Plant-based diets and potassium management in CKD: how to balance both?

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Patients with chronic kidney disease (CKD), especially those on dialysis, face extensive dietary restrictions to control their electrolytes, minerals, acid-base, and volume balance. Prescribing an adequate dietary plan to this population is a challenging task for renal dietitians as they need to consider all the dietary recommendations that goes beyond the control of potassium intake and include also providing adequate protein and energy intake, combined to the patient´s preferences, and economic, cultural background, and other medical constraints.

Potassium is especially difficult to manage since it is contained in numerous foods traditionally considered healthy. The major dietary sources of potassium include fruits (especially bananas, avocados, oranges, grapefruit, and some dried fruits), vegetables (especially potatoes, tomatoes, and leafy greens), beans and lentils, nuts, and whole grains. These nutrients represent the foundation of plant-based diets, such as vegetarian, vegan, Mediterranean, DASH (Dietary Approaches to Stopping Hypertension), Okinawan, and the general healthy eating plan. The common features of all these eating plans are a high intake of plant foods and strict avoidance of ultra-processed food and sugar, with variable limitations to the intake of animal-derived foods and oils. Although plant-based diets are generally rich in potassium, recent studies showed that higher adherence to such dietary regimes is associated with a lower risk of CKD and favorable kidney disease outcomes. Namely, Kim et al. conducted a large prospective study that included nearly 15,000 adult participants whose dietary habits were followed for a median of 24 years. Diets were characterized using four plant-based diet indices: in the overall plant-based diet index, all plant foods scored positively; in the healthy plant-based diet index, only healthful plant foods scored positively; in the pro-vegetarian diet, selected plant foods scored positively; and in the less healthy plant-based diet index, only less healthy plant foods scored positively. All indices negatively scored animal foods. During the follow-up, 4,343 incident CKD cases occurred and higher adherence to an overall plant-based diet and a healthy plant-based diet was associated with slower eGFR decline.

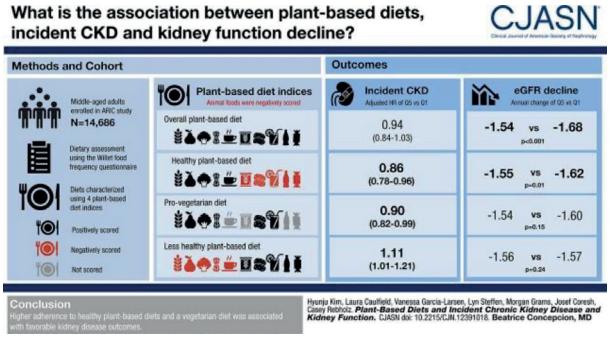

Figure 1.
Plant-based diets and CKD

Several explanations have been proposed for this reno-protective effect of a plant-based diet. One is that this dietary regimen has a low net endogenous acid load, which could mitigate metabolic acidosis in patients with CKD and potentially slow the progression of kidney disease. Lower acidity also decreases bone reabsorption, improves insulin sensitivity, and prevents sarcopenia. Furthermore, lower net endogenous acid production is associated with a decrease of vasoconstricting agents (such as endothelin 1), thus promoting renal perfusion and glomerular

filtration and preserving overall renal function. Plant-based diets also have high fiber content, shifting the gut microbiota profile towards increased production of anti-inflammatory compounds and reduced production of uraemic toxins. Conversely, numerous studies observed unfavourable effects of lower plant consumption (reduced intake of fruits, vegetables, nuts, beans, and whole grains), including dysbiosis, constipation, inflammation, oxidative stress, and accumulation of uremic toxins.

Relationship between dietary potassium and serum potassium

Recommendations for dietary potassium intake in renal patients evolved from rather strict instructions to limit potassium intake to 1950-2730mg/day in hemodialyzed population if serum K>6mmol/L, to the latest broad guidance to simply adjust potassium intake to maintain normokalemia in all CKD stages. Whether dietary potassium intake is related to serum potassium levels is still a matter of debate. Ramos et al. recently performed a cross-sectional study to assess if such association exists in both nondialysis-dependent CKD patients and hemodialysis cohorts. Dietary potassium intake was assessed by 3-day food records and patients with low energy intake were excluded. Results showed that dietary potassium intake was not associated with serum potassium or hyperkalemia in either group, thus challenging dietary potassium restriction as a measure to control hyperkalemia. In line with these results, Bernier-Jean et al. also concluded that higher dietary potassium intake was not associated with hyperkalemia or death in over 8,000 hemodialyzed patients in their cohort.

Several reasons have been suggested for this lack of association between potassium intake and potassium serum levels. Firstly, the alkalizing effect of fruits and vegetables reverses the movement of potassium and hydrogen ions, thus effectively reducing hyperkalemia. Secondly, potassium absorption is affected by intestinal transit time and fiber-rich diets induce bowel movement and increase potassium excretion in stool. Finally, higher glucose intake increases insulin and therefore reduces potassium rise. Other factors that might contribute to these findings are an underestimation of food intake by food diaries and some disease-related conditions, such as GFR, acidosis, and dialysis therapy. These shortcomings could be overcome by interventional studies, but these are difficult to conduct due to ethical challenges. A recently published study by Turban et al. tackled this issue by conducting a controlled feeding trial, with a 2-period crossover design, on adult patients with CKD stage 3 who received ready-made meals containing 100 or 40 mmol of potassium per day for a period of 4 weeks.

The primary outcome was 24h ambulatory systolic blood pressure level, which did not vary significantly related to potassium intake. However, serum potassium was significantly higher following a higher-potassium diet, even though the levels remained within the reference range in most patients, whereas two out of 29 subjects developed hyperkalemia. In a trial conducted by Gritter et al. of 191 patients with CKD phase 3b-4 who were treated with 40 mmol potassium chloride (KCl) per day for 2 weeks, 21 participants (11%), mostly older and with higher baseline potassium, developed hyperkalemia. KCl supplementation significantly increased urinary potassium secretion, plasma potassium, chloride, and aldosterone, and reduced plasma bicarbonate. These results emphasize a cautionary approach when prescribing potassium intake, and especially potassium supplementation, to patients with advanced CKD.

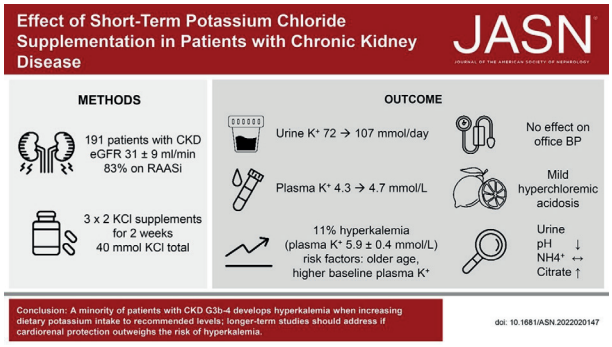

Figure 2.
Effects of short-term KCl supplementation in patients with CKD 3b-4

Hidden sources of potassium and preventive measures

The use of potassium additives in processed foods is growing, and with the use of additives, the potassium concentration far exceeds naturally occurring potassium. Ultra-processed foods, such as bread, snacks, preserved meats, packed fruit juices, which contain various food stabilizers, additives, and flavor enhancers pose a risk of hidden sources of potassium. Some types of wine, and sodium-reduced products (know as salt substitutes) also contain poassium addtives and constitute a hidden source o´f potassium in the food. The problem we face is that the accuracy of potassium content reporting on food labels is insufficient and unreliable, which makes difficult to counsel patients in which food contain potassium additives to avoid. In fact, a recent study by Picard et al. showed that only 5.7% of 239,089 examined products from the USA provided potassium content on their labels, whereas 14.7% of them actually

contained potassium-based additives. Potassium content increased by 66% when a 1-day sample menu compared foods with and without additives. Evidence also suggests that potassium additives are more bioavailable than potassium found in whole foods. Nevertheless, potassium bioavailability is not routinely considered in nutritional guidelines for CKD patients and they might not be aware of these hidden sources of potassium. The European Renal Nutrition ERA working group recently endorsed the Nephrology Cookbook with useful dietary advice and recipes to help the renal community address this problem.

Potassium-binding agents have long been used for treating and preventing hyperkalemia in high-risk patients. Sodium zirconium cyclosilicate and patiromer have recently been introduced as alternatives to sodium polystyrene sulfonate, which is poorly tolerated and associated with serious gastrointestinal adverse effects. In randomized controlled studies they effectively reduced serum potassium and were generally well tolerated, thus allowing patients to receive the benefits of a potassium-rich diet and optimize their RAAS inhibition therapy. The currently ongoing feasibility, descriptive, single-arm, open-label HELPFUL study is investigating the effect of sodium zirconium cyclosilicate on patient satisfaction, symptoms, energy, and protein intake when taken with low- and high-potassium diet to maintain plasma potassium within 3.5 to 5.0 mmol/L. Preliminary study results show an increase in fruits, vegetables, nuts, dairy products, fiber, and protein intake with a high-potassium diet while maintaining an adequate serum potassium level and without the need to cease their RAAS inhibition therapy with the use of sodium zirconium cyclosilicate.

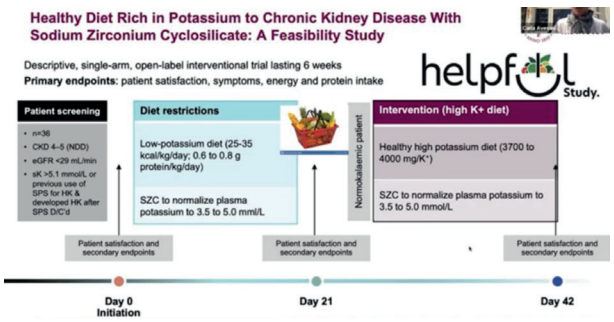

Figure 3.
The HELPFUL study

Written by Jasna Trbojevic-Stankovic.
All the speakers reviewed and approved the content.

KEY POINTS

1 Dietary potassium restriction in people receiving maintenance hemodialysis is commonly prescribed and is recommended in guidelines, despite a lack of evidence.

2 Restriction of plant foods as a strategy to prevent hyperkalemia deprives CKD patients of the potential beneficial effects of these foods.

3 Fruits with low potassium content and cooking vegetables, legumes, and beans in water provide a choice for those who need to restrict their potassium intake, but still need sufficient consumption of vitamins and fibers.

4 Patients should be instructed to carefully look for "hidden" sources of potassium in highly processed foods.

5 More research is needed to address knowledge gaps, particularly regarding the relevance and extent of diet-induced hyperkalemia in patients undergoing dialysis.

Further readings

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