

Kidney Function and Metabolic Profile of Chronic Kidney Disease and Hemodialysis Patients During Ramadan Fasting

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Introduction. This study aimed to investigate effects of fasting during the Ramadan month among chronic kidney disease (CKD) and hemodialysis patients.

Materials and Methods. A prospective study was carried out on patients seen between August and November 2010 at two hospitals of King Saud University. Volunteers from among patients with CKD and hemodialysis patients were evaluated for kidney function and complications before, during, and after 14-hour daily Ramadan fasting for 30 days. A modified schedule for medication and dialysis regimen was provided to the participants.

Results. Thirty-nine CKD patients (41.0% in stage 3 and 43.6% in stage 4) were included. There were no differences in the laboratory and clinical variables before, during, and after the fasting month. Thirty-two hemodialysis patients with a mean duration of dialysis of 4.4 ± 3.7 years were also included in the study. There was a significant increase in erythrocyte count, serum creatinine, blood urea, serum phosphorus, serum albumin, and serum uric acid levels during the fasting period. Hyperkalemia developed in 25.0% and 15.6% of the hemodialysis patients during and after the fasting period and hyponatremia in 15.6% and 28.0%, respectively. Forty-six percent of the patients developed hypertension and 36.7% fluid overload. No adverse events requiring hospital admission were observed.

Conclusions. Fourteen-hour fasting for one month was tolerated by CKD and hemodialysis patients, although there were considerable changes among hemodialysis patients in some of the blood chemistry variables. No serious adverse events occurred.

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INTRODUCTION

Ramadan is the 9th lunar month of the Islamic calendar during which fasting is required for all adult Muslims. The Arabic (Hegira) calendar changes according to the lunar cycle. Because of this, fasting does not always fall on the same particular month every year, but changes from season to season each year. Fasting during Ramadan

entails abstaining from eating, drinking, and sexual relations from dawn till sunset.¹ However, there are exemptions to these fundamental obligations particularly for menstruating women, pregnant women, travelers, and sick people.^{1,2} Research showed that fasting during Ramadan is safe among healthy subjects.³⁻⁷ Beneficial effects of fasting are being increasingly recognized in the

sphere of blood pressure, blood lipids, oxidative stress, insulin sensitivity, chronic heart failure, and coronary heart disease.^{7,8} Fasting was also found to be safe among diabetic patients, kidney transplant recipients, and patients with urinary calculi.⁹⁻¹³

Recently, we have published the recommendation guideline for fasting among peritoneal dialysis patients.¹⁴ Patients with chronic kidney disease (CKD) and patients who are on hemodialysis are advised not to fast during Ramadan because these types of patients carry a higher risk for dehydration during long fasting hours, and on the other hand, are at risk for fluid overload due to increased fluid intake when breaking fast after sunset. There are limited studies to assess the effect of fasting Ramadan in CKD and hemodialysis patient^{15, 16}; thus, this study was conducted to further investigate the effect of fasting on the kidney status of these patients in hot long summer days of Ramadan.

MATERIALS AND METHODS

We invited volunteer CKD and hemodialysis patients from 2 hospitals in Riyadh, Saudi Arabia (Dallah Hospital and King Khalid University Hospital) to participate in the study, between August and September 2010. We included all CKD patients (stage 3 and higher) as defined by the National Kidney Foundation criteria by using Modification of Diet in Renal Disease formula to calculate glomerular filtration rate (GFR).¹⁷ We also excluded all patients who were unstable for the last 3 months or who had recurrent pulmonary edema, mental disability, recurrent hypoglycemia, poorly controlled diabetes mellitus, and acute on top of acute kidney failure in the last 3 months. In addition, patients with end-stage renal disease who were on 3-time per week dialysis for at least 6 months or more were also included in the study. We excluded patients with mental disability, inability to fast, being on dialysis sessions during the fasting time, and those who were unable or unwilling to change dialysis schedule, or consent for participation. We monitored these volunteers for 2 months prior to the actual study to ensure that they were in a stable general medical condition. We took informed written consent from all patients who satisfied the inclusion criteria who agreed to participate in the study.

During the study period, Ramadan was during the summer and Muslims had to fast from about 4 AM to 6:30 PM and the duration of fasting was

around 14 hours every day. The temperature was around 40°C to 43°C in the daytime and humidity was 10% to 13%.

All enrolled patients were interviewed and cases were reviewed by a consultant nephrologist and a dietician. Patients were advised to avoid a diet particularly high in potassium, and CKD patients were advised to consume 1.5 L to 2 L of fluid at night, to check body weight daily and to report episodes of weakness, feeling unwell, shortness of breath, progressive increase in body weight, and severe persistent headache to the hospital, if any. All antihypertensive medications and diuretics were recommended for patients after breaking their fasting as well as for hemodialysis patients after their hemodialysis, on the day of their hemodialysis or after breaking their fasting, using single daily dose tablets. Patients with a tendency of developing hyperkalemia were also asked to shift from angiotensin-converting enzyme inhibitors or angiotensin receptor blockers to other antihypertensive medication, and were advised to receive calcium or sodium polystyrene sulphonate. Diabetic patients were advised to monitor their blood glucose level 4 times daily consequently before fasting (considered as *Sohor* time by Muslim people), at the middle of the day, before breaking their fasting, and at midnight. Insulin or oral hypoglycemic medication dosage was reduced to two-thirds or half of the regular daily dose. And two-thirds of morning dose was given before breakfast at Magrib time (as regarded by Muslim people) and half of the night dose was given before dinner (or *Sohor* time).

Patients with CKD were advised to report to the clinic between day 7 and day 10, between day 21 and day 24, and 3 to 4 weeks after the end of the fasting month for medical examinations and biochemical checkups, including a 24-hour urine collection and creatinine clearance. Changes in serum creatinine were considered significant if serum creatinine changed by 25% or creatinine clearance or estimated GFR by 2 mL/min.

Hemodialysis patients were usually on dialysis before fasting for 4 hours, 3 times a week, over 3 shifts. For fasting patients during Ramadan, dialysis period was set to after sunset, from 7:00 PM to 10:30 PM and from 11:00 PM to 3:00 AM. Duration of the dialysis sessions was reduced to 3 to 3.5 hours to accommodate all hemodialysis

patients. This allowed hemodialysis patients to spend time with their activities including eating with family members, social gatherings, and praying. Evening sessions were coordinated with creation of teams including a nephrologist who was on call during the time of dialysis sessions (7 PM till 3 AM), to modify the medication schedule especially antihypertensive medications, the nurses shifts, a pharmacist to prepare the patients' medications, a nutritionist, housekeeping staff, and security personnel.

Patients were evaluated clinically for overall health status and clinical complications including demographic and clinical data, cause of kidney disease, comorbid conditions, hemodialysis data, schedule of dialysis, KT/V, weight gain, presence of edema, signs and symptoms of uremia, presence of hypertension (systolic blood pressure > 140 mm Hg predialysis and diastolic pressure > 90 mm Hg), presence of hypotension (systolic blood pressure < 100 mm Hg predialysis), and fluid overload (> 4% weight gain from the previous hemodialysis session). The frequency of complications was calculated by the percentage of the total number of each complication divided by the total number of hemodialysis sessions. The frequency of abnormal laboratory result was calculated as the percentage of each abnormal laboratory result divided by the total laboratory results for all patients during the entire study.

In hemodialysis patients, laboratory investigations were done 1 week before fasting, during fasting (7th and 15th day) and on the last day of fasting including complete blood count, all electrolytes, serum creatinine, urea, and bone profile. Patients who were on antihypertensive medications were considered hypertensive (controlled or uncontrolled). The study was approved and supported by the Deanship of Scientific Research, College of Medicine, King Saud University, Riyadh, Saudi Arabia.

All data were analyzed using Predictive Analytical Software version 19.0 (PASW, Statistical Package for the Social Sciences, version 12.0, SPSS Inc, Chicago, Ill, USA). Continuous variables were expressed as mean \pm standard deviation. Categorical variables were expressed as percentages. To compare variables obtained before and after fasting, the Student *t* test was used. *P* values less than .05 were considered significant.

RESULTS

Chronic Kidney Disease

Thirty-nine CKD patients were studied, with a mean age of 52.1 ± 18.3 years. Twenty-three percent were males. Patients with CKD stages 3 and 4 constituted 41% and 43.6% of the study population. Hypertension was the most common comorbid condition in these patients. (Table 1). The patients' weight and blood pressure did not differ significantly across the three measurements done before, during, and after Ramadan (Table 2).

Table 1. Baseline Characteristics of Participants With Chronic Kidney Disease (CKD) and Hemodialysis Patients

Characteristic	Value	
	CKD Patients	Hemodialysis Patients
Number of patients	39	32
Mean age, y	52.1 ± 18.3	47.7 ± 17.1
Sex, %		
Male	23.1	53.1
Female	76.9	46.9
CKD stages, %		
Stage 2	2.6	0
Stage 3	41	0
Stage 4	43.6	0
Stage 5	12.8	100
Cause of kidney disease, %		
Hypertension	18.8	16.0
Polycystic kidney disease	7.7	9.4
Diabetes mellitus	35.0	34.0
Lupus nephritis	5.1	18.8
Others or unknown	33.3	21.8
Other comorbidities, %		
Hypertension	94.9	75.0
Dyslipidemia	56.4	34.4
Diabetes mellitus	35.9	40.0
Ischemic heart disease	30.8	15.6
Hepatitis	2.6	25.6
Medications, %		
Vitamin B-complex	10.0	84.4
Calcium carbonate	54.0	84.4
Sevelamer	3.0	65.6
Erythropoiesis stimulating agents	3.0	62.5
Proton pump inhibitor	15.0	59.4
Calcium channel blocker	46.0	37.5
Statin	56.0	31.3
Acetylsalicylic acid	35.8	28.1
Loop diuretic	36.0	25.0
Insulin	10.0	9.4
Beta-blocker	28.0	9.4
Angiotensin-converting enzyme inhibitor	13.0	6.7
Prednisolone	15.0	6.3

Table 2. Mean Laboratory Data Values Before, During, and After Ramadan Fasting Among Participants With Chronic Kidney Disease

Parameter	Before Ramadan Fasting	During Ramadan Fasting	After Ramadan Fasting	P
Weight, kg	76.6 ± 19.7	75.9 ± 19.2	76.5 ± 19.2	.70
Height, cm	163.4 ± 7.8	163.4 ± 7.8	163.4 ± 7.8	> .99
Body Mass Index, kg/m ²	28.2 ± 5.8	27.8 ± 5.5	28 ± 5.4	.90
Systolic Blood Pressure, mm Hg	133.7 ± 18.4	131.6 ± 15.2	133.9 ± 21.4	.78
Diastolic Blood Pressure, mm Hg	76.9 ± 14.0	74.4 ± 13.4	76.2 ± 14.3	.56
Hemoglobin, mg/dL	12.0 ± 1.9	12.1 ± 1.8	12.1 ± 1.8	.86
Hematocrit, %	35.1 ± 5.8	35.7 ± 5.4	35.1 ± 5.3	.60
Creatinine clearance, mL/min	40.8 ± 25.4	37.2 ± 24.7	44 ± 29.3	.60
Serum creatinine, μmol/L	300.4 ± 143.5	286.6 ± 115.5	280.8 ± 131.1	.20
Serum albumin, g/L	36.5 ± 5.6	37.1 ± 4.9	37.8 ± 5.8	.10
Urea, mmol/L	18.9 ± 10.0	15.6 ± 5.9	16.9 ± 7.7	.08
Serum sodium, mmol/L	138.4 ± 3.0	138.2 ± 4.1	137.5 ± 3.3	.20
Serum potassium, mmol/L	4.8 ± 0.6	4.8 ± 0.5	4.7 ± 0.5	.30
Serum calcium, mmol/L	2.1 ± 0.2	2.2 ± 0.2	2.2 ± 0.2	.10
Serum phosphate, mmol/L	1.4 ± 0.5	1.3 ± 0.3	1.5 ± 1.2	.40
Serum uric acid, mmol/L	445.8 ± 95.3	434.9 ± 95.4	415.8 ± 104.6	.60
Urine protein, g/L	1.0 ± 1.3	1.0 ± 1.0	1.0 ± 1.1	.30
24-hour urine volume, L/d	2.1 ± 0.6	2.1 ± 0.6	2.1 ± 0.6	.40
24-hour protein in urine, g/24 h	2.9 ± 2.9	3.8 ± 3.2	3.6 ± 3.5	.40

The mean readings for serum creatinine, serum albumin, blood urea nitrogen, hemoglobin, and 24-hour urine parameters, as well as the other laboratory tests did not significantly differ across the three measurements in CKD patients (Table 2). Also there were no significant changes in the progression of the CKD stage and estimated GFR in the CKD patients (Tables 2, 3, and 4).

Hemodialysis Group

Thirty-two hemodialysis patients were included in the study. They were on maintenance hemodialysis for a mean of 4.4 ± 3.7 years. Their mean age was 47.7 ± 17.1 years, and 53.1% were males. Twenty-eight percent of our patients were diabetic, 18.8% had glomerulonephritis, and 75.0% had hypertension (Table 1). The mean duration of sessions during Ramadan was significantly different from those before and after Ramadan ($P = .005$). However, KT/V values did not differ significantly before,

during, and at the end of Ramadan measurements (1.2 ± 0.21, 1.16 ± 0.16, and 1.23 ± 0.19, respectively; $P = .22$). None of the other clinical hemodialysis variables differed significantly among the three measurements (Tables 5 and 6).

Significant changes before, during, and after Ramadan fasting were observed in the mean values of serum creatinine (928.7 ± 237.0 μmol/L, 1022.3 ± 263.1 μmol/L, and 931.6 ± 222.2 μmol/L, respectively; $P < .001$); blood urea (23.6 ± 5.1 mmol/L, 26.4 ± 5.9 mmol/L, and 25.5 ± 7.2 mmol/L, respectively; $P = .02$); serum albumin (33.2 ± 3.3 g/L, 34 ± 2.9 g/L, and 32.5 ± 2.7 g/L, respectively; $P = .01$); uric acid (428.6 ± 82.7 μmol/L, 475.9 ± 78.6 μmol/L, and 448.4 ± 92.9 μmol/L, respectively; $P = .01$); and erythrocyte count ($P = .005$; Table 6).

Complications During Fasting Ramadan

Six patients from the CKD group (15.4%) had lower-limb edema during fasting, 5 (12.8%) before

Table 3. Mean Creatinine Clearance Before, During, and After Ramadan Fasting Among Participants With Chronic Kidney Disease by the Disease Stage

Chronic Kidney Disease	Mean Creatinine Clearance, mL/min		
	Before Ramadan Fasting	During Ramadan Fasting	After Ramadan Fasting
Stage 3	40.9 ± 11.2 (n = 10)	38.5 ± 7.8 (n = 12)	40.1 ± 8.6 (n = 11)
Stage 4	20.9 ± 3.6 (n = 19)	21.1 ± 3.9 (n = 17)	22.7 ± 4.1 (n = 18)
Stage 5	11.7 ± 3.3 (n = 10)	11.9 ± 2.3 (n = 10)	12.1 ± 3.1 (n = 10)

Table 4. Effects of Ramadan Fasting on Kidney Function by Stage of Chronic Kidney Disease

Chronic Kidney Disease	Serum Creatinine, $\mu\text{mol/L}$				Glomerular Filtration Rate, mL/min				Change During Fasting				Change After Fasting							
	Before Ramadan Fasting		During Ramadan Fasting		Before Ramadan Fasting		During Ramadan Fasting		Improved		Stable		Deteriorated		Improved		Stable		Deteriorated	
	138	168.2 \pm 35.6	150	176.1 \pm 27.8	63	38.4 \pm 8.6	57	36.1 \pm 8.2	—	8 (88.9)	—	8 (88.9)	1 (11.1)	1 (11.1)	—	1 (11.1)	6 (66.7)	2 (22.2)	—	—
Stage 2 (n = 1)	138	168.2 \pm 35.6	150	176.1 \pm 27.8	63	38.4 \pm 8.6	57	36.1 \pm 8.2	—	8 (88.9)	—	8 (88.9)	1 (11.1)	1 (11.1)	—	1 (11.1)	6 (66.7)	2 (22.2)	—	—
Stage 3 (n = 9)	168.2 \pm 35.6	176.1 \pm 27.8	150	176.1 \pm 27.8	178.7 \pm 28.6	38.4 \pm 8.6	57	36.1 \pm 8.2	—	8 (88.9)	—	8 (88.9)	1 (11.1)	1 (11.1)	—	1 (11.1)	6 (66.7)	2 (22.2)	—	—
Stage 4 (n = 19)	281.9 \pm 60.8	279.1 \pm 73.4	279.1 \pm 73.4	279.1 \pm 73.4	266.2 \pm 67	20.9 \pm 3.6	21.9 \pm 6.4	23.1 \pm 6.9	5 (26.3)	11 (57.9)	3 (15.8)	5 (26.3)	11 (57.9)	3 (15.8)	—	3 (15.8)	13 (68.4)	3 (15.8)	—	—
Stage 5 (n = 10)	471.9 \pm 156.7	412.8 \pm 113	412.8 \pm 113	412.8 \pm 113	413.7 \pm 174	11.7 \pm 3.3	14.1 \pm 5.9	15.4 \pm 9.8	3 (30)	7 (70)	—	3 (30)	7 (70)	—	3 (30)	6 (60)	1 (10)	—	—	—

fasting and 3 (7.8%) after fasting. None of the patients from the CKD group had any signs and symptoms of uremia during or after fasting (Table 7). Of the hemodialysis group, 8 patients (25%) had hyperkalemia on day 15 of fasting and 5 patients (15.6%) at the end of the month. Hyponatremia was documented in 5 hemodialysis patients (15.6%) on the 15th day of fasting and 9 hemodialysis patients (28.1%) had hyponatremia on the 30th day of fasting. When we counted the number of frequencies of incidents of complications, out of a total of 416 measurements predialysis, there were 199 (47.8%) documented episodes of blood pressure elevations, followed by fluid overload (> 4% interdialytic weight) which occurred in 36.7% of the total episodes. Out of all laboratory measurements, hyponatremia and hyperkalemia constituted 21.9% and 20.3% of the total untoward episodes during the study period, respectively (Table 8).

DISCUSSION

Although Muslims constitute 1.6 billion of the world's population, data available on the exact prevalence of various kidney diseases in the Muslim countries is very limited. The prevalence of CKD in Saudi Arabia is 5.7% and the prevalence of end-stage renal disease is 498 pmp.^{18,19} In Indonesia, CKD was found in 8.6%, and in Iran, 18.9%.^{20,21} In the light of these numbers, studying the effect of fasting Ramadan was important. To our knowledge, this is the most comprehensive study that provides in-depth exploration on the effect of fasting Ramadan on the hemodialysis patients and further validation of previous finding in CKD patients.

The study was conducted also on dialysis patients. Although a larger number of patients was favorable, there were limitations to only patients who agreed to fast. In fact, fasting is difficult for debilitated and compromised patients. Not only that, fasting hours lasted for 14 hours, and drinking water was not allowed. Therefore, it was necessary to thoroughly evaluate the impact of fasting on the health and kidney function in chronic kidney disease and hemodialysis patients. In contrast to our study, previous studies were done on small number of patients, and the studies investigated only a few aspects of these diseases.^{15,16} The present study is an elaborated comprehensive study where

Table 5. Mean Values of Hemodialysis Data Before, During, and After Fasting Ramadan*

Parameter	Before Ramadan Fasting	During Ramadan Fasting	After Ramadan Fasting	P
Duration of hemodialysis session, min	226.9 ± 13.9	220.2 ± 14.8	224.1 ± 15.1	.005
KT/V	1.2 ± 0.21	1.16 ± 0.16	1.23 ± 0.19	.22
Predialysis weight, kg	69.2 ± 19.1	69 ± 18.7	69.1 ± 18.5	.74
Postdialysis weight, kg	65.6 ± 18.1	65.7 ± 18.3	65.9 ± 17.9	.17
Interdialytic weight gain, kg	3.3 ± 1.7	2.9 ± 1.4	2.8 ± 1.5	.20
Predialysis systolic blood pressure, mm Hg	138.4 ± 16.3	142.8 ± 16.6	141 ± 21.4	.36
Predialysis diastolic blood pressure, mm Hg	77.7 ± 11.6	76.2 ± 10.7	75.3 ± 13.8	.32
Postdialysis systolic blood pressure, mm Hg	125.7 ± 19.6	129.3 ± 15.5	128.6 ± 19.9	.17
Postdialysis diastolic blood pressure, mm Hg	73.1 ± 11.7	72.1 ± 10.2	72.6 ± 13.5	.82

*Values are composite variable of the last 2 sessions before fasting, composite variable of 13 dialysis sessions during fasting, and composite variable of 2 sessions right after fasting.

Table 6. Mean Predialysis Laboratory Data Before, During, and After Ramadan Fasting in the Hemodialysis Patients

Parameter	1 Week Before Ramadan Fasting	During Ramadan Fasting*	After Ramadan Fasting	P
Erythrocyte count, × 10 ⁹ /L	6.4 ± 1.5	7 ± 1.5	7.2 ± 1.8	.005
Hemoglobin, mg/dL	11.8 ± 1.2	11.7 ± 1.5	11.3 ± 1.2	.10
Hematocrit, %	34.5 ± 3.7	35.6 ± 4.5	34.2 ± 4.5	.21
Platelet count, × 10 ³ /μL	209 ± 54.9	213.2 ± 54.1	206 ± 60.2	.76
Serum sodium, mmol/L	134.6 ± 3.7	133.2 ± 2.6	134.2 ± 4	.06
Serum potassium, mmol/L	5.1 ± 0.7	5.0 ± 0.5	5.3 ± 1.0	.07
Serum calcium, mmol/L	2.0 ± 0.1	2.0 ± 0.4	2.0 ± 0.2	.65
Serum phosphate, mmol/L	1.3 ± 0.5	1.5 ± 0.5	1.1 ± 0.4	.001
Blood urea, mmol/L	23.6 ± 5.1	26.4 ± 5.9	25.5 ± 7.2	.02
Serum creatinine, μmol/L	928.7 ± 237.0	1022.3 ± 263.1	931.6 ± 222.2	< .001
Serum albumin, g/L	33.2 ± 3.3	34.0 ± 2.9	32.5 ± 2.7	.01
Serum uric acid, μmol/L	428.6 ± 82.7	475.9 ± 78.6	448.4 ± 92.9	.01

*Mean measurements on Day 7 and day 15

Table 7. Frequency of Complication Incidents Before, During, and After Ramadan Fasting Among Participants With Chronic Kidney Disease

Complication	Incident, %		
	Before Ramadan Fasting	During Ramadan Fasting	3 to 4 Weeks After Ramadan Fasting
Edema	12.5	15.4	7.5
Nausea	0	0	0
Vomiting	0	0	0
Itching	0	2.5	2.5
Muscle cramps	2.5	0	0
Hyperkalemia	8.5	5.1	5.1
Hyponatremia	0.0	6.8	1.7
25% increase in serum creatinine	...	1.7	1.7

Table 8. Frequency of Complication Incidents During Dialysis in Hemodialysis Patients

Complication	Incident, %
Fluid overload	36.7
Hypertension	47.8
Hyperkalemia	20.3
Hyponatremia	21.9
Restlessness	0.25
Bleeding	0.25
Exit site infection	0.25

both CKD patients and hemodialysis patients were included.

The main finding of our study was that the fasting CKD as well as hemodialysis patients in our cohort tolerated fasting for long hours during Ramadan. Despite the change in dietary habits during Ramadan as well as the timing of medications, indicators of the kidney function did not differ significantly before, during, and after

Ramadan. Also, in hemodialysis patients, despite the shorter duration of hemodialysis sessions, KT/V did not differ significantly. Complications in both groups were either negligible or were manageable under direct supervision of the staff nephrologist, and none of these complications required admitting the patients to the hospital.

Our study conforms with the findings of Bernieh and colleagues among CKD patients,¹⁵ on the note that they found no new clinical symptoms or signs in fasting patients, no significant differences in their patient's weight, blood pressure, and most of their laboratory investigations, except for a significant increase in estimated GFR by 1 mL/min to 2 mL/min, which was attributable to weight loss, and in lipid profile that could be related to the change of time of blood extraction. Our study showed no significant differences in the laboratory, creatinine clearance, and clinical variables. However, in Bernieh and colleagues' study,¹⁵ the length of fasting hours was only 12.5 hours, whereas it was more than 14 hours in our cohort. The 1.5-hour difference in the fasting hours may contribute to a significant difference in the findings between their study and our study. Other differences are that they have a smaller-sized population and different food preparation compared to our study.

The study of El-Wakil and coworkers in 2007 on the renal effects of fasting suggested some injurious effects on the renal tubules in CKD patients with some insignificant drops in the estimated GFR and increased levels of N-acetyl-B-D-glucosaminidase.¹⁶ Our study was not able to determine levels of N-acetyl-B-D-glucosaminidase; however, similar to their study, our patients did not show any significant drops in the GFR either.

In our review of the literature, we only identified one original investigation that studied the effect of fasting Ramadan on hemodialysis. Al-Khader and colleagues published an earlier study on fasting hemodialysis patients that was performed in 1991,²³ in which they examined 40 hemodialysis patients and asked them to fast on nondialysis days only. They found significant increase in the interdialytic weight gain and predialysis serum potassium, but no significant difference in the mean arterial blood pressure. Because the patients did not require hospitalization, they recommended that fasting on nondialysis days was probably safe. However, our study is more comprehensive with long hours

of daily fasting.

We reported a favorable as well as manageable metabolic outcome in CKD and hemodialysis patients who volunteered to fast in Ramadan. In the meantime, nephrologists must advise their patients regarding their dietary habits and physical activity. Hemodialysis must be performed after sunset and before sunrise in order for the fast to take place. The length of dialysis session can also be reduced. However, nephrologists and the hemodialysis centers should be aware that this entails several logistical challenges of coordinating with multiple hospital teams as discussed above in the methods. Larger prospective cohort studies are strongly advised to confirm the findings of this study. This will provide the Muslim hemodialysis patients as well as their treating nephrologists with evidence-based recommendations for fasting Ramadan.

The small sample size of our study has limited us to conclude on the adverse effects of fasting; however, it provides evidence-based suggestions for the effects of fasting in the metabolic and kidney variables of CKD and hemodialysis.

CONCLUSIONS

Fasting during Ramadan can be practiced safely and can be tolerated by CKD and hemodialysis patients, provided they are routinely monitored and guided by a team of healthcare providers.

CONFLICT OF INTEREST

None declared.

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