

Effect of Ramadan fasting on renal physiology

Abstract

Background: Total abstinence from food and water from sunrise to sunset during the month of Ramadan, is practiced by hundreds of millions of Muslims throughout the world. This pattern of fasting during Ramadan is different from the usual fasting as people are allowed to eat and drink between sunset and dawn but not after dawn. According to Islam, sick people are exempted from Fasting, but still a significant number of patients with various chronic diseases including chronic kidney diseases (CKD) insist on fasting in Ramadan due to their personal beliefs and physicians are facing this problem every year: What to advise their patients as there are no guidelines or protocols about who can and who cannot fast.

Results

Normal individuals: Slight increase in serum uric acid, urea and creatinine, K which are non significant in most of the studies. Slight decrease in urine output and no changes in plasma or urine osmolality, serum Calcium and Phosphorous, PH and serum bicarbonate were found.

CKD patients: Mainly tendency towards increase in serum creatinine.

Renal transplanted patients: No harmful effect due to fasting in most of patients.

Conclusion: In general no detrimental effects on healthy individuals and renal transplanted patients have been directly attributed to fasting during Ramadan. However caution is advised for CKD patients as they could be affected more by changes creatinine especially if they are taking diuretics, Renin-angiotensin system (RAAS) blockers or having cardiovascular diseases. The physicians should monitor his patients carefully during Ramadan in order to avoid any deleterious effects.

Keywords: fasting, ramadan, renal physiology, electrolytes, kidney function, ckd patients, renal transplanted patients

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Abbreviations: CKD, chronic kidney diseases; RAASp, renin-angiotensin system; S. Creatinine, serum creatinine

Introduction

All the world's religions recommend a period of fasting, and of these, one whole month of intermittent fasting every year is particular to Islam. Muslims have two meals, one immediately after sunset and the other just before dawn with a period of fasting ranging from 11-18hours. Therefore, we can assume that physiological changes occurring during Ramadan would be different from those occurring during other types of fasting.

According to Islam, sick people are exempted from fasting especially people with chronic diseases as diabetics, hypertensive, hepatic and renal patients, still a significant number of them insist on observing this religious practice due to their personal beliefs and satisfaction. In these cases, physicians face a dilemma as to how they can offer clinical advice for their fasting patient. In this article, I am doing a review on the findings of studies on the effect of fasting in Ramadan on renal physiology trying to help both, physicians and patients, to take the right decision. These studies were done on healthy peoples, renal grafted patients with normal kidney function, CKD patients and recurrent stone formers. They included males and females from age of 22 till 80 in some studies.

Regulation of fluid volume

The 24 hour urine output during Ramadan tend to be lower than that of the pre fasting level; however the decline is not significant (150-

200ml/day).¹⁻³ In a recent study using an isotopic tracer technique,⁴ it was demonstrated that total body water content was conserved during Ramadan although daily water turnover was mildly reduced (or compensated after fast breaking which is encouraged), due to a drop in non-renal losses. In CKD patients and transplanted patients, slight decrease in 24hours urine output was also observed.^{5,6}

Regulation of electrolyte balance

Na

Observations about total Na excretion were contradictory; While it remains normal in some studies,^{2,3} others^{1,7} observed significant decline of total Na excretion (about 20%) throughout the fasting period due to decrease food (and consequently decrease electrolytes) intake and this decrease was prolonged to the following month compared to the month before Ramadan indicating that the kidneys of the studied patients were responding well to the reduced fluid intake during fasting.

The later finding was also found in CKD patients as urinary Na decreased from 66mmol/l before fasting to 61.4mmol/l during fasting⁵ and in renal transplanted patients.⁶ No change in serum Na was observed in all the studies including those on CKD patients^{5,8} and renal transplanted patients.^{6,9}

K

Conflicting results; either serum K remains normal^{1,2,10} or increased during fasting¹¹ and this may be due to the common practice

of drinking large volumes of fruit juices, eating dates and dried fruits during when breaking fasting as well as reduced potassium excretion.¹ The same conflicting results were found also in CKD patients and renal transplanted patients: stable serum K before and after fasting,^{5,8,9} and tendency towards hyperkalemia was found in other study.^{6,12}

Miladipour et al.,³ showed that total excretion of calcium, phosphate and magnesium during fasting were significantly lower than those of the non-fasting in recurrent calcium calculus formers and non calculus formers as well. This have been confirmed in other studies in CKD patients, moreover, any renal changes are fully reversible after 10 days from the end of the fasting.^{13,14} No changes in serum calcium or phosphorus were detected in normal or stone former individuals.^{2,15,16}

Excretion of metabolites

Uric acid

Slight increase in serum uric acid^{2,10,11} in normal individuals. In 2 studies done on renal grafted patients with stable kidney function, there was no significant change in serum uric acid during fasting^{6,9} and increased in 1 study on CKD patients¹⁷ till 2weeks after end of fasting. Uric acid super- saturation increased during fasting period in both healthy individuals and stone formers^{3,18} but 24hours uric acid excretion was not significantly different from non fasting peoples.

Urea

Usually increases: While this increase was no significant in some of the studies,^{2,10} others found significant increase up to 23%¹⁹⁻²² due to dehydration, increase protein intake during Ramadan or increase protein catabolism, But serum Urea returns to the baseline by the end of Ramadan.^{19,23,24} Non significant increase of serum urea in CKD patients^{5,17} and in transplanted patients^{6,9} and was reversible at variable intervals after Ramadan.

Creatinine and kidney function

Only slight changes that are statistically non significant in most of the studies done on normal individuals,^{2,11,25,26} in few studies^{27,28} a significant increase in serum creatinine up to 12% was found and was reversible after the end of fasting.

Only few studies were done on CKD patients, one study⁵ shows minimal improvement in e GFR during fasting in CKD 3,4 and 5 patients (from 29.6ml/minute to 30.9 and 32.7ml/minute during and after fasting respectively), this was explained by several mechanisms: First, the reduction in the blood pressure during fasting with a positive effect on the kidney function in CKD patients, Second, weight loss indicating reduction in the relative over hydration, with subsequent improvement of cardiac function and better renal perfusion. Third, dietary reduction of protein intake and exogenous creatinine intake. Finally, modest directional changes in serum creatinine and weight result in an increment in eGFR.

The other studies^{8,17,29} showed increase serum creatinine more in CKD group compared with the normal group. The presence of pre-existing cardiovascular diseases and use of RAAS Blockers and diuretics were associated with risk of increase serum creatinine with fasting. The class Of CKD per se was not a risk factor for the drop of e GFR during fasting. Six cardiovascular events (2 acute coronary syndromes, 2 acute exacerbations of chronic peripheral vascular diseases requiring surgical interference, 1 case of acute heart failure and 1 minor ischemic stroke) occurred in patients who experienced a creatinine exceeded 30% compared with baseline values. Five of the six patients with events also had pre-existing cardiovascular disease.²⁹

By the end of the month, serum creatinine in the fasting group was higher than baseline in 29 patients (54.7%) but the magnitude of deviation of eGFR from baseline was insignificant, P=0.5. Marked elevations of serum creatinine exceeding 30%, were noted at the end of the month in only seven instances (13.2%). Mean deviation from baseline eGFR was -3% among fasting compared with -1.3% in non-fasting patients, P=0.9. Three months after the end of Ramadan, serum creatinine remained elevated in 12 of 52 (23%) patients in the fasting group, not significantly different from control group 19/54 (35%), P=0.17. One patient in the fasting group had to be put on temporary dialysis and one patient in the control group was started on permanent dialysis during the period of follow-up.

Regarding the studies done on renal transplanted patients,^{6,9,12,30-35} the concentration of immunosuppressive drugs tends to remain stable, and biochemical parameters do not change significantly. No organ rejection or deterioration of kidney functions was observed up to 6 months post Ramadan.¹² Only one author reported of adverse effects due to cyclosporine toxicity, acute rejection episodes, and urinary infections.³³ No kidney loss has been documented.

Plasma and urine osmolality

Fasting did not affect the plasma osmolality,^{1,10} indicating that the subjects were probably not subjected to severe water deprivation due to the fact that food and water are available between sunset and sunrise. Urinary osmolality was higher during Ramadan than either before or after Ramadan (ranging from 849-1023mOsmol/kg) indicating effective water conservation³⁶ both by maximum urinary concentration and a decreased obligatory urine output.^{1,22,37,38} Plasma osmolality decreased in CKD patients from 451mOsmol/l to 384mOsmol/l⁵ and was maintained normal in renal transplanted patients.⁶

Reabsorption of glucose and amino acids

Protein and glucose were not detected in the urine¹ suggesting normal reabsorptive function during Ramadan. Proteinuria increased in CKD patients from 1.7g/l to 4g/l during fasting then decreased again to 1.6g/l at the end of fasting but the reason was not clear.⁵ The same results were found in renal transplanted patients.⁶

Acid-base balance

Cheah et al.,¹ showed a decline in total titratable acidity (partly due to the decreased urine phosphate excretion) and an absence of ketonuria suggesting that any adipose tissue breakdown that might have occurred must have been relatively slow.³⁹ No changes in PH² or serum bicarbonate were detected in normal individuals and in CKD⁵ and renal transplanted patients.^{6,9} No evidence that changes in blood pressure or Hemoglobin level observed during fasting were attributed to the kidney.

Conclusion

In general no detrimental effects on health have been directly attributed to fasting during Ramadan in normal individuals, only mild reversible changes could occur. The differences in serum Na, K, Uric acid, urea, and creatinine are most probably due to variations in type of diet, climate, activity level and duration of fasting. These variables may affect more CKD and renal transplanted patients especially climate and duration of fasting (between sunrise and sunset) that varies largely between seasons and continents. Most of the studies were done in cold climate^{5,6,8,9,30,34} except very few ones in hot climate,^{12,29,30} while in the other studies this information was not available.

Renal transplanted patients with stable kidney function did not suffer from any deleterious effects while fasting except in 1 study provided that the patients were able to take their immunosuppressive drugs on time every 12hours. This leads us to duration of fasting that must be less than 12hours which is not always the case. The mean fasting duration is usually 12-14h, but depending on the place and the year it can last also up to 18hours or even 22hours, in the extreme latitudes. Studies involving CKD patients are very few with small number of patients having different CKD stages, so the results may be not generalizable. Randomized clinical trials with large number of patients are particularly encouraged since there is a lack of evidence-based guidelines and protocols which correctly address the issue of the impact of the fasting on CKD patients and proper counsel and advise them.

We could give some recommendations, based on these studies, for CKD patients willing to fast and their physicians

- I. Stable kidney function, controlled blood pressure and blood sugar, and absence of proteinuria before fasting are important elements before giving the patient consent for fasting.
- II. Patients with cardiovascular diseases,²⁹ CKD 4 and 5¹⁷ are more liable for complications.
- III. Replace or stop diuretics and RAAS blockers.²⁹
- IV. Encourage drinking large quantity of water (1.5 to 2L), avoid high potassium diet and high protein diet as well.⁴⁰
- V. Regular (every 1-2weeks) evaluation of the patient clinically and biologically, if more than 30% increase in serum creatinine, severe hyperkalemia, uncontrolled blood pressure, signs of volume overload; patient should stop fasting.⁴⁰
- VI. Individualization of the advice given to the patients about Ramadan fasting is an important thing; 70years old CKD 2 patient with uncontrolled diabetes may suffer from fasting while a 30years old CKD3 patient with no cardiovascular risk factors may not (Table 1).

Table 1 Summary of changes in renal physiology during fasting in Ramadan in normal individuals, CKD patients and Renal Transplanted (RT) patients NC, No Change

	Normal individuals	CKD patients	RT patients
24hrs urine output	Slight decrease	Slight decrease	Slight decrease
Urinary Na	NC/ Decrease	NC/ Decrease	NC/ Decrease
Serum Na	NC	NC	NC
Serum K	NC/ Increase	NC/ Increase	NC/ Increase
Urinary Ca	NC	NC	NC
S. Uric acid	Slight increase	Mild increase	NC/ Slight increase
S. Urea	NC/ Mild increase	Mild increase	Mild increase
S. Creatinine	NC/ slight increase	Variable results	NC
Plasma osmolarity	NC	decreased	NC
proteinuria	NC	NC	NC
HCO ₃	NC	NC	NC

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Conflict of interest

The author declares no conflict of interest.

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