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Pregnancy outcome in a patient with end-stage kidney disease treated with an intensive automated peritoneal dialysis regimen: A case report

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Abstract

Pregnant women with end-stage kidney disease who undergo peritoneal dialysis have lower pregnancy rates and higher obstetric risk than their peers undergoing hemodialysis. Although there has been some improvement in pregnancy rates and outcomes due to the intensification of dialysis prescriptions, there is currently a lack of guidelines for optimizing peritoneal dialysis regimens for pregnant women with end-stage kidney disease. Besides, there is limited data available regarding pregnancy outcomes in women with end-stage kidney disease undergoing peritoneal dialysis. We report the case of a 23-year-old Hispanic woman with end-stage kidney disease caused by focal and segmental glomerulosclerosis. She became pregnant while undergoing successful treatment with an intensified automated peritoneal dialysis regimen. The patient gave birth to a live female preterm infant weighing 938 g during the 28th week of her pregnancy. The baby required neonatal intensive care due to prematurity, extremely low birth weight, and respiratory distress syndrome.

Keywords

End-stage kidney disease, pregnancy, cervical shortening, glomerulosclerosis, automated peritoneal dialysis

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Introduction

Women with end-stage kidney disease (ESKD) have lower pregnancy rates and higher obstetric risk than women without ESKD.[1] This is especially true in patients receiving peritoneal dialysis (PD) for their kidney replacement therapy, since the incidence of pregnancy is only 1.06 per 1000 person-years in such patients, in contrast to 2.54 per 1000 person-years in patients undergoing hemodialysis (HD).[2]

There are several reasons why women with ESKD may have reduced pregnancy rates, like the dysregulation of the hypothalamic-pituitary-gonadal axis secondary to uremia and hyperprolactinemia, causing decreased estrogen and progesterone levels inducing menstrual cycle irregularities and potentially, anovulation.[3] Additionally, in patients undergoing PD, the dialysate solutions may interfere with the regular transit of the ovum.[3]

The intensification of the dialysis prescription in women with ESKD has led to a gradual improvement in pregnancy rates and outcomes.[2] However, despite these clear benefits, there are no guidelines for the optimization of the PD regimen in pregnant patients with ESKD; additionally, there is also scarcity of data on pregnancy outcomes in this group of patients.[3]

Here, we present the case of a 23-year-old pregnant Hispanic woman with ESKD successfully managed using PD exclusively during her entire pregnancy. We also include a detailed description of the adjustments made to her PD prescription during pregnancy.

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Table 1. Laboratory findings and weight of the patient during her pregnancy.

Parameter	Weight (Kg)	BUN	Hb	Kt/V	Ca^{2+}	PO4	Na^{+}	K^{+}	Creatinine
Normal range (Units)		7–20 (mg/dL)	10–14 (g/dL)		8.4–10.2 (mg/dL)	2.8–4.5 (mg/dL)	135–145 (mmol/L)	3.5–5.5 (mmol/L)	0.4–0.8 (mg/dL)
Date									
About one month before conception	48	50	10.3	2.3	9.2	5.3	135	3.9	10.7
Pregnancy week									
5th week	48	35	8.8		8.8	4.6	136	3.2	9.87
9th week	48	46	10		8.8	5.4	137	4.3	10.2
13th week*	48	54	11		9.2	4.5	135	3.8	10.5
16th week	48	29	12.5		9.8	3.7	138	3.6	10.8
20th week	48	36	11.9	2.3	9.5	3	142	3.5	11
24th week†	48	33	8.1		9	3.5	140	3.3	9.98
28th week	48	37	9	2.6	9.5	4.8	135	4	9.8

BUN: blood urea nitrogen; Ca^{2+}: serum calcium; Hb: serum hemoglobin; K^{+}: serum potassium; Kt/V: measure assessing dialysis adequacy; Na^{+}: serum sodium; PO4: serum phosphate.
*The week during which the patient's pregnancy was diagnosed.
†Laboratory tests conducted during the first urgent hospitalization of the patient.

Case presentation

A 23-year-old nulliparous Hispanic woman suffered from biopsy-confirmed focal and segmental glomerulosclerosis and secondary hypertension. At the time of her histological diagnosis, the patient was found to have focal and segmental glomerulosclerosis affecting 95% of glomeruli, accompanied by interstitial fibrosis and 50% tubular atrophy. Based on the histopathology, the patient was treated with lisinopril to prevent further proteinuria and treat hypertension. She was not recommended to start immunosuppressants, as the histopathology suggested chronic nephropathy. The patient had an estimated glomerular filtration rate of $<15\,mL/min/1.73\,m^2$ and was diagnosed with ESKD. For this reason, she was initiated on continuous ambulatory peritoneal dialysis (CAPD).

At the 14th month of the initiation of her CAPD, the patient presented an asymptomatic increase in her abdominal girth that she had started to notice recently, prompting her to consult her obstetrician. The patient had remained amenorrheic for the past 2 years, and she was not taking any contraceptives; nevertheless, she was diagnosed with a viable intrauterine pregnancy at 13 weeks, confirmed by ultrasound. Until this moment, she had been receiving and appropriately tolerating CAPD for her kidney replacement therapy.

Her daily medications included an oral iron supplement, nifedipine 30 mg once daily, and metoprolol 50 mg once daily; she also received weekly subcutaneous injections of 8000 IU of erythropoietin. Her CAPD prescription consisted of four daily manual exchanges of 2000 mL with a 1.5% dextrose solution every 4–6 h, including an overnight dwell, 7 days a week. At this time, she had adequate volume tolerance to the dialysate without any maternal or obstetric complications. She had a residual diuresis of 1300 mL/day and was classified as a low transporter based on a peritoneal equilibration test (PET).

Since she had ESKD and elevated obstetric risk, a multidisciplinary team, including a nephrologist, a maternal-fetal medicine specialist, a psychologist, a psychiatrist, and a dietitian were required to follow-up with the patient optimally. The multidisciplinary team recommended to switch to HD during the pregnancy to keep up with evidence-based recommendations. Nevertheless, the patient declined it due to the fear of contracting COVID-19 in a dialysis center.

Her CAPD prescription was intensified after the pregnancy was confirmed to avoid pregnancy complications from elevated serum urea levels. She was switched to automated PD (APD) with a continuous cycling modality for 10 h during the day, consisting of 6 exchanges of 2000 mL each, totaling 12,000 mL of dialysate with a 1.5% dextrose solution. Additionally, a manual infusion of 2000 mL of the dialysate solution would be administered at bedtime and remain in the abdominal cavity throughout the night.

The patient was also closely followed up by her nephrologist and maternal-fetal medicine specialist each week and her dietitian, psychiatrist, and psychologist each month; during some of the follow-ups, her weight, electrolytes, blood urea nitrogen (BUN), and hemoglobin levels were monitored (Table 1). She was also recommended to start a diet of 35 kcal/kg/day, with a daily intake of 1.8 g of protein per kilogram of ideal body weight. This recommendation was made by a dietitian after detecting the patient's low maternal weight of 48 kg (≈106 pounds) with a body mass index (BMI) of 18.

Throughout her pregnancy, our patient maintained an adequate dialysate volume tolerance, an average residual diuresis of 1300 mL/day, and an appropriate ultrafiltration volume of 1.2–1.5 L/day. At this time, the patient remained with a controlled blood pressure, and there had been no maternal or obstetric complications.

In the 24th week of her pregnancy, the patient was admitted to the emergency room with an elevated blood pressure of 160/100 mmHg; she was diagnosed with superimposed preeclampsia based on a 3+ proteinuria on a dipstick test. On admission, her serum creatinine remained abnormally elevated at 9.98 mg/dL without any substantial changes from her baseline levels, which was expected given her ESKD (Table 1). Her serum albumin level was also low at 2.6 g/dL.

Her platelets, peripheral smear, haptoglobin, aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, prothrombin time, international normalized ratio, partial thromboplastin time test and serum bilirubin levels returned normal, ruling out Hemolysis, Elevated Liver enzymes, Low Platelets syndrome. The patient was diagnosed with preeclampsia with severe features due to her substantial blood pressure elevation.

Additionally, an obstetric ultrasound was done to confirm fetal well-being. The ultrasound reported a posteriorly implanted placenta, a fetus in a cephalic position with an estimated fetal weight of 681 g, a fetal growth in the 24th percentile, and a normal amniotic fluid index. The results of the fetal and uteroplacental circulations Dopplers returned normal.

The patient received adequate intravenous antihypertensive therapy with labetalol and seizure prophylaxis with magnesium sulfate during the hospitalization. The results of additional blood tests during the hospital admission also showed normal BUN and electrolyte levels; nonetheless, she persisted with mild multifactorial anemia (Table 1).

After her blood pressure normalized, her regular antihypertensive doses were optimized, with nifedipine increased to 30 mg twice daily, metoprolol increased to 100 mg twice daily, and 25 mg of hydrochlorothiazide added once daily. She also received a prophylactic cervical cerclage after a short cervix was identified during an ultrasound vaginal cervicometry.

Due to her high obstetric risk, low maternal weight, and increased risk of preterm labor, the patient was strongly recommended to remain hospitalized for the remainder of her pregnancy. The hospitalization would additionally allow us to optimize her nutritional status, as she remained at a low maternal weight. However, she declined and opted for voluntary discharge.

During the 28th week of her pregnancy, the patient experienced another episode of superimposed preeclampsia with severe features once again secondary to elevated blood pressure, granting her to consult the emergency room. During the examination, it was discovered that she was in active labor. At this moment, all dialysate was drained from her peritoneal cavity in preparation for birth.

Her cervical cerclage was removed, and 12 h later, she underwent an uncomplicated preterm vaginal delivery after she received antenatal corticosteroid therapy with betamethasone to assist with fetal maturation. Her newborn baby had Apgar scores of 8 and 9 at 1 and 5 min after birth, respectively. The baby was female and weighed 938 g. Both the mother and her baby were admitted to the hospital.

After an uneventful recovery from the vaginal childbirth and the normalization of her blood pressure, the patient was discharged. She was switched back from the APD prescription to her previous CAPD prescription based on her personal preferences and the fact that the intensified APD regimen was no longer required. Her newborn, however, remained in the neonatal intensive care unit due to extremely low birth weight (LBW) and respiratory distress syndrome and was discharged 30 days later. Both the patient and her newborn remained stable during follow-up.

Discussion

Most of the information available in the literature about the outcomes in pregnant patients with ESKD receiving dialysis derives from patients undergoing HD but not PD. Evidence suggests that low maternal BUN levels are associated with an increase in the newborns' weight and gestational age at the time of birth; some authors also report that BUN levels >48 mg/dl are associated with a higher incidence of complications like neonatal death, LBW, and preterm labor.[4,5]

Premature birth and LBW are two of the most common obstetric complications in newborns from women with ESKD undergoing dialysis.[6] Moreover, newborns from women undergoing PD have an increased risk of being small for gestational age and a greater chance of requiring neonatal intensive care; these are some of the reasons why it is generally recommended to switch pregnant patients with ESKD from PD to HD, yet our patient opted not to do so.[6] The fear of contracting COVID-19 has previously been reported to reduce the number of hospital consults and admissions; this was the reason why our patient opted not to receive any type or combination of kidney replacement therapy that included HD.[7]

Although there are benefits to transitioning pregnant patients with ESKD to HD, alternative approaches that combine HD and PD have been successfully implemented to decrease the treatment burden and time constraints associated with intensive HD regimens.[6] Our approach using APD could also be an alternative for patients who prefer not to switch to HD or to implement a regimen that combines both dialysis modalities.

We sought to reduce complications from elevated serum urea levels; thus, we intensified our patient's PD prescription when her pregnancy was discovered. We aimed to maintain BUN levels below 50 mg/dl, as these have been associated with improved pregnancy outcomes.[5] We decided to switch her from the CAPD regimen to APD since the latter allows for longer dialysis sessions, with larger dialysate volumes and a reduced intraperitoneal pressure, which is especially useful in low transporters like our patient, as confirmed by her PET.[8]

Our PD regimen achieved the target BUN levels throughout our patient's pregnancy while allowing us to successfully

maintain adequate residual diureses averaging 1300 mL/day and ultrafiltration volumes of up to 1.5 L/day with normal electrolyte and phosphate levels (Table 1). The patient tolerated our approach using APD without presenting substantial abdominal discomfort or any complications associated with the peritoneal catheter, like peritonitis, catheter malposition, or flow alterations or obstruction.[9] Our APD prescription even resulted in comparable Kt/V and average BUN levels to those reported in a study of 93 pregnant women undergoing HD.[10]

The KDIGO guidelines suggest that patients with ESKD should maintain a daily intake of 0.8 g of protein per kilogram to improve kidney hemodynamics and reduce uremic toxin production.[11] However, pregnant women on intensified dialysis prescriptions require higher amounts of both micro and macronutrients, partly because the intensification of dialysis increases proteins, glucose, and vitamin loss.[12] Therefore, a diet with increased caloric intake is necessary. This includes protein supplementation that doubles the recommended intake for ESKD patients to 1.5–1.8 g of protein per kilogram of ideal body weight.[12]

We aimed to increase the maternal weight in our patient since a pregravid BMI < 19.8 is also a risk factor for preterm labor and LBW.[13] Despite strictly following the dietitian's advice and the recommendations of the Institute of Medicine for underweight (BMI <18.5) pregnant women, our patient failed to gain weight adequately.[14]

Finally, we implemented a prophylactic cervical cerclage, as this intervention has been proven to potentially increase the gestational age at delivery in women with asymptomatic cervical shortening or dilation, even in patients with twin pregnancies.[15] In spite of all our preventive measures, including those of a multidisciplinary team, and suggesting that our patient remain hospitalized at the time of her first episode of preeclampsia, our patient had a premature baby with extreme LBW.

Conclusions

Our intensive APD prescription was well-tolerated by the patient and helped maintain normal levels of electrolytes and phosphate throughout pregnancy. Additionally, our APD prescription resulted in comparable Kt/V and average BUN levels to HD. Therefore, APD is an acceptable alternative to HD in pregnant patients.

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Author contributions

J.E.H.S, L.A.A, A.J.Q.A, E.E, J.J.P.P, and M.T.T participated in the manuscript drafting, performed the relevant literature review, and edited the revisions and final draft. J.E.H.S, L.A.A and A.J.Q.A made revisions while creating the drafts. J.E.H.S was the nephrologist in charge of the patient's care. L.A.A and E.E were the nephrology fellows in charge of the patient's care. All authors contributed enough to claim authorship of the manuscript and approved the final versions of it.

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Ethics approval

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Informed consent

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