



Effect of Mealtime During Hemodialysis on Patients' Complications

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ABSTRACT

Introduction: Food intake during hemodialysis increases the risk of problems such as hypotension, nausea, and vomiting in patients undergoing hemodialysis. This study aimed to determine the effect of mealtime during dialysis on the patients' complications.

Methods: This is a quasi-experimental study consisted of all eligible hemodialysis patients in Hamadan teaching hospitals. All of 48 patients were selected through census method. The research was conducted in two sessions. At both sessions, patients were kept fasting prior to hemodialysis. In the first session, after one hour and in the second session after two hours of hemodialysis, a meal containing 350 kcal of energy was given to the patients. Blood pressure and intensity of nausea and vomiting was measured and recorded immediately before the start of hemodialysis, and then every half an hour before the termination of the hemodialysis.

Results: The results showed that in both sessions, food intake caused a drop in the systolic and diastolic blood pressure, but changes in the mealtime had no effect on the systolic and diastolic blood pressure. Also, statistical test showed that changes in the mealtime had no significant impact on the intensity of nausea and vomiting.

Conclusion: Food intake during hemodialysis had no effect on the nausea and vomiting, but caused a drop in the systolic and diastolic blood pressure, the drop continued for one hour and one and a half hour after the meal. It is suggested, mealtime in the early hours of hemodialysis could be better managed during the hemodialysis process.

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Introduction

Renal replacement therapies (RRT) including hemodialysis and kidney transplantation are necessary to save the life of patients with end-stage renal disease.¹ Due to the dramatic increase in the use of RRT in recent decades and its increasing trend, also due to the shortage of available kidneys for transplantation, hemodialysis is the most common method used in these patients.^{2,3} This method is used for acute patients and patients who need short-term dialysis like daily or weekly dialysis, as well as patients with chronic renal failure who require constant and

long-term treatments.^{4,5} However, dialysis cannot cure kidney failure and cannot compensate for its endocrine and metabolic functions, but is a life-saving procedure and play a vital role in increasing the longevity of the patients.⁴ These patients have to spend a lifetime in the dialysis centers. The time and the number of sessions depends on the amount of metabolic wastes, dialysis clearance capacity and amount of accumulated waste products in the body. Usually, it takes 12 hours per week, each session 3 to 4 hours.⁶

Although hemodialysis is a common procedure, it has some complications. They

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can be classified into two groups of acute (early) and chronic (long term) complications.⁷

Hypotension (Decrease more than 20 mmHg in systolic blood pressure) is the most common and serious complication during hemodialysis, which occurs in 20-30% of dialysis sessions.⁸ It has been reported in up to 60% of dialysis sessions in some previous studies.^{3,9} This complication is usually associated with symptoms of dizziness, headache, weakness, nausea, vomiting, muscle cramps, and fatigue.^{2,10}

Moreover, a high incidence of hypotension could lead to the hemodialysis insufficiency.¹¹ Many factors could contribute to hemodialysis hypotension during hemodialysis. The main factor in intradialytic hypotension is the reduction of circulating blood volume followed by huge ultrafiltration and sodium uptake, subsequently the imbalance between the ultrafiltration rate and the plasma refilling rate.⁹ Other factors include: rapid reduction in plasma osmolality, rapid liquid uptake to achieve dry weight, lack of appropriate measurement of dry weight in hemodialysis patients, eating before and during hemodialysis.^{9,12}

Another common complication during hemodialysis is gastrointestinal symptoms. The prevalence of these symptoms in hemodialysis patients is much higher than the general population.¹³ Meanwhile, nausea and vomiting as gastrointestinal symptoms occur in more than 10% of hemodialysis patients.^{3,14}

Nausea and vomiting may be the early signs of the dialysis disequilibrium syndrome, hyperkalemia, insufficient dialysis and presence of urea; but most of its periods are associated with hypotension.¹⁵ Due to the lengthy dialysis session and dietary restrictions associated with the disease, patients undergoing hemodialysis usually are interested to eat their meal during these sessions.¹⁶ However, as mentioned earlier, eating during hemodialysis is one of the causes of hypotension. Food intake leads to displacement and shift in peripheral blood circulation to visceral blood circulation, so that the blood flow rises as eight times during the

digestion of food in the villi and adjacent areas of intestinal mucosa. Particularly, digestion of fats and carbohydrates could lead to intestinal hyperemia. Food consumption, initially increases the heart rate and thus increases the cardiac output, but after increasing liver and visceral blood flow, reducing systemic vascular resistance and thereby reducing the overall venous return and blood accumulation in the viscera, both heart filling and cardiac output would reduce and finally could lead to hypotension.¹⁷ However, because of the nutritional limitations, nutritional status of hemodialysis patients is poor, which can reduce their quality of life. Mealtime during hemodialysis may have some benefits for the patients, including improving the patients' nutritional status.¹⁶

Providing food and dietary supplements during dialysis may improve the nutritional status and reduce the morbidity and mortality of patients undergoing dialysis. However, food intake during dialysis is different in various countries.¹⁸ In some countries such as the United States and Canada, patients have severe limitations for food intake during dialysis. The reasons of this limitation may include postprandial hypotension after meals, increasing the risk of aspiration, hemodynamic instability, reducing the efficiency of treatment and increasing gastrointestinal symptoms,^{16,19} as well as financial constraint. Countries such as Germany, Japan, and many other European and Asian countries, consider regular mealtime during hemodialysis sessions. They believe that careful selection of meal under strict medical supervision can be a cheap, practical, and patient-friendly strategy.¹⁹

Given the aforementioned facts and all other common problems experienced by hemodialysis patients, they should firstly receive a treatment with minimal side effects, and secondly receive an appropriate treatment regimen during hemodialysis. This study was carried out to (i) identify the most suitable mealtime and (ii) to reduce the sufferings of patient under hemodialysis and eventually, (iii) use it as a practical guide to prevent hemodialysis complications. Patients

undergoing hemodialysis usually are interested to eat their meal during in the hemodialysis because of dietary restrictions associated with the disease and tolerance of hemodynamic changes. But researchers have shown that food intake during hemodialysis is associated with complications such as nausea, vomiting, hypotension, etc ²⁰⁻²³ Therefore, the aim of this study was to determine the effect of mealtime during hemodialysis on complications experienced by patients undergoing hemodialysis.

Materials and methods

This study was one group quasi-experimental study using repeated measures analysis. The study was conducted on hemodialysis patients referring to Hamadan teaching hospitals (Besat and Shahid Beheshti) in 2012. After explaining the aim of the study to the patients, written consent was taken from all participants. They were also assured that the name of samples was not mentioned in to data collection tools and their information were kept confidential. Moreover, the permissions were obtained from Ethical Committee of Hamadan University of Medical Sciences and from presidents of the hospitals. The sampling was done by census method in a period of three months. Inclusion criteria were: having a history of at least 6 month of hemodialysis treatment; at least two dialysis sessions per week; no changes in the drug protocol during the research; not using different profiles for hemodialysis; using the same dialysis machine (Fresenius hemodialysis machines, Germany), dialysis solution (sodium bicarbonate), and time of the hemodialysis (4 hours); using the same dialysis filter, pump speed, dialysate flow rate, solution temperature, and amount of ultrafiltration; receiving same constant meals, eating all intended food, and the same positions for measuring blood pressure. From all 60 patients who were undergoing hemodialysis in the morning shift at both hospitals, twelve were excluded from the study because of a lack of inclusion criteria. Finally, a total of 48 patients were participated

in the study. After coordinating with nutrition expert and their doctor at both hospitals, a meal containing 350 kcal were considered for all patients and was given to subjects during the study.

Data were collected using a four-part check list: 1) Demographic data and information on the dialysis machine was completed using the patient's records, patient's answers, and measuring tools, 2) Hypotension check list, 3) nausea self-report tool (it was constructed by a researcher), and 4) vomiting observation check list were also used. Nausea self-report tool was composed of a 10 cm line, ranging from 0-10. Zero was assigned for no nausea and 10 showed severe nausea. Rating tool were as follows: zero was related to having no nausea, scores in the range of 1-3 showed mild nausea, and scores in the ranges 4-6 and 7-10 were related to moderate and severe nausea, respectively. Vomiting check list was a criterion from zero to three. Frequencies of vomiting were recorded based on the researcher observation.²⁴

In order to inform the patients to prepare for fasting and not changing the medications, the study session was fixed one week earlier and also the patients were informed. In case of having inclusion criteria on the study day, the patients were weighted and before connecting to the machine, blood pressure was checked and recorded. One hour after the start of the hemodialysis determined meal was given to the patients, and in another hemodialysis session it was given two hours after the start of hemodialysis. For a total of eight times during the dialysis, blood pressure and intensity of nausea and vomiting was measured and recorded immediately before the start of the hemodialysis and every half an hour to half an hour before separation from the machine. Data were analyzed by SPSS ver. 13 software using descriptive statistics mean (standard deviation) and inferential statistics (RM ANOVA, Tukey and chi-square).

Results

The demographic results showed that 54.2% of

the subjects were female, 33.3% were over 60 years, 41.7% were illiterate and most of them (83.3%) were married. 56.3% of the patients had a history of less than 4 years of hemodialysis and 85.4% of them underwent hemodialysis three times a week. The dry weight of most of the patients (31.3%) was in the ranges of 60-70 kg.

Systolic and diastolic blood pressures of the patients were taken during 3 time periods before food intake, in the first session, (Immediately prior to initiation of dialysis, 0.5 and 1 hour after initiation of dialysis) it was considered as time 1. Five time period after food intake in the first session, (1.5, 2, 2.5, 3 and 3.5 hour after initiation of dialysis) it was considered as time 2. Five time periods before food intake in the second session, (Immediately prior to initiation of dialysis, 0.5, 1, 1.5 and 2 hour after initiation of dialysis) it was considered as time 3. Finally, third period of time in the second session after food intake (2.5, 3 and 3.5 hour after initiation of dialysis) was considered as time 4. Mean, standard deviation and RM ANOVA of systolic and diastolic blood pressure in the first and second session were present in Table 1, 2.

Based on the results of the study, there was a significant difference between the mean systolic and diastolic blood pressure before and after food intake in the first session (one hour after the start of hemodialysis) ($P < 0.01$).

Also there was a significant difference between the mean systolic and diastolic blood pressure before and after the food intake in the second session (one hour after the start of hemodialysis) ($P < 0.05$). The results showed that food consumption in both times of food

intake during hemodialysis caused hypotension in the systolic and diastolic blood pressure. There was no statistically significant difference between them (systolic and diastolic blood pressure) in the two sessions ($P > 0.05$). In other words, the time of food intake had no effect on the blood pressure in the studied patients (Tables 3 and 4).

The results showed that systolic and diastolic blood pressure had a downward trend from 1.5 hour after food intake and then begun to increase (Figure 1).

According to the figure 1, in the first hour receiving hemodialysis can be seen mean systolic blood pressure to an hour and a half after food intake downward trend and then has again started to rise. In the second session, two hours after food intake it was observed that the mean systolic blood pressure were downtrend every half hour.

In the second session, the mean systolic and diastolic blood pressure had a decreasing trend two hours after food intake (Figure 2). According to this diagram, the mean diastolic blood pressure shows downward trend in the first hour to an hour and a half after food intake and then has again started to rise. In the second session, it also was observed that two hours after food intake the mean systolic blood pressure showed downtrend every half hour.

The majority of patients in the first and second sessions before and after the meal had no nausea and only a limited number of them had moderate nausea during the study sessions. Chi-square test showed no significant difference between the observations (Tables 5 and 6).

Table 1. Mean, standard deviation and RM ANOVA of systolic and diastolic blood pressure in the first session (N=48)

Variable	Time 1 (Hour)*			Time 2 (Hour)†				RM ANOVA		
	Immediately prior to initiation of dialysis	0.5 [‡]	1 [‡]	1.5 [‡]	2 [‡]	2.5 [‡]	3 [‡]	3.5 [‡]	F	P
Systolic	138.2 (24)	134.17 (20.35)	133.02 (22.75)	131.25 (21.75)	127.92 (20.94)	125.83 (22.03)	126.88 (21.45)	128.02 (21.53)	12.619	<0.001
Diastolic	81.88 (15.69)	79.06 (14.12)	77.40 (13.68)	76.46 (12.50)	74.669 (13.73)	74.69 (14.19)	75.21 (14.69)	75.21 (13)	12.619	<0.001

*Before food intake in the first session, † After food intake in the first session, ‡After initiation of dialysis

Table 2. Mean, standard deviation and RM ANOVA of systolic and diastolic blood pressure in the second session (N=48)

Variable	Immediately prior to initiation of dialysis	Time 3(Hour)*					Time 4(Hour)‡			RM ANOVA	
		Mean (SD)									F
Descriptive Statistics		0.5†	1†	1.5 †	2†	2.5†	3†	3.5†			
Systolic	139.27 (20.88)	134.58 (19.87)	130.10 (20.35)	1290.6 (19.53)	130 (20.73)	129.38 (22.72)	128.13 (21.89)	126.56 (23.18)	7.405	<0.001	
Diastolic	81.88 (13.74)	77.71 (13.36)	75.94 (13.19)	75.10 (13.02)	74.48 (12.64)	74.90 (13.87)	74.17 (12.73)	72.60 (11.10)	10.439	<0.001	

*Before food intake in the first session, ‡ After food intake in the first session, †After initiation of dialysis

Table 3. Pairwise comparison of mean systolic blood pressure in two times based on Tukey analysis

Times Comparing	Mean difference	Standard error	P
Time 1 with Time 2*	7.09	0.953	<0.001
Time 3 with Time 4‡	4.55	0.953	<0.001
Time 2 with Time 4†	-0.08	0.953	1

*before and after food intake in the first session, ‡before and after food intake in the second session, †after food intake in the first session and after food intake in the second session

Table 4. Pairwise comparison of mean diastolic blood pressure in two times based on Tukey analysis (N=48)

Times Comparing	Mean difference	Standard error	P
Time 1 with Time 2*	4.40	0.778	0.001
Time 3 with Time 4‡	2.99	0.778	0.001
Time 2 with Time 4†	1.22	0.778	0.396

*Before and after food intake in the first session, ‡Before and after food intake in the second session, †After food intake in the first session and after food intake in the second session

Table 5. Comparing of patients' nausea in first session based on chi-square test

Variable	Time 1 (Hour)*					Time 2 (Hour)‡		
	Immediately prior to initiation of dialysis	0.5†	1†	1.5 †	2†	2.5†	3†	3.5†
Nausea								
No	95.8	91.7	93.8	93.8	95.8	100	97.9	95.8
Mild nausea	2.1	8.3	6.2	6.2	4.2	0	0	2.1
Moderate nausea	2.1	0	0	0	0	0	2.1	2.1
Severe nausea	0	0	0	0	0	0	0	0
Chi-square test***	3.8					3.4		
P	0.4					0.5		

*Before food intake in the first session, ‡After food intake, †After initiation of dialysis *** Chi-square test used between have and have not nausea

Table 6. Comparing of patients' nausea in second session based on chi-square test

Variable	Time 3 (Hour)*					Time 4 (Hour)‡		
	Immediately prior to initiation of dialysis	0.5†	1†	1.5 †	2†	2.5†	3†	3.5†
Nausea								
No	97.9	95.8	87.5	87.5	91.7	100	100	95.8
Mild nausea	2.1	2.1	10.4	6.2	8.3	0	0	0
Moderate nausea	0	2.1	0	4.2	0	0	0	4.2
Severe nausea	0	0	2.1	2.1	0	0	0	0
Chi-square test***	5.7					4.1		
P	0.22					0.13		

*Before food intake in the first session, ‡After food intake, †After initiation of dialysis *** Chi-square test used between have and have not nausea

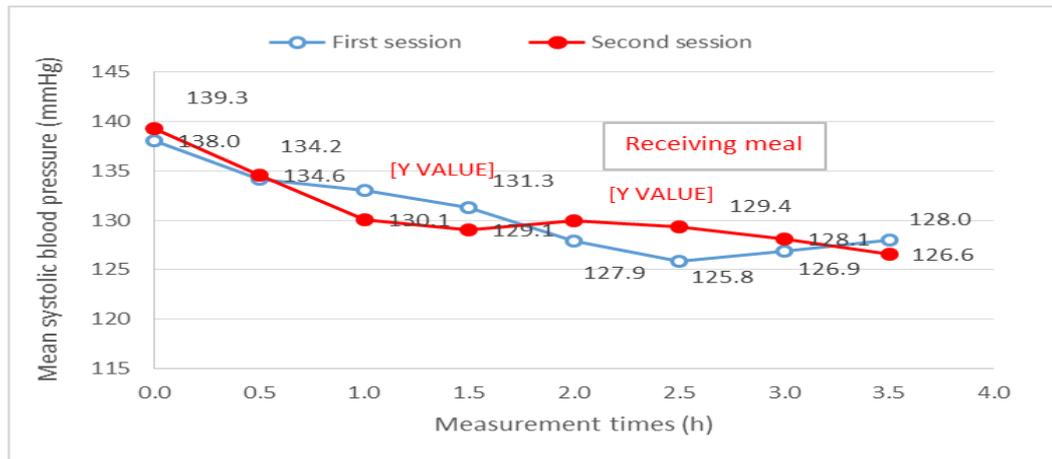


Figure 1. Comparison of the mean systolic blood pressure trend between first and second session

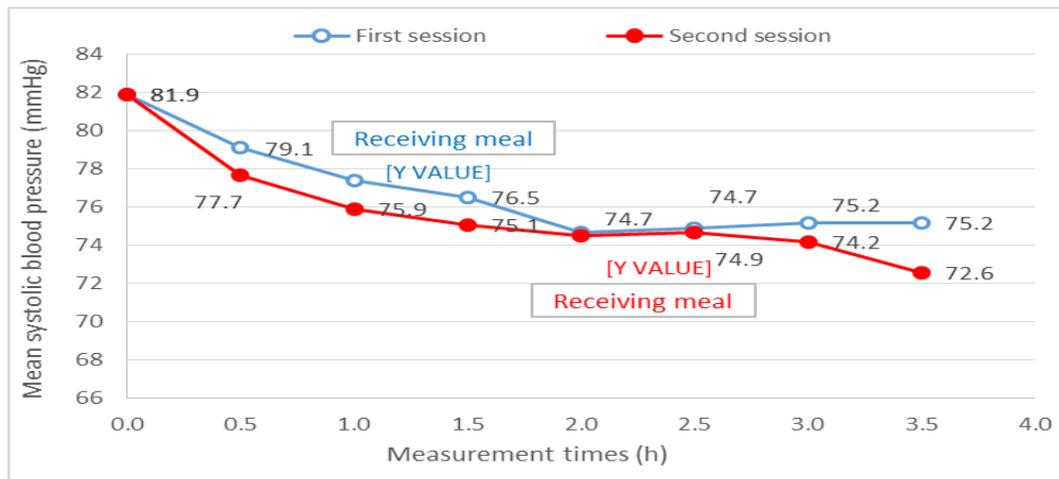


Figure 2. Comparison of the mean diastolic blood pressure trend between first and second session

On the other hand, because vomiting have not been observed in the patients in the two sessions before and after food intake, there was no possibility for conducting statistical analysis.

Discussion

The results showed that food intake during dialysis led to hypotension. Several studies have examined the relationship between food intake and drinking with hypotension during hemodialysis. The results of this study are consistent with the results of Zoccali *et al.*²² In order to evaluate the blood pressure changes after food intake and during hemodialysis, they studied the impact of an identical meal (400 kcal) on 13 patients with uremia undergoing hemodialysis. Mean blood

pressure was significantly reduced two hours after the meal in the group compared to the control group.²² In another study Sherman *et al.*,²³ investigated the effect of food intake on blood pressure during hemodialysis on 9 non-diabetic patients with end-stage renal disease. The results showed that after about an hour of eating both systolic blood pressure and diastolic blood pressure have significantly dropped than those who were kept fasting during hemodialysis at the same time.

Eventually, they recommended that patients who are more prone to hypotension, should avoid eating during hemodialysis. Also, Strong *et al.*,²⁵ confirmed the fact that, food intake during hemodialysis caused hypotension significantly. In contrast, as a results of a large study, Benaroya *et al.*,²⁶ studied on 126

hemodialysis patients. They found no relationship between food intake and blood pressure. This difference was probably due to a discrepancy in the study methods. Benaroya et al.,²⁶ did not studied on stable patients, and it seemed that food intake is better tolerated in stable patients. In this regard, Kistler et al.,¹⁶ have found that people who consumed food during hemodialysis suffered from hypotension. However, the results of Sivalingam et al.,²⁷ study, showed a significant decrease in blood pressure 30 minutes after food intake which was consistent with the present study. Also Kara & Acikel¹ investigated the effect of standard meal in 25 hemodialysis patients and found that hypotension created no problem. Muller et al.,²⁸ study can be noted as another conflicting study. This study was conducted on 40 patients to evaluate the impact of food intake on hemodynamic status and treatment effectiveness. The results did not show any reduction in the systolic and diastolic blood pressure and also mean arterial blood pressure after the food intake. Therefore, the researchers suggested that food intake during hemodialysis, especially in stable patients can be tolerated better. Further researches are recommended to determine the differences of patients who have experienced hypotension.

Regarding the impact of food consumption on nausea and vomiting during hemodialysis, the findings of the present study showed no significant association. Several studies have reported nausea and vomiting in 10% of hemodialysis sessions.^{3,13,14,16} As well as studies that examined the effects of food supplements on gastrointestinal symptoms during hemodialysis reported similar or even less nausea and vomiting incidences.^{16,29,30}

However, very few studies have directly examined the effects of food intake on the incidence and severity of gastrointestinal symptoms during hemodialysis.¹⁶ Kistler et al.,¹⁸ showed that the majority of physicians (71%) from different countries had reported gastrointestinal complications in patients during hemodialysis rarely or they failed to report it at all. Whereas, Parke³¹ stated that

food intake during hemodialysis leads to higher incidence of nausea and vomiting. These findings are inconsistent with findings of the present study. The difference could be due to using sodium bicarbonate as dialysis solution and having more than 6 months of hemodialysis history. The use of sodium acetate solution in comparison with a solution containing sodium bicarbonate leads to cardiovascular instability and in some patients causes nausea and vomiting. The findings of Raziq & Veyceh³² also confirmed that the incidence of nausea and vomiting were higher in sodium acetate solution compared to sodium bicarbonate solution. Also, apart from hypotension, another reason for nausea and vomiting was "dialysis disequilibrium syndrome" usually seen at the first hemodialysis session. However, this factor has been controlled in this study since a history of more than six months of hemodialysis was considered as the inclusion criteria.

Conclusion

The results of statistical analysis showed that there was no statistically significant difference between the mean systolic and diastolic blood pressure in the first session after food intake compared with the second session. This means that mealtime has no effect on hypotension in the studied patients. On the other hand, the results showed that the mean systolic and diastolic blood pressure in the first session had a downward trend up to one and a half hours after the food intake; but, then it started to increase. Also mean systolic and diastolic blood pressure in the second session showed a decreasing trend after food intake until the end of the session, and an hour and a half later.

Eventually, it could be concluded that without considering mealtime, food consumption during hemodialysis could cause hypotension which may last for an hour and a half. Also, our findings showed that food intake had no effect on the incidence of nausea and vomiting.

As several other studies emphasized,^{30,31} due to the duration of hemodialysis in each

session, it is not moral to deprive the patients from food intake during hemodialysis.

Therefore, it is recommended that the patient's food intake program should be scheduled in the first hour after starting hemodialysis, so in case of hypotension which continues up to an hour and a half later, nursing care such as fluid replacement and blood pressure modification before the end of hemodialysis is possible. But in the case of food intake in the second hour of hemodialysis, there are no more possibilities to modify blood pressure before the end of the hemodialysis; therefore hypotension may continue even after the end of the hemodialysis. Some factors that impact nausea and vomiting such as electrolyte abnormalities were not evaluated in this study which could be considered as our research limitation. Attention to the mealtime during hemodialysis for decrease complication is an important finding in this research.

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Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

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