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The effect of intradialytic food intake on hemodialysis adequacy and blood pressure; a quasi-experimental study

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ABSTRACT

Introduction: Food intake during hemodialysis (HD) is a controversial issue. The potential benefits include improvement of nutritional status and patient satisfaction. However, the risks include the possibility of intradialytic hypotension (IDH) and dialysis inadequacy. There are no guidelines regarding food intake during HD.

Objectives: To assess the impact of food intake during HD on IDH and dialysis adequacy.

Patients and Methods: This was a single-center quasi-experimental study. Thirty patients undergoing regular maintenance HD were recruited for the study. The patients themselves served as their controls. In three separate sessions, they were assessed for IDH and dialysis adequacy (spKt/V, URR). The first session was without a meal, the second with a small meal, and the third with a large meal. Change in measured variables (spKt/V, URR) was assessed by repeated-measures analysis of variance (ANOVA). The McNemar test was conducted to compare the incidence of IDH between three different dialysis sessions.

Results: Nine patients (30%) had IDH when they consumed a small meal ($P=0.02$, McNemar test), and eight patients had IDH (26.7%) when they consumed a large meal ($P=0.03$, McNemar test). The mean spKt/v and URR were not significantly different in the three sessions.

Conclusion: There is a significantly increased risk of IDH due to food intake. IDH is associated with significant morbidity and mortality; hence, restricting food intake during HD sessions would be prudent.

Implication for health policy/practice/research/medical education:
Food intake during HD has been a controversial issue with no clear guidelines. Our study shows that this practice can be associated with significant adverse effects, hence can preferably be avoided.

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Original Article

Introduction

Hemodialysis (HD) is one of the treatment modalities for end-stage renal disease (ESRD). The health of HD patients is greatly impacted by nutrition. Poor nutrition and protein-energy loss in HD patients are prevalent and indicate poor outcomes (1). The common practice among clinicians has been to provide food and nutritional supplements during HD treatment, and that has a positive impact on nutritional status and possibly outcomes (2,3). However, some studies have shown that food intake during HD is associated with hypotension and dialysis inadequacy (4-6). Unfortunately, there are very few studies on this essential aspect, even though we are frequently faced with this dilemma daily in our patients on HD. There is no uniform policy regarding food intake during HD in India and worldwide. Hence there is a need for well-conducted studies to address this issue so that clear guidelines can be given to dialysis technicians and nurses. Observational studies have yielded conflicting results, with one showing an increased risk of symptomatic hypotension. However, another study failed to show the same (4,7). The interventional study can address this issue more clearly.

Objectives

To assess the relationship between intradialytic food intake

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and quantity of food on intradialytic hypotension (IDH) and dialysis adequacy.

Patients and Methods

Study design

This is a single-center quasi-experimental study conducted over six months in the HD unit of our institute. The study included 30 patients, and the participants served as their controls. Patients 18 years or older had ESRD on maintenance HD twice or thrice per week for at least three months using arteriovenous fistula as vascular access. Patients with acute illnesses, using dialysis catheters as vascular access, autonomic neuropathy, and severe left ventricular systolic dysfunction (ejection fraction <45%) were excluded. The first dialysis session was without a meal, followed by the next with a small meal and the third with a large meal. For each patient, the second and third dialysis sessions were done on the same day of the week as the first session. The meal was consumed within the first hour of the dialysis session. Small meals consisted of Upma (a thick porridge-like dish made from semolina) of approximately 200 g (1 cup) containing 270 calories and 4-g protein. The large meal had a larger serving of Upma amounting to 400 g (2 cups), 540 calories, and 8-g protein. The caloric content of food was calculated using the nutritive value of Indian foods (8). Each HD session was of 4 hours duration. Dialysis was conducted on Fresenius 4008B machines with low flux, polysulfone dialyzer F6HPS (surface area 1.3 m^2, TMP max 600 mm Hg). Standard bicarbonate dialysate was used. The dialysate composition, temperature, dialysate flow rate, and blood flow rate remained unchanged in all three sessions. The patient's dry weight was determined by the treating nephrologist. Ultrafiltration was as per weight gain. The antihypertensive medications remained unchanged between the three sessions. Blood pressure monitoring was done pre-dialysis and then every 30 minutes and post-dialysis using a sphygmomanometer and the patient in a supine position. IDH symptoms like nausea, vomiting, cramps, restlessness, and dizziness, if present, were noted. Both systolic and diastolic blood pressures were noted, and mean arterial pressure (MAP) was calculated by the formula MAP= Diastolic BP+ [(SBP - DBP)/3]. IDH was defined as "A decrease in SBP ≥20 mm Hg or a decrease in MAP ≥10 mm Hg associated with symptoms that include: abdominal discomfort; yawning; sighing; nausea; vomiting; muscle cramps; restlessness; dizziness or fainting; and anxiety" (9). All episodes of IDH were promptly treated with foot end elevation, temporary cessation of ultrafiltration, and a saline bolus (200 mL) infusion.

Pre- and post-dialysis urea levels were assessed at each of the three sessions. Immediately before starting dialysis, pre-dialysis urea samples were taken using a method that prevents saline or heparin from diluting the blood sample. For post-dialysis urea collection, the pump was slowed to 100 mL per min for 15 seconds, following which the pump was turned off, and blood was collected from the sampling port for the arterial bloodline (10). Urea reduction ratio (URR) was calculated by the formula (pre-dialysis urea – post-dialysis urea) / pre-dialysis urea.

spKt/V calculated by Daugirdas formula spKt/V = -ln (R – 0.03) + [(4 – 3.5R) × (UF / W)].

Where K denotes the urea clearance of the dialyzer, t denotes the length of the dialysis treatment in minutes, V denotes the volume of urea distribution in the body in milliliters, UF denotes the volume of ultrafiltration in litters, W denotes the post-dialysis weight in kilograms, and R denotes the post-dialysis to pre-dialysis urea ratio (11).

Statistical analysis

All statistical analyses were conducted using SPSS 23 software. The McNemar test was used for comparing the incidence of IDH between three different dialysis sessions. Changes in measured variables (spKt/V, URR, and UF) were assessed by repeated-measures analysis of variance (ANOVA). The paired samples t test was conducted to compare the means of continuous variables and Fischer's exact test for discrete variables in those with and without IDH. A *P* value of less than 0.05 was considered significant.

Results

Of the 30 patients who participated in this study, 14 (46.7%) were female, and 16 (53.3%) were male. The cohort's mean age was 54.83±10.86 years (Mean ± SD). The most common native kidney disease was diabetic nephropathy (12 patients, 40%), followed by CKD-unknown (seven patients, 23.3%), autosomal dominant polycystic kidney disease (three patients,10%), antineutrophilic cytoplasmic antibody vasculitis (one patient, 3.3%), chronic glomerulonephritis (three patients,10%), chronic glomerulosclerosis (two patients 6.7%), chronic interstitial nephritis (one patient, 3.3%) and lupus nephritis (one patient,3.3%). Twenty-four (80%) patients were on thrice-weekly dialysis, and 6 (20%) patients were on twice-weekly dialysis. The duration for which patients were on dialysis was 2.72 ± 2.83 years (Mean ± SD). One patient had IDH in the session when they did not consume a meal. A significantly higher number of patients experienced IDH in sessions where the meal was consumed. Eight patients (26.7%) had IDH with a large meal ($P = 0.03$; McNemar test), and nine patients (30%) had IDH with a small meal ($P = 0.02$; McNemar test). The incidence of IDH was not significantly different between the session with large and

Table 1. Comparison of intradialytic hypotension between dialysis sessions without a meal and large meal

Dialysis session	Number of patients with IDH (%)	Number of patients without IDH (%)	*P* value[a]
Without meal (n=30)	1 (3.3)	29 (96.7)	0.03
With large meal (n=30)	8 (26.7)	22 (73.3)	

[a] McNemar test; IDH, intradialytic hypotension.

Table 2. Comparison of intradialytic hypotension between dialysis sessions without a meal and with a small meal

Dialysis session	Number of patients with IDH (%)	Number of patients without IDH (%)	*P* value[a]
Without meal	1 (3.3)	29 (96.7)	0.02
With small meal	9 (30)	21 (70)	

[a] McNemar test; IDH, intradialytic hypotension.

Table 3. Comparison of intradialytic hypotension between dialysis sessions with a large meal and a small meal

Dialysis session	Number of patients with IDH (%)	Number of patients without IDH (%)	*P* value[a]
With large meal (n=30)	8 (26.7)	22 (73.3)	1.000
With small meal (n=30)	9 (30)	21 (70)	

[a] McNemar test; IDH, intradialytic hypotension.

small meals (Tables 1-3**).**

All episodes of IDH were resolved with saline infusion, foot end elevation, and temporary cessation of ultrafiltration. No dialysis sessions were terminated due to IDH. The mean spKt/V and URR did not differ significantly between the sessions without and with meals (Table 4).

The mean spKt/v, ultrafiltration volume, hemoglobin, albumin, dialysis duration, age, sex, and dialysis frequency did not differ between those who had IDH and did not have IDH (Table 5 to Table 8).

Discussion

Food intake during dialysis sessions has been a controversial issue. The advocates in favor of food intake argue about the potential benefits in the form of improved nutrition and patient satisfaction. However, the concern is of increased incidence of IDH and reduced dialysis adequacy. IDH is associated with increased cardiovascular events and mortality (12). It is also associated with an increased incidence of dementia (13), accelerated loss of residual renal function (14), and vascular access thrombosis (15). Studies have also shown increased morbidity and mortality in patients with inadequate dialysis (16). There are no guidelines regarding food intake during HD and in our dialysis unit prior to this study we had left it to the patient choice. In this study we found that food intake during dialysis significantly increases the risk of IDH, however, it did not affect dialysis adequacy. The number of meals did not make any difference in the incidence of IDH. Our findings are in line with several observational and interventional studies done in the past (4,5,17,18). However, Benaroia and Iliescu (7) did not find any association of food intake with IDH. They followed the definition of IDH as nadir SBP <100 mm Hg at any point of time whereas we followed the presently accepted definition of SBP drop>20 mm Hg and MAP drop>10 mm Hg associated with symptoms of hypotension (9).

Table 4. Comparison of spKt/V and URR with and without meals

Parameter		N	Mean ± SD	*P* value[a]
spKt/v	Without meal	30	1.66±0.33	0.78
	Large meal session	30	1.64±0.32	
	Small meal session	30	1.66±0.32	
URR	Without meal	30	0.74±0.07	0.78
	Large meal session	30	0.73±0.06	
	Small meal session	30	0.74±0.06	

[a] ANOVA test; URR, urea reduction ratio; spKt/V, Single pool Kt/V.

Table 5. Comparison of variables between patients who had and did not have IDH with large meal intake

Parameter		N	Mean±SD	*P* value[a]
Hemoglobin (g/dL)	Had IDH	8	10.31±1.71	0.71
	No IDH	22	10.57±1.69	
spKt/v	Had IDH	8	1.60±0.38	0.67
	No IDH	22	1.66±0.31	
Ultrafiltration (L)	Had IDH	8	2.30±1.43	0.82
	No IDH	22	2.39±0.76	
Albumin (g/dL)	Had IDH	8	3.63±0.23	0.59
	No IDH	22	3.73±0.49	
Dialysis duration (y)	Had IDH	8	1.8±0.78	0.29
	No IDH	22	3.05±3.24	

[a] *t* test; IDH, intradialytic hypotension; spKt/V, Single pool Kt/V.

Table 6. Comparison of variables between patients who had and did not have intradialytic hypotension with large meal intake

Parameter		Had IDH (n=8)	No IDH (n= 22)	*P* value[a]
Age (y)	<60 (n=21)	5 (23.8%)	16 (76.2%)	0.58
	>60 (n=9)	3 (33.3%)	6 (66.7%)	
Gender	Male (n=16)	4 (25%)	12 (75%)	0.82
	Female (n=14)	4 (28.6%)	10 (71.4%)	
Type 2 diabetes	Absent (n=18)	5 (27.8%)	13 (72.2%)	0.86
	Present (n=12)	3 (25%)	9 (75%)	
Frequency of hemodialysis	2/week (n=6)	1 (16.7%)	5 (83.3%)	0.53
	3/week (n=24)	7 (29.2%)	17 (70.8%)	

[a] Fischer's exact test; IDH, intradialytic hypotension.

Table 7. Comparison of variables between patients who had and did not have IDH with small meal intake

Parameter		N	Mean±SD	*P* value[a]
Hemoglobin (g/dL)	Had IDH	9	10.36 ±2.25	0.77
	No IDH	21	10.56 ±1.41	
spKt/v	Had IDH	9	1.73 ±0.39	0.48
	No IDH	21	1.63 ±0.29	
Ultrafiltration (L)	Had IDH	9	2.45 ±0.90	0.83
	No IDH	21	2.39±0.70	
Albumin (g/dL)	Had IDH	9	3.74±0.29	0.78
	No IDH	21	3.69±0.49	
Dialysis duration (y)	Had IDH	9	2.44±1.88	0.73
	No IDH	21	2.84±3.20	

[a] *t* test; IDH, intradialytic hypotension; spKt/V, Single pool Kt/V.

Redistribution of intravascular volume in the postprandial period due to splanchnic vasodilation and pooling of blood in a splanchnic system which reduces the systemic volume during dialysis has been proposed as a possible mechanism of IDH due to food intake (19). We also tried to address whether a small number of meals like a snack is safe. In contrast to a previous report (6) our study did not show any change in the incidence of IDH with regard to the quantity of food intake. Patients developed significantly higher incidences of IDH irrespective of the quantity of food. Older age, female gender, low-hemoglobin, low-albumin, longer dialysis vintage, less frequent dialysis presence of diabetes, and excess ultrafiltration are risk factors for IDH (20). In our study, these parameters were

Table 8. Comparison of variables between patients who had and did not have intradialytic hypotension with small meal intake

Parameter		Had IDH (n=8)	No IDH (n= 22)	*P* value[a]
Age (y)	<60 (n=21)	7 (33.3%)	14 (66.7%)	0.54
	>60 (n=9)	2 (22.2%)	7 (77.8%)	
Gender	Male (n=16)	3 (18.8%)	13 (81.2%)	0.15
	Female (n=14)	6 (42.9%)	8 (57.1%)	
Type 2 diabetes	Absent (n=18)	6 (33.3%)	12 (66.7%)	0.62
	Present (n=12)	3 (25%)	9 (75%)	
Frequency of hemodialysis	2/week (n=6)	2 (33.3%)	4 (66.7%)	0.84
	3/week (n=24)	7 (29.2%)	17 (70.8%)	

[a] Fischer's exact test; IDH, intradialytic hypotension.

not different between those who developed IDH and those who did not. Therefore, it is likely that food intake itself was responsible for IDH.

The preferred approach for determining the dialysis dosage is Kt/V. The Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines state that patients receiving three weekly sessions of HD should aim for a single-pool Kt/V of 1.4, with a minimum delivered single-pool Kt/V of 1.2 (21). Receiving adequate dialysis greatly enhances a patient's appetite and nutritional condition (22). Hence factors that can reduce the delivered dialysis dose will have an adverse impact on the nutritional status of the patient. Interventional studies have previously found that dialysis adequacy significantly reduces with intradialytic meal intake (6,22). In contrast, we did not observe any decline of spKt/V or URR with food intake. The proposed mechanism of reduction in dialysis adequacy is that meal intake during dialysis increases urea generation through protein breakdown and an increase in splanchnic vasodilation causing pooling of blood that is not available in the systemic circulation (6,22). The meal consumed by patients in our study (Upma) was rich in carbohydrates but relatively low in protein. The episodes of IDH recovered promptly to corrective measures and none of the dialysis sessions were terminated prematurely. These factors could possibly explain why we did not observe any decline in dialysis adequacy.

Conclusion

Our study has clearly shown that taking food during HD regardless of quantity increases the risk of IDH. Food intake during HD should be discouraged as IDH is linked to serious negative effects.

Limitations of the study

This was a single center study on a limited number of patients. A multicenter study with more participants can yield better conclusion.

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Authors' contribution

Conceptualization: Shanki Goyal, Ashok Bhat, Sushanth Kumar.
Data curation: Shanki Goyal, Ashok Bhat.
Formal analysis: Shanki Goyal, Ashok Bhat.
Investigation: Shanki Goyal.
Methodology: Shanki Goyal, Ashok Bhat, Sushanth Kumar
Project administration: Shanki Goyal, Ashok Bhat, Sushanth Kumar.
Resources: Shanki Goyal, Ashok Bhat, Sushanth Kumar.
Supervision: Ashok Bhat, Sushanth Kumar.
Validation: Shanki Goyal, Ashok Bhat, Sushanth Kumar
Visualization: Shanki Goyal, Ashok Bhat.
Writing-original draft: Shanki Goyal, Ashok Bhat.
Writing-review and editing: Shanki Goyal, Ashok Bhat, Sushanth Kumar.

Conflicts of interest

The authors declare that they have no conflict of interest.

Ethical issues

The research followed the tenets of the Declaration of Helsinki. The study was extracted from the DNB thesis of Shanki Goyal at KMC Hospital Mangalore, Manipal Academy of higher education (Thesis #1701205195). The institutional Ethics committee at KMC Hospital Mangalore approved this study protocol (Ethical code #KMCH:DNB: NEPHROLOGY:012:2020). Accordingly, written informed consent was taken from all participants. Ethical issues (including plagiarism, data fabrication, and double publication) have been completely observed by the authors.

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