57.50 years (interquartile range 35.00-64.25 years), and an equal representation of males and females. They underwent a total of 80 hemodialysis sessions during this study period. A vast majority (n=17; 85.00%) were on a three-times-weekly HD schedule, whereas 3(15.00%) patients were getting hemodialysis twice a week. Comparison of different parameters amongst patients given predialytic nutritional supplementation and intradialytic nutritional supplementation is shown in Table-I.

Table-I: Comparison of different parameters amongst patients receiving predialytic and intradialytic nutritional supplementation (n=20)

Parameter	Predialytic nutritional supplementation (n=20)	Intradialytic nutritional supplementation (n=20)	*p*-value
Pre-dialysis Serum Urea (mmol/L)	19.14±7.06	19.99±9.02	0.539
Kt/V	1.42±0.38	1.40±0.34	0.852
Urea reduction ratio (%)	66.43±16.59	65.82±17.22	0.869

Kt/V = Klearance (dialyzer urea clearance) × time (dialysis duration) / Volume (urea distribution volume/total body water)

As shown in Table-II, there were no statistically significant differences in proportions of hemodialysis sessions during which Kt/V and URR targets were achieved with predialytic or intradialytic nutritional supplementation. Intradialytic hypotension was seen in 1(0.03%) of the sessions with predialytic nutritional supplementation and 3(0.08%) of the sessions with intradialytic nutritional supplementation (p=0.999).

Table-II: Proportions of hemodialysis sessions associated with fulfilment of adequacy targets (n=80)

Parameter	On Target	Below Target	*p*-value
Kt/V Predialytic	27(33.75%)	13(16.25%)	0.418
Kt/V intradialytic	28(35.00%)	12(15.00%)	
URR Predialytic	23(28.75%)	17(21.25%)	0.973
URR Intradialytic	26(32.50%)	14(17.50%)	

Kt/V = Klearance (dialyzer urea clearance) × time (dialysis duration) / Volume (urea distribution volume/total body water), URR= urea reduction ratio

DISCUSSION

This study compared the effects of oral nutritional supplementation at two different points in time in relation to hemodialysis sessions. It did not show any difference between predialytic and intradialytic administration of a protein-rich supplement with regard to adequacy of hemodialysis.

Caring for patients with end-stage renal disease is a great challenge. Nephrologists are concerned all the time about ensuring adequacy of hemodialysis, as this is related to clinical outcomes.[11] Traditionally, Kt/V has been the gold standard for this assessment. The National Kidney Foundation's Kidney Disease Outcomes Quality Initiative guidelines recommend a minimum single pool Kt/V of 1.2 and an ideal single pool Kt/V of 1.4 to be achieved in a single hemodialysis session amongst patients on thrice weekly hemodialysis, as reported by Van-Gelder *et al*.[12] Whereas this parameter assesses small molecule (urea) clearance, we already know that middle molecules and protein-bound substances also affect patient survival.[9] Moreover, adequacy of hemodialysis is not synonymous with adequacy of patient care. Other factors, such as control of biochemical markers reflecting mineral bone disease in chronic kidney disease, quality of life, patients' perceptions, and cardiovascular outcomes, should thus also be considered in this regard, as reported by Fotiadou *et al*.[13]

Whether patients should be allowed to eat during hemodialysis sessions or not is controversial. Gharib *et al*., documented a fall in blood pressure with intradialytic feeding.[14] Kistler *et al*., have recently shown that intradialytic hypotension was more common amongst those who had food during hemodialysis as compared to those who did not eat.[15] This is due to pooling of blood in the splanchnic circulation, and is probably unrelated to the timing of food intake during the dialysis sessions, as shown by Usakali *et al*.[16] Whether this phenomenon affects adequacy of dialysis or not is still not clear, with different studies providing conflicting results. Kittiskulum *et al*., have recently shown that protein intake during hemodialysis does not affect the removal of uraemic toxins.[17]

Nevertheless, there is ample evidence to suggest that nutritional supplementation during hemodialysis improves the nutritional status and inflammation in ESRD.[11] Nutritional status of hemodialysis can be improved through supplementation during the session.[18] Mahato *et al*., in their study, established that intradialytic supplementation improves the dialytic outcomes in reference to a decrease in cumulative inflammation and physical functional improvement.[19]

Many decades ago, prolonged hemodialysis sessions were seen as a golden opportunity to provide nutritional support, but with better solute clearance leading to shortening of individual sessions, this tended to fall out of fashion.[2] However, intradialytic nutrition still provides a chance to fight malnutrition in patients with non-compliance to dietary advice.

Our results are different from those of Rao *et al*.[6] They found predialytic serum urea levels to be higher amongst patients receiving predialytic nutrition, and have put this down to a more rapid absorption as compared to standard food items. Similarly, they established predialytic nutritional supplementation to be associated with a higher Kt/V, as the adequacy of hemodialysis was reduced with intradialytic nutritional supplementation because of hemodynamic and metabolic factors. The authors administered nutritional supplementation one hour before the start of hemodialysis session in the predialytic arm. Extending the time beyond this was not possible because many of our patients come from far away, and would not have consented to wait for this much time.

The authors were not sure if this study failed to identify any advantage of predialytic nutritional supplementation just because serum urea levels continued to rise during the intradialytic period, like that seen with intradialytic supplementation, but to a lesser extent. The hemodynamic response (hypotension) to intradialytic nutritional supplementation was not marked/ frequent in our patients.

LIMITATION OF STUDY

Patients typically eat regular food during hemodialysis, but in this study, they were provided with NOVASOURCE Renal at a set time with regular foods restricted. This may limit real-world applicability, as normal food is generally preferred and more affordable. The supplement was chosen to standardize caloric intake across participants, though not all may have favored a single dish of regular food either. Notably, this is the first report of such data from Pakistan. However, oral nutritional supplements are costly and likely unsustainable for long-term use. Additionally, the short study duration prevented assessment of long-term outcomes such as patient perceptions and quality of life.

CONCLUSION

Predialytic administration of oral nutritional supplementation does not produce a change in adequacy of hemodialysis as compared to intradialytic administration. Both approaches were evaluated for their impact on hemodialysis effectiveness, but no significant difference was observed. This suggests that the timing of nutritional supplementation, whether before or during dialysis, does not alter dialysis adequacy outcomes.

ACKNOWLEDGEMENT

The authors are grateful to Miss Sana, Intern Dietitian at Pak Emirates Military Hospital, Rawalpindi, for her help during data collection.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

FR & ARA: Data acquisition, data analysis, critical review, approval of the final version to be published.

ZA & MI: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MZS & RP: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Floria I, Kontele I, Grammatikopoulou MG, Sergentanis TN, Vassilakou T. Quality of Life of Hemodialysis Patients in Greece: Associations with Socio-Economic, Anthropometric and Nutritional Factors. Int J Environ Res Public Health 2022; 19(22): 15389. https://doi.org/10.3390/ijerph192215389
2. Malik S, Allen RJ, Vachharajani TJ, Kluger B, Ahmad I, Saeed F. Dialysis Decision Making, Dialysis Experiences, and Illness Perceptions: A Qualitative Study of Pakistani Patients Receiving Maintenance Hemodialysis. Kidney Med 2022; 4(11): 100550. https://doi.org/10.1016/j.xkme.2022.100550
3. Arshad AR, Jamal S, Amanullah K. Agreement Between Two Nutritional Assessment Scores as Markers of Malnutrition in Patients with End-stage renal disease. Cureus 2020; 12(3): e7429. https://doi.org/10.7759/cureus.7429
4. Lin TY, Chou HH, Hsieh TH, Huang HL, Hung SC, TRENDPAD Study Group. Malnutrition is associated with increased morbidity and death in dialysis patients undergoing endovascular therapy for peripheral artery disease. European J Vasc Endovasc Surg 2022; 64(2-3): 225-233. https://doi.org/10.1016/j.ejvs.2022.03.045
5. Piccoli GB, Lippi F, Fois A, Gendrot L, Nielsen L, Vigreux J. Intradialytic Nutrition and Hemodialysis Prescriptions: A Personalized Stepwise Approach. Nutrients 2020; 12(3): 785. https://doi.org/10.3390/nu12030785
6. Rao NS, Chandra A, Saran S, Kulshreshta MR, Mishra P, Tiwari P. Predialytic versus Intradialytic Nutrition: A Study to Assess Effects on Intradialytic Blood Pressure, Dialysis Adequacy, and Urea Removal. Blood Purif 2021; 50(6): 823-828. https://doi.org/10.1159/000512540
7. Du A, Shi X, Guo X, Pei Q, Ding Y, Zhou W, et al. Assessing the Adequacy of Hemodialysis Patients via the Graph-Based Takagi-Sugeno-Kang Fuzzy System. Comput Math Methods Med 2021; 9036322. https://doi.org/10.1155/2021/9036322

8. Avci M, Arikan F. The effect of food intake during hemodialysis on blood pressure: A nonrandomized experimental trial. Ther Apher Dial 2023; 27(4): 661-668. https://doi.org/10.1111/1744-9987.13967
9. Fotiadou E, Georgianos PI, Chourdakis M, Zebekakis PE, Liakopoulos V. Eating during the haemodialysis session: a practice improving nutritional status or a risk factor for intradialytic hypotension and reduced dialysis adequacy? Nutrients 2020; 12(6): 1703. https://doi.org/10.3390/nu12061703
10. Mah JY, Choy SW, Roberts MA, Desai AM, Corken M, Gwini SM, McMahon LP. Oral protein-based supplements versus placebo or no treatment for people with chronic kidney disease requiring dialysis. Cochrane Database Syst Rev 2020; 5(5): CD012616. https://doi.org/10.1002/14651858.CD012616.pub2
11. Hendriks FK, Kuijpers JHW, van Kranenburg JMX, Senden JMG, van der Sande FM, Kooman JP, et al. Intradialytic Protein Ingestion and Exercise do Not Compromise Uremic Toxin Removal Throughout Hemodialysis. J Ren Nutr 2023; 33(2): 376-385. https://doi.org/10.1053/j.jrn.2022.07.006
12. van Gelder MK, Middel IR, Vernooij RW, Bots ML, Verhaar MC, Masereeuw R, et al. Protein-bound uremic toxins in hemodialysis patients relate to residual kidney function, are not influenced by convective transport, and do not relate to outcome. Toxins 2020; 12(4): 234. https://doi.org/10.3390/toxins12040234
13. Fotiadou E, Georgianos PI, Vaios V, Sgouropoulou V, Divanis D, et al. Feeding during Dialysis Increases Intradialytic Blood Pressure Variability and Reduces Dialysis Adequacy. Nutrients 2022; 14(7): 1357. https://doi.org/10.3390/nu14071357
14. 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 2023; 24(1): 125. https://doi.org/10.1186/s12882-023-03181-7
15. Kistler BM, Benner D, Burrowes JD, Campbell KL, Fouque D, Garibotto G, et el. Eating during hemodialysis treatment: a consensus statement from the International Society of Renal Nutrition and Metabolism. J Ren Nutr 2018; 28(1): 4-12. https://doi.org/10.1053/j.jrn.2017.10.003
16. Usakli S, Mirioglu S, Dincer MT, Karatas B, Karaca C. Effect of intradialytic dietary support on nutritional status, muscle strength, and clinical markers in patients on hemodialysis: a cross-sectional study. BMC Nephrol 2025; 26(1): 342. https://doi.org/10.1186/s12882-025-04277-y
17. Kittiskulnam P, Banjongjit A, Metta K, Tiranathanagul K, Avihingsanon Y, Praditpornsilpa K, et al. The beneficial effects of intradialytic parenteral nutrition in hemodialysis patients with protein energy wasting: a prospective randomized controlled trial. Sci Rep 2022; 12(1): 4529. https://doi.org/10.1038/s41598-022-08726-8
18. Liang D, Dou X, Wen L, Liang Y, Zhang W, Liu L, et al. Effects of oral low-protein energy supplements on nutritional status in maintenance hemodialysis patients with protein-energy wasting: a randomized controlled trial. Asia Pac J Clin Nutr 2025; 34(3): 316-324. https://doi.org/10.6133/apjcn.202506_34(3).0006
19. Mahato SKS, Apidechkul T, Sriwongpan P, Hada R, Sharma GN, Nayak SK, Mahato RK. Factors associated with quality of life among chronic kidney disease patients in Nepal: a cross-sectional study. Health Qual Life Outcomes 2020; 18(1): 207. https://doi.org/10.1186/s12955-020-01458-1