Medical Nutrition Therapy for Chronic Kidney Disease in Pregnancy: A Case Report

IN THE UNITED STATES, THE prevalence of chronic kidney disease (CKD) in pregnant women has been reported to be 0.03% to 0.12%.[1,2] In Mexico, in a third-level specialty hospital, the prevalence was 0.33%.[3] Chronic kidney disease during pregnancy has been associated with higher risk of gestational hypertension, preeclampsia, polyhydramnios, intrauterine growth restriction, preterm birth, and low birth weight.[3-5]

Pregnancy involves many metabolic, physiologic, and hemodynamic adaptations that are necessary for adequate fetal development and growth. Women with CKD have lower capacity to adapt to these changes.[6] Dialysis treatment and its intensity during pregnancy have been shown to decrease the clinical adverse outcomes and improve nutritional status.[7]

Medical nutrition therapy (MNT) in CKD during pregnancy is essential, but nutrient recommendations are very general, and evidence is scarce.[5,8,9] Although some guidelines exist, most recommendations have been extrapolated from CKD nutrition treatment (without pregnancy) and from pregnancy nutrition recommendations.[9,10]

We present a case study from a pregnant young woman with CKD (stage V), receiving hemodialysis (HD).

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CASE STUDY

Nutrition Assessment (First Visit—14.3 Weeks of Gestation)

Client History. A 22-year-old woman had a CKD diagnosis (stage V— *Kidney Disease Outcomes Quality Initiative*)[11] (7 months ago) from an unknown cause. She was from a rural area, close to Mexico City, where she was diagnosed and referred to a third-level hospital in Mexico City. Hemodialysis was started (10.5 h/wk). At 13.5 weeks of gestation, she was referred to another specialty hospital for follow-up of her gestation. The departments of Nephrology, Gynecology, Fetal-Maternal Medicine, and Nutrition were involved in her treatment. Hemodialysis was continued during pregnancy and was increased to 14 h/wk.

Food/Nutrition-Related History. Before pregnancy, the patient never received any nutritional guidance. Usual dietary intake was recorded: Energy intake was adequate (112%); protein intake was excessive (1.9 g/kg pregestational ideal body weight [IBW]); sodium (Na) intake appeared to be excessive, given that Na intake from foods represented 100% of needs, without considering table salt; and iron (Fe) intake (dietary and supplemented) was adequate (92% of recommended) (Table 1).

Since becoming pregnant, she reported starting some positive lifestyle changes (decreased sweetened carbonated beverage intake, minimum salt use, and eating more meals at home); nevertheless, high-energy-density foods were frequently consumed (eg, pastries, Mexican fried foods). She ate three meals/day (only one at home), and her mother prepared her food.

Daily fluid intake included natural water (500 mL/day), 100% fruit juice (250 to 300 mL/day), and lemon tea (480 mL/day). She reported drinking sweetened carbonated beverages (250 to 500 mL/day), 4 times/wk.

She was taking several nutrition supplements: folic acid (5 mg/day), calcium (Ca; 300 mg/day), and vitamin D3 (200 IU/day).

Anthropometric Measurements. The patient was overweight when she became pregnant (pregestational body mass index, 27.08), and during the first visit she had an adequate weight gain for gestational age (1.2 kg).[12]

Biochemical Data, Medical Tests, and Procedures. Electrolyte and mineral status were within normal ranges at week 10.5. Biochemical data are described in Table 2.

She had a diuresis of 1.8 L. She was receiving 4,000 IU/HD session of erythropoietin, and 100 mg/HD session of elemental Fe.

Estimated Requirements

Energy. 30-35 kcal/d×pregestational IBW=30-35 kcal×62.8 kg[13]=1,884-2,198 kcal/d+352 kcal/d (2nd trimester)=2,236 to 2,550 kcal/d.

Protein. 1.2-1.5 g/d*pregestational IBW=1.2-1.5×62.8 kg[13]=75.3-94.2 g/d+10 g/d=85.3-104.2 g/d.[9,10]

Table 1. Energy, macronutrient, vitamin, and mineral intake throughout pregnancy for a woman with chronic kidney disease receiving medical nutrition therapy[a]

	First trimester[b]	Second trimester[c]	Third trimester[d]	Reference intake[10,18]
Gestational age (wk)	13.3	24.2	30.5	
Energy (kcal/d)	2,869	2,281	1,873	Individualized
Protein (g/d)	122.5	83.9	91.1	75.3-94.2 (1st trimester) 85.3-104.2 (2nd and 3rd trimesters)[e]
Carbohydrates (g/d)	376.9	288.8	247.5	175 g
Carbohydrates (%)	50.0	49.7	52.4	45-65
Fiber (g/d)	34.0	23.8	19.9	28
Fat (g/d)	113.0	92.7	59.2	—
Fat (%)	33.7	35.9	28.3	20-35
SFA[f] (g/d)	26.8	26.1	18.2	—
SFA (%)	8.0	10.1	8.7	—
MUFA[g] (g/d)	34.5	29.7	18.0	—
MUFA (%)	10.3	11.5	9.0	—
Vitamin C (mg/d)	61.2	117.7	41.7	≥170
Vitamin A (μg/d)	327.4	177.2	659.9	800
Vitamin A supplementation (μg)	—	450	450	
Folate (dietary folate equivalents) (μg/d)	532.9	200.3	153.5	1,800
Folic acid supplementation (mg)	5,000	6,000	6,000	
Iron (mg/d)	25.5	10.2	14.7	200
Iron supplementation (mg/d)	160	160	460	
Calcium (mg/d)	1,437.1	1,002.2	806.7	1,000-1,200
Calcium supplementation (mg/d)	300	550	550	
Potassium (mg/d)	2,656.8	1,690.5	2,525.1	2,512[h] or Individualized
Sodium (mg/d)	2,503.3	1,484.7	958.7	2,000-3,000
Phosphorus (mg/d)	1,570.4	1,392.6	1,493.5	1,200 or individualized (labs)
Magnesium (mg/d)	295.2	302.4	271.4	200-300

[a]Nutrient analysis was obtained with Food Processor SQL software (version 10.4, 2008, ESHA Research).
[b]Usual intake with detailed quantities and ingredients.
[c]2-d food record.
[d]Two multiple-pass 24-h recalls.
[e]1.2-1.5 g/kg pregestational ideal body weight (IBW); + 0 g/d (1st trimester) or + 10 g/d (2nd and 3rd trimesters).
[f]SFA=saturated fatty acids.
[g]MUFA=monounsaturated fatty acids.
[h]40 mg/kg pregestational IBW.

Nutrition Diagnosis

Excessive protein intake (NI, 5.7.2 [Nutrient Intake category from the Academy of Nutrition and Dietetics' Nutrition Care Process terminology]) (1.9 g/kg pregestational IBW) related to lack of knowledge regarding nutrition and CKD and undesirable food choices, as evidenced by proteinuria (1,036 mg/24-h urine).

Undesirable food choices (NB, 1.7 [Behavioral category from the Academy of Nutrition and Dietetics' Nutrition Care Process terminology]) related to eating away from home and a complicated schedule because of HD sessions were evidenced by high intake of high-energy-density and high-Na foods.

Nutrition Intervention

MNT Objectives:

1. Promote adequate intake of energy, protein, and other nutrients to promote optimal fetal

Table 2. Biochemical data about renal function, electrolyte and mineral status, anemia, and hepatic function throughout pregnancy for a woman with chronic kidney disease receiving medical nutrition therapy

Biochemical marker	First trimester	Second trimester			Third trimester		
Gestational age (wk)	10.5	16.5	23.3	27.2	31.3	32.5	34.2
Glucose (mg/dL)[a]	81	105	73	78	—	73	137
Oral glucose tolerance test: 0 min/60 min/120 min (mg/dL)	—	103/91/105	—	—	72/67/95		
Blood urea nitrogen (BUN; mg/dL)[b]	29	36	28	32	37	42	38
Creatinine (mg/dL)[c]	5.2	4.3	3.7	4.2	4.4	5.6	5.1
Uric acid (mg/dL)[d]	4.1	4.7	2.9	4.1	3.8	5.4	5.3
Creatinine clearance (mL/min)	—	6.04	4.5	6.3	6.9	3.5	—
Sodium (mEq/L)[e]	135.0	134.8	139.0	134.0	134.0	137.0	135.0
Potassium (mEq/L)[e]	4.5	5.1	4.6	5.4	4.5	4.9	5.1
Chloride (mEq/L)[e]	98	101	103	97.5	98.1	100	98.9
Magnesium (mg/dL)[f]	2.2	2.2	2.1	2.2	2.0	2.2	1.7
Calcium (mg/dL)[g]	8.9	9.5	9.1	9.8	8.9	8.8	8.0
Hemoglobin (g/dL)	6.1	9.3	9.1	9.4	8.1	7.3	7.6
Hematocrit (%)	19.7	28.5	28.2	28.1	24.1	21.7	23.1
Proteinuria (mg/24 h)	—	1,036	—	—	976	640	—
Aspartate aminotransferase (IU/L)	7	7	7	9	10	15	12
Alanine aminotransferase (IU/L)	5	7	9	9	8	13	8
Total bilirubin (mg/dL)	0.2	0.2	0.2	0.3	0.3	0.3	0.8
Direct bilirubin (mg/dL)	0.1	0.1	—	0.1	0.1	0.1	0.2
Indirect bilirubin (mg/dL)	0.1	0.1	—	0.2	0.2	0.2	0.5

[a]To convert mg/dL glucose to mmol/L, multiply mg/dL by 0.0555. To convert mmol/L glucose to mg/dL multiply by 18. Glucose of 108 mg/dL=6 mmol/L.
[b]To convert mg/dL BUN to mmol/L, multiply mg/dL by 0.357. To convert mmol/L BUN to mg/dL, mg/dL, multiply mmol/L by 2.8. BUN of 11.2 mg/dL=4 mmol/L.
[c]To convert mg/dL creatinine to μmol/L, multiply mg/dL by 88.4. To convert μmol/L creatinine to mg/dL, multiply μmol/L by 0.0113. Creatinine of 0.9 mg/dL=80 μmol/L.
[d]To convert mg/dL uric acid to μmol/L, multiply mg/dL by 59.5. To convert μmol/L uric acid to mg/dL, multiply μmol/L by 0.017. Uric acid of 5 mg/dL=297.5 μmol/L.
[e]Sodium mEq/L=mmol/L, potassium mEq/L=mmol/L, chloride mEq/L=mmol/L.
[f]To convert mg/dL magnesium to mmol/L, multiply mg/dL by 0.4114. To convert mmol/L magnesium to mg/dL, multiply mmol/L by 2.431. Magnesium of 2.43 mg/dL=1 mmol/L.
[g]To convert mg/dL calcium to mmol/L, multiply mg/dL by 0.25. To convert mmol/L calcium to mg/dL, multiply mmol/L by 4.01. Calcium of 10 mg/dL=2.5 mmol/L.

growth and to meet nutrient needs according to CKD and hemodialysis treatment.
2. Increase awareness about the importance of improvement of food choices for perinatal health and maintaining adequate electrolyte and mineral status.

Nutrition Prescription

Nutrition Plan. Energy: 2,000 kcal/d (considering fewer HD sessions than indicated for pregnancy and being overweight), and 99 g/d protein (1.4 g/kg pregestational IBW+10 g/d) were recommended.

Macronutrients. Fifty-five percent carbohydrates, 19% protein, and 26% lipids were recommended.

Fluid. No restriction of fluids was instituted.

Food and/or Nutrient Delivery

Decreased Protein Intake. The patient was asked to eliminate high-phosphorus foods, except for dairy products that were recommended. Moderate Na intake (2,000 g/d) and potassium (K) restriction (foods providing >250 mg/serving size) were recommended, as well as eating five meals/day. The patient was told to continue with nutrient supplements (Fe, folic acid, Ca, vitamin D3).

Nutrition Education

The importance of MNT for her condition was explained, as well as risks and complications associated with her disease. Food sources with high Na, K, and phosphorus content were discussed. We also explained the nutrition plan with the different choices from each food group. An example of a 1-day menu with the recommended food groups and serving sizes was provided to the patient.

Nutrition Monitoring

Nutrition monitoring ensued every 2 to 4 weeks.

Follow-up

Nutrition Assessment and Monitoring. The patient moved to Mexico City from Tuesday to Friday with her mother. Mother still cooks for her during breakfast and dinner; lunch was prepared by the housekeeper. The patient's food intake schedule varies according to activities, especially during HD days.

Primary positive nutrition changes during pregnancy included decreased

Table 3. Weight gain during pregnancy and classification according to the Institute of Medicine guidelines[12]

Gestational week	Weight gain (kg)	Weekly weight gain[a]	Interpretation
14.3	1.2	—	—
18.3	0	0 kg	Insufficient
22.2	1.8	0.46 kg	Excessive
24.5	1.3	0.56 kg	Excessive
27.5	3.2	1.06 kg	Excessive
29.5	1.4	0.7 kg	Excessive
31.5	0.5	0.25 kg	Adequate

[a]Recommended weekly weight gain in overweight women: 0.23-0.33 kg.[12] Pregestational weight=79 kg.

intake of sweetened carbonated beverages and fried or high-fat Mexican food, select low-fat cooking methods, increased vegetable intake, and decreased intake of high-Na, high-phosphorus, and other high-fat foods. At the end of pregnancy, she reported good adherence to the nutrition plan. The patient was successful in increasing the number of meals (4-5 meals/day). Fluid intake was maintained at 1,000 to 1,100 mL/day.

In general, her energy intake tended to decrease. Total protein, carbohydrate, and fat intake were significantly reduced during pregnancy. Her estimated Na intake from food sources decreased from 2,500 mg/d to 958 mg/d. Potassium was maintained within the recommended intake. Phosphorus intake was decreased from the first trimester to the second trimester, but it appeared to be on the upper limit. Iron intake (dietary and supplement) was low during the second trimester, achieving adequate intake until the third trimester, because of an increase in Fe dose to 400 mg/HD session (Table 1).

Folic acid, vitamin D3, and erythropoietin supplementation was maintained throughout pregnancy. A multivitamin was added at 22.2 weeks of gestation that provided 1,500 IU vitamin A, 200 mg vitamin C, 250 IU vitamin D3, 1 mg folic acid, 250 mg Ca, and 60 mg Fe. Physical activity was increased; mainly, the patient used the stationary bike during her HD sessions (4 days/wk).

From 22 weeks of gestation, the patient's weight gain per week of gestation was accelerated (Table 3 and Figure 1). The interdialytic weight gain range was between 2.2 and 2.5 kg, which is higher than recommended.

Fetal growth was reported to be adequate, except at week 30.2, when the fetus was classified as large for gestational age (LGA; estimated fetal weight percentile, 81), and polyhydramnios was diagnosed.

Blood urea nitrogen (BUN), uric acid, and creatinine were within goals throughout pregnancy; BUN was always maintained at less than 50 mg/dL. Sodium, K, chloride, magnesium, and Ca were within normal range during pregnancy; phosphorus was not measured. Proteinuria was decreased from 1,036 mg/day to 640 mg/day (Table 2). Residual renal function was maintained (range, 800 to 1,850 mL/24-h urine output). No physical evidence of overhydration was observed.

Impaired glucose tolerance was diagnosed with a 75-g oral glucose tolerance test (OGTT) performed at 16.5 weeks of gestation.[14] A second OGTT was performed at 31.3 weeks, with a normal result. Blood pressure was maintained within normal ranges.

Anemia was present during the pregnancy, with Hb values less than 10 mg/dL (100 g/L; range, 6.1 to 9.4 mg/dL [61 to 94 g/L]), and hematocrit between 19.7% and 28.5%, respectively.

Primary Nutrition Diagnosis during Follow-up

Excessive carbohydrate intake (NI, 5.8.2) related to impaired glucose

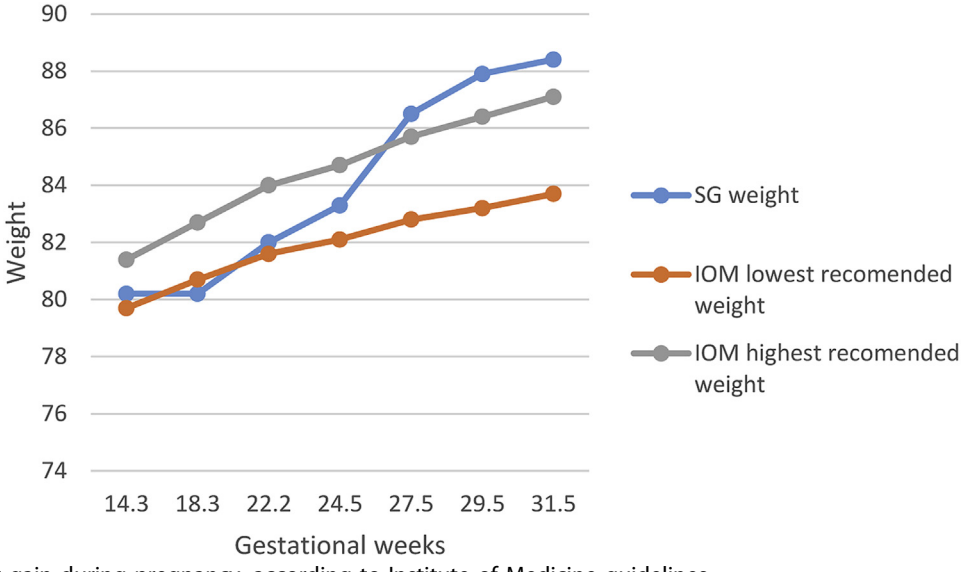

Figure 1. Weight gain during pregnancy, according to Institute of Medicine guidelines.

	Maternal and fetal	Perinatal outcome	Newborn
Optimal outcomes	Blood urea nitrogen, potassium, and sodium serum levels maintained	Alive newborn	Normal anthropometric indices at birth (10th-90th percentile)
	Blood pressure within normal ranges throughout pregnancy	Newborn classified as adequate for gestational age	
	Proteinuria was reduced (1,036-640 mg/24 h urine)	No intrauterine growth restriction	
	No preeclampsia		
	Normal fetal growth during 1st and 2nd trimesters		
Adverse outcomes	Impaired glucose tolerance at 2nd trimester	Preterm birth (gestational age: 34.2 wk)	Clinical diagnoses: respiratory distress syndrome, hyperbilirrubinemia, patent ductus arteriosus, sepsis, neuroinfection, and severe pulmonary bronchodysplasia
	Anemia	Apgar 4/9	Suboptimal growth rate during hospitalization
	Polyhydramnios	Low birth weight (1,900 g)	43 d in neonatal intermediate/ intensive care
	Large for gestational age fetus at 30.2 wk	Borderline low thorax circumference (29 cm)	

Figure 2. Perinatal outcomes: Optimal and adverse.

tolerance, as evidenced by altered fasting glucose (103 mg/dL).

Imbalance of fluids (NI, 5.5) probably was related to insufficient HD therapy (14 h/wk) and irregular urine output as evidenced by excessive interdialytic weight gain and adequate fetal growth.

Inadequate Fe intake (NI, 5.10.1) (85% of recommendation) (from diet and supplementation) during the second trimester was related to higher requirements attributable to HD sessions, erythropoietin use, and pregnancy, as evidenced by low hemoglobin and hematocrit values (9.1 to 9.4 g/dL [91 to 94 g/L], and 28.1% to 28.5%, respectively).

Nutrition Intervention

Energy and protein intake recommendations were maintained throughout pregnancy (2,050 kcal/d and 99 g/d, respectively). High-quality protein was emphasized. At 22.2 weeks' gestation, a carbohydrate-controlled nutrition plan was recommended (45% carbohydrates, 230 g/d), with 35% of lipids, because of the diagnosis of impaired glucose tolerance.

Basic carbohydrate counting was taught. Food sources of carbohydrates, serving sizes, the even distribution of carbohydrates throughout the day, as well as the importance of consistency of carbohydrate eating between days was discussed.

Healthy food selection was always a primary nutrition education subject. Moderate restriction of K was continued throughout the pregnancy, as well as a decrease in high-sugar, high-fat food sources. Individual goals were to decrease juices, pastries, and chips. Phosphorus intake was controlled. The importance of eating high-Fe food sources also was emphasized.

Clinical Outcomes

Pregnancy was interrupted because of premature rupture of membranes at 34.2 weeks' gestation. A male newborn was born, with a weight of 1,995 g (*z*-score −0.8), length of 44 cm (*z*-score −0.4), and head circumference 32 cm (*z*-score 0.4).[15] His Apgar score was 4/9. He was hospitalized with respiratory distress syndrome, multi-etiology hyperbilirubinemia, patent ductus arteriosus, late sepsis, neuroinfection, and severe pulmonary bronchodysplasia. Growth rate during hospitalization (43 d) was subadequate (Figure 2).

DISCUSSION

MNT for CKD during pregnancy is essential but remains a challenge. This case demonstrates that a multidisciplinary treatment may help attenuate the high-risk profile of CKD during pregnancy.

Our patient did not develop hypertensive disorders in pregnancy. Even though impaired glucose tolerance was observed during the second trimester, low glucose values were observed on a third trimester OGTT. A preterm birth of 34.2 weeks was a positive outcome, considering the reported mean of 32 weeks of gestation in this population.[5] Although the newborn was classified as low birth

weight (<2,500 g), anthropometric indices at birth were all adequate (10th to 90th percentiles).[15]

Nutrition intervention was successful in reducing the patient's intake of high-energy foods, sweetened carbonated beverages, juices, and in controlling Na, K, and phosphorus intake. The patient was able to increase her vegetable intake. The intervention appeared to have a positive effect on electrolyte and mineral status. Considering past reports, HD for these patients should be given for a total of 20 h/wk,[16,17] although this patient received HD for 14 h/wk, and BUN was maintained at less than 50 mg/dL.[8] Residual renal function was stable, and anuria was avoided.

One of the main challenges of MNT was the recommendation of energy intake. For CKD in pregnancy receiving HD treatment, energy intake may be estimated as 30 to 35 kcal/kg.[5,8,10] Most reports did not specify whether this should be calculated using current dry body weight, pregestational IBW, or other; some suggest adding the energy cost of pregnancy. In this case, fetal surveillance was the primary outcome to modify energy or protein recommendations. Higher Fe supplementation doses should have been given during pregnancy to maintain Hb values at greater than 10 g/dL, as well as erythropoietin treatment.[9] Fetal growth was adequate throughout pregnancy, except for an upper limit estimated fetal weight at 30.2 weeks. In pregnant women with CKD receiving HD, weight gain is difficult to interpret. This patient had excessive weight gain from 22.5 to 29.5 weeks of gestation.[12] Possibly the HD was insufficient. Thus, considering fetal growth and the patient's weight gain, the energy intake recommendation was estimated and maintained at 30 kcal/kg pregestational IBW.

Adverse perinatal outcomes for this patient included polyhydramnios, anemia, and premature rupture of membranes, and the clinical evolution of the newborn was not optimal (Figure 2).

CONCLUSIONS

This is one of the few cases that reports the challenge of applying the nutrition care process for CKD during pregnancy. As expected, some positive and some adverse clinical outcomes were observed. The renal RDN has a unique role within the health care team responsible for treating CKD in pregnancy. RDNs must provide specific renal nutrition therapy interventions and nutrition education and counseling. Studies describing nutritional and clinical status throughout pregnancy in women with CKD are urgent, as is the evaluation of MNT with specific nutrition strategies.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

O. Perichart-Perera is a speaker/consultant of the Nestlé Nutrition Institute in Mexico. No potential conflict of interest was reported by the other authors.