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Clinical and Biochemical Parameters among Hemodialysis Patients before and during the month of Ramadan

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ABSTRACT

Ramadan fasting among hemodialysis patients is a complex issue in the Muslim world, with varying opinions and outcomes. **Objectives:** To evaluate clinical and biochemical parameters in hemodialysis patients before and after Ramadan. **Methods:** This quasi-experimental study was conducted in a private tertiary care hospital in Karachi from March to April 2024.Patients undergoing hemodialysis for more than three months were included, except those who did not consent.Participants were categorized into three groups: complete fasting, intermittent fasting, and non-fasting. Clinical and biochemical parameters were measured before and after Ramadan, including ultra-filtrate, dry weight, potassium, phosphorus, and albumin. Data were analyzed using SPSS version 27.0, with paired t-tests and significance set at $p<0.05$. **Results:** 132 patients participated (56.1% male, 43.9% female). Most (90.9%) did not fast, while 5.3% fasted continuously and 8.3% intermittently. Hypertension was the most common comorbidity (47.7%). Ultra-filtrate levels significantly increased in both male and female. Potassium levels rose significantly in female and in patients on thrice-weekly dialysis. Albumin levels declined across all groups. No significant changes were observed in dry weight or phosphorus levels. **Conclusions:** It was concluded that increased ultra-filtrate and potassium levels post-Ramadan, with albumin declining in most groups. However, the fasting group showed no significant changes, highlighting the need for group-specific monitoring in hemodialysis patients during Ramadan.

INTRODUCTION

Ramadan fasting brings certain clinical, hemodynamically, and biochemical changes among healthy individuals, specifically and generally for chronic kidney diseases (CKD) and diabetic patients [1].However, these changes are not without side effects in certain high-risk groups of patients, and there are still no established guidelines to follow for Ramadan fasting [2].Ramadan fasting among hemodialysis patients has been a challenging problem and area of discussion in the Muslim world due to different opinions and outcomes [3].Studies on clinical or biochemical changes have not been conducted in a large number of studies recently. Previous studies were summarized in a literature review by Habas *et al.*, revealing hyperkalemia, hyperphosphatemia, and higher mortality in one study published in 2015, which might be related to other comorbidities [2].A recent study by Adanan *et al.*, depicts the opposite picture with improvement in phosphorus, serum creatinine levels, and weight reduction with the demography of younger patients [4]. A prospective cohort study conducted in Palestine on clinical and biochemical parameters shows that all dialysis patients, whether doing complete or partial fasting, developed intradialytic weight gains and high potassium levels.This study also concludes with the remark that hemodialysis patients should be aware of the potential risk of hyperkalemia and fluid gain [5]. A study from the dialysis unit of an Egyptian hospital on

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hemodialysis patients fasting during Ramadan concluded that complete or partial fasting may be tolerated without any significant complications, that are intradialytic hypotension (IDH) and muscle cramps.Moreover, an interesting finding was that significant weight reduction was observed in the fasting group as compared to the non-fasting group [6].No recent study or data are available to see the changes regarding biochemical parameters or clinical symptoms in hemodialysis patients with fasting in the population living in South Asia.In a center in Karachi, fasting and non-fasting hemodialysis patients were compared with a focus on pre-dialysis weight, electrolytes reflecting the dietary pattern at the beginning and during the last week of Ramadan.This study shows a decrease in phosphorus and an increase in albumin in the non-fasting group as compared to an increase only in phosphorus level in the fasting group [7].However, this study contradicts the dietary pattern of our population as dietary habits of mostly Pakistani families during Ramadan consists of food rich in carbohydrates and fat which is further augmented with phosphorus containing items and fluids intake at Iftar time [8] which might also reflect certain biochemical changes during the month of Ramadan in high-risk patients of hemodialysis [9].Despite all the above-mentioned literature, this question still arises and remains unanswered that is whether hemodialysis patients should fast during Ramadan or not, and whether this month's (Ramadan) dietary habits of hemodialysis patients reflect in their clinical symptoms or alteration in biochemical parameters, or not in both fasting and non-fasting.

This study aims to assess and compare the biochemical parameters among hemodialysis patients before and during the month of Ramadan.

METHODS

This quasi-experimental study was conducted among patients on hemodialysis in the dialysis unit of a private tertiary care unit in Karachi from the month of Ramadan from March 2024 to April 2024 using a purposive sampling technique after taking IRB approval from Memon Medical Institute Hospital (IRB/MMH/2023/14). Patients undergoing regular hemodialysis sessions (twice or thrice weekly, with each session lasting approximately 3 to 4 hours) for more than three months were selected for the study. Patients with a history of recent hospitalization within the past month, acute bacterial or viral infections, active malignancy, decompensated liver disease, or any unstable medical condition were excluded. Ramadan fasting was defined as abstaining from eating any food and drinks from dawn to sunset during Ramadan [10]. Informed consent was taken from the patients. They were assured that their information would be kept confidential and used only for research. All patients on maintenance hemodialysis were divided into three groups based on their fasting status during Ramadan. Complete fasting group (those who fast for the whole month), intermittent fasting group (those who fast on non-dialysis days), and non-fasting group (who didn't fast for the whole month). Demographic data, including age, gender, co-morbidities, and cause of end-stage renal disease (ESRD), were collected. All biochemical parameters (serum potassium, serum phosphorus, and serum albumin) before and during the month of Ramadan were measured at an interval of 30 days. Hyperphosphatemia is a serum phosphate concentration >4.5 mg/dL [11]. The serum levels of phosphorus should be maintained between 3.5 and 5.5 mg/dL as per KDOQI guidelines 2003, however 2017 KDOQI guidelines suggest keeping the Phosphorus level towards normal value. For hyperphosphatemia >5.5 mg/dl was used as a cut-off value to label as hyperphosphatemia [12]. Hyperkalemia was taken as a serum potassium concentration greater than approximately 5.5 mEq/L in adults [13]. The normal range of serum albumin was taken as 3.5 to 5.5 g/dL [14]. Similarly, clinical parameters like average ultrafiltration (in liters) during dialysis and average dry weight (in kilograms) were measured before and during the month of Ramadan. Ultrafiltration was defined as the removal of fluid (in liters) from a patient and is one of the functions of the kidneys that dialysis treatment replaces. Ultrafiltration occurs when fluid passes across a semipermeable membrane (a membrane that allows some substances to pass through but not others) due to a driving pressure [15]. Dry weight was defined as the optimum post-dialysis weight (in kilograms) at which all or most excess body fluids have been removed [16]. Any visit to ER, admission to hospital, or extra need for dialysis was notified, including any sign or symptom (like shortness of breath, nausea, fluid overload, deranged laboratory parameters). During the month of Ramadan. Data analysis was done by using SPSS software version 27.0. Age was mentioned as mean ± standard deviation. Gender, co-morbidities, and cause of ESRD were mentioned as percentages and frequencies. Continuous variables like serum phosphorus, potassium, albumin, ultrafiltration, and dry weight before and during Ramadan were compared for complete fasting, intermittent fasting, and non-fasting groups and were presented as mean ± standard deviation. The difference in numerical data pre and post was assessed by a Paired T test. Association between categorical variables was assessed using the chi-square. A p-value less than 0.05 was taken as significant.

RESULTS

A total of 132 patients were included in the study, with 74 (56.1%) male and 58 (43.9%) female. Among them, 61 (46.2%) underwent dialysis twice weekly, while 71 (53.8%)

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were on thrice-weekly dialysis. Hypertension was the most common comorbidity, affecting 67 (47.7%) participants. The fasting group comprised 7 (5.3%) participants, the intermittent fasting group included 11 (8.3%) participants, and the non-fasting group accounted for 120 (90.9%) participants. The results indicate significant shifts in certain parameters, particularly ultrafiltrate, potassium, and albumin levels. Ultra-filtrate levels showed a significant increase after Ramadan, rising from a pre-Ramadan mean of 2.44 ± 0.91 L to 2.69 ± 0.96 L (p=0.000). This suggests an increased fluid removal requirement post-Ramadan, potentially due to changes in dietary habits and fluid intake during fasting. Dry weight remained relatively stable, with a slight increase from 60.12 ± 14.25 kg to 60.23 ± 14.31 kg. However, this change was not statistically significant (p=0.231), indicating that fasting did not have a notable impact on overall body weight. Potassium levels increased significantly from 4.89 ± 0.76 mEq/L pre-Ramadan to 5.18 ± 0.80 mEq/L post-Ramadan (p=0.000). This suggests a higher risk of hyperkalemia, possibly due to dietary changes or alterations in dialysis sessions during Ramadan. Phosphorus levels showed a minor increase from 5.21 ± 1.61 mg/dL to 5.36 ± 1.56 mg/dL, but the difference was not statistically significant (p=0.229). This indicates that fasting had little effect on phosphorus balance in this patient population. Albumin levels significantly declined from 4.07 ± 0.50 g/dL to 4.22 ± 0.49 g/dL (p=0.000), suggesting potential nutritional concerns during Ramadan. This decrease may reflect inadequate protein intake or changes in metabolic processes due to fasting (Table 1).

Table 1: Pre and Post-Ramadan Changes Among All Participants

Parameter	n	Pre-Ramadan Mean ± SD	Post-Ramadan Mean ± SD	Mean Difference	t	p-value
Ultrafiltrate (L)	132	2.44 ± 0.91	2.69 ± 0.96	-0.253	-5.89	0.000
Dry Weight (kg)	132	60.12 ± 14.25	60.23 ± 14.31	0.111	1.20	0.231
Potassium (mEq/L)	132	4.89 ± 0.76	5.18 ± 0.80	-0.294	-4.21	0.000
Phosphorus (mg/dL)	132	5.21 ± 1.61	5.36 ± 1.56	-0.152	-1.20	0.229
Albumin (g/dL)	132	4.07 ± 0.50	4.22 ± 0.49	0.153	5.45	0.000

The results indicate significant changes in ultra-filtrate, potassium, and albumin levels, while dry weight and phosphorus levels remained relatively stable. Ultra-filtrate levels significantly increased from a pre-Ramadan mean of 2.46 ± 0.92 L to 2.70 ± 0.97 L (p=0.000), indicating a higher fluid removal requirement despite the patients not fasting. This could be attributed to dietary variations or fluid intake adjustments during Ramadan. Dry weight showed a minor increase from 60.24 ± 14.51 kg to 60.34 ± 14.55 kg, but this change was not statistically significant (p=0.306). This suggests that the non-fasting group maintained relatively stable body weight throughout the period. Potassium levels significantly increased from 4.90 ± 0.77 mEq/L to 5.17 ± 0.81 mEq/L (p=0.000), indicating a notable rise in potassium levels post-Ramadan. This may suggest dietary influences or altered dialysis efficiency, even among those who did not fast. Phosphorus levels showed a slight increase from 5.22 ± 1.63 mg/dL to 5.34 ± 1.57 mg/dL, but the difference was not statistically significant (p=0.368), implying minimal impact of Ramadan on phosphorus balance in the non-fasting group. Albumin levels significantly increased from 4.08 ± 0.50 g/dL to 4.23 ± 0.49 g/dL (p=0.000). This suggests improved nutritional status or protein intake in the non-fasting group, potentially due to regular meal consumption. The result presents the pre- and post-Ramadan changes in clinical and biochemical parameters among the non-fasting group of hemodialysis patients (n=120) (Table 2).

Table 2: Pre and Post-Ramadan Changes in Non-Fasting Group

Parameter	n	Pre-Ramadan Mean ± SD	Post-Ramadan Mean ± SD	Mean Difference	t	p-value
Ultrafiltrate (L)	120	2.46 ± 0.92	2.70 ± 0.97	-0.239	-5.20	0.000
Dry Weight (kg)	120	60.24 ± 14.51	60.34 ± 14.55	0.101	1.02	0.306
Potassium (mEq/L)	120	4.90 ± 0.77	5.17 ± 0.81	-0.269	-3.64	0.000
Phosphorus (mg/dL)	120	5.22 ± 1.63	5.34 ± 1.57	-0.121	-0.903	0.368
Albumin (g/dL)	120	4.08 ± 0.50	4.23 ± 0.49	0.151	5.09	0.000

Despite the small sample size, notable differences were observed in ultrafiltrate and potassium levels, while other parameters showed minimal changes. Ultrafiltrate levels significantly increased from 2.38 ± 0.89 L to 2.74 ± 0.91 L (p=0.010), indicating a greater need for fluid removal post-Ramadan. This suggests possible fluctuations in fluid intake or retention due to intermittent fasting patterns. Dry weight remained almost unchanged, with a slight increase from 58.92 ± 12.34 kg to 58.96 ± 12.36 kg (p=0.844), confirming that intermittent fasting did not lead to significant weight variations in this group. Potassium levels showed a significant increase from 4.91 ± 0.74 mEq/L to 5.50 ± 0.79 mEq/L (p=0.021). This notable rise suggests a potential risk of hyperkalemia, possibly due to dietary changes, reduced dialysis frequency, or altered potassium excretion during fasting. Phosphorus levels increased from 5.24 ± 1.59 mg/dL to 5.83 ± 1.62 mg/dL, but this change was not statistically

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significant (p=0.148).This indicates that intermittent fasting had a limited impact on phosphorus regulation.Albumin levels showed a slight increase from 4.07 ± 0.52 g/dL to 4.22 ± 0.53 g/dL, but the difference was not statistically significant (p=0.155), suggesting stable nutritional status despite intermittent fasting. The result presents the pre- and post-Ramadan changes in clinical and biochemical parameters among the intermittent fasting group (n=11)(Table 3).

Table 3: Pre and Post-Ramadan Changes in Intermittent Fasting Group

Parameter	n	Pre-Ramadan Mean ± SD	Post-Ramadan Mean ± SD	Mean Difference	t	p-value
Ultrafiltrate (L)	11	2.38 ± 0.89	2.74 ± 0.91	-0.363	-3.19	0.010
Dry Weight (kg)	11	58.92 ± 12.34	58.96 ± 12.36	0.036	0.201	0.844
Potassium (mEq/L)	11	4.91 ± 0.74	5.50 ± 0.79	-0.590	-2.72	0.021
Phosphorus (mg/dL)	11	5.24 ± 1.59	5.83 ± 1.62	-0.590	-1.56	0.148
Albumin (g/dL)	11	4.07 ± 0.52	4.22 ± 0.53)	0.154	1.53	0.155

Due to the small sample size, no statistically significant changes were observed in any parameter. Ultra-filtrate levels increased from 2.40 ± 0.93 L to 2.79 ± 1.02 L, but this change was not significant (p=0.142), suggesting a potential but inconclusive increase in fluid removal needs post-Ramadan. Dry weight showed a slight decrease from 57.46 ± 13.12 kg to 57.32 ± 13.18 kg (p=0.766), indicating minimal weight fluctuations among fasting patients. Potassium levels remained almost unchanged, increasing marginally from 4.87 ± 0.75 mEq/L to 4.88 ± 0.78 mEq/L (p=0.962), suggesting no significant impact of fasting on potassium balance. Phosphorus levels increased from 5.30 ± 1.68 mg/dL to 6.18 ± 1.74 mg/dL, but this change was not statistically significant (p=0.193), indicating a potential trend toward higher phosphorus levels without conclusive evidence. Albumin levels slightly increased from 4.05 ± 0.51 g/dL to 4.14 ± 0.52 g/dL (p=0.578), suggesting stable nutritional status during fasting. The result presents the pre- and post-Ramadan changes in clinical and biochemical parameters among the fasting group (n=7)(Table 4).

Table 4: Pre and Post-Ramadan Changes in Fasting Group

Parameter	n	Pre-Ramadan Mean ± SD	Post-Ramadan Mean ± SD	Mean Difference	t	p-value
Ultrafiltrate (L)	7	2.40 ± 0.93	2.79 ± 1.02	-0.389	-1.68	0.142
Dry Weight (kg)	7	57.46 ± 13.12	57.32 ± 13.18	-0.142	-0.311	0.766
Potassium (mEq/L)	7	4.87 ± 0.75	4.88 ± 0.78	-0.014	-0.05	0.962
Phosphorus (mg/dL)	7	5.30 ± 1.68	6.18 ± 1.74	-0.877	-1.46	0.193
Albumin (g/dL)	7	4.05 ± 0.51	4.14 ± 0.52	0.088	0.588	0.578

DISCUSSION

The current study indicates that hyperkalemia and increased ultra-filtrate removal were observed among the non-fasting and intermittent fasting groups, suggesting that dietary habits during Ramadan may contribute to these changes. Despite not fasting, these patients may have consumed potassium-rich diets and increased fluid intake while eating with their families. This finding contrasts with a study from Saudi Arabia, where non-fasting dialysis patients showed no significant changes in potassium levels or intradialytic weight gain [17]. Likely, reflecting dietary variations between populations. Regarding weight changes, our study found a decrease in dry weight in the non-fasting and intermittent fasting groups, while the fasting group experienced weight gain. This contrasts with a study from Egypt, where both complete and partial fasting groups showed significant weight loss without adverse effects [6]. While an Indonesian study reported significant pre-dialysis weight loss in fasting patients [18]. Since intradialytic weight gain is associated with high mortality and poor survival rates [19]. Understanding these variations is crucial. Some of the observed biochemical and clinical changes, such as the statistically significant decrease in albumin and ultra-filtrate removal, may have important clinical implications. Hypoalbuminemia is a known risk factor for poor nutritional status and increased mortality in dialysis patients [20]. And its decline across all groups suggests potential nutritional deficiencies, emphasizing the need for closer monitoring and dietary guidance during dialysis prescriptions to prevent complications like volume overload or dehydration. Similarly, significant changes in ultra-filtrate removal may reflect altered fluid balance, necessitating adjustments. Also, show that phosphorus levels increased post-Ramadan, while albumin levels declined across all groups, consistent with findings from a Malaysian study, which reported significant hyperphosphatemia and a decline in serum albumin after prolonged fasting [4]. Hyperphosphatemia is strongly associated with cardiovascular mortality in dialysis patients [20]. Emphasizing the need for dietary phosphate control, while low albumin levels are linked to higher first-year mortality rates [21]. Reinforcing the importance of nutritional interventions during Ramadan. In the Malaysian cohort, prolonged fasting and poor dietary intake contributed to hypoalbuminemia [4], and in the current study, the decline

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in albumin levels may indicate insufficient dietary protein intake, which should be addressed through targeted nutritional counseling. Despite these biochemical changes, most patients remained asymptomatic, with only a few experiencing acute shortness of breath, regardless of fasting status. No studies have reported worse outcomes in dialysis patients due to Ramadan fasting; however, a multicenter study from Egypt found higher mortality in the non-fasting group, potentially because fasting patients were younger [22]. This study is unique in assessing the impact of Ramadan fasting on dialysis patients in Karachi, Pakistan, where the climate is moderate during March and April, and it highlights dietary pattern changes during Ramadan, regardless of fasting status.

CONCLUSIONS

It was concluded that ultra-filtrate and potassium levels significantly increased post-Ramadan in the overall population, with similar trends observed in the non-fasting and intermittent fasting groups. Albumin levels significantly declined in the overall and non-fasting groups but remained stable in the intermittent fasting group. However, in the fasting group, no significant changes were observed in ultra-filtrate, potassium, phosphorus, or dry weight, while albumin showed a slight, non-significant increase. These findings emphasize the need for group-specific monitoring of hemodialysis patients during Ramadan.

Authors Contribution

Conceptualization: ARQ
Methodology: ARQ, SF
Formal analysis: FA, SHD,
Writing review and editing: ARQ, FA, SHD

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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