An Alternative Approach to Delivering Intensive Dialysis in Pregnancy

Pregnancy outcomes in patients with end-stage renal disease (ESRD) on dialysis are improving. Recent literature supports intensive hemodialysis (HD) as the modality of choice during pregnancy in ESRD. We report the successful delivery of a healthy infant at full term in a patient with ESRD by supplementing peritoneal dialysis (PD) with intermittent HD to achieve adequate dialysis intensity.

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Pregnancy in patients with end-stage renal disease (ESRD) on maintenance dialysis remains infrequent, with annual incidences reported at 0.3 – 2.0% per year (1). Historically, the proportion of live births has been reported to be as low as 40 – 50%, with only 0 – 16% of pregnancies progressing beyond 37 weeks' gestation (2). However, in the new millennium, infant survival rates in women receiving hemodialysis (HD) has improved substantially, with some series reporting 100% live births, although pre-term delivery remains common (67 – 100%) (3). Improvement in survival rates is mainly attributed to increased dialysis intensity and advances in neonatal care (4,5).

Pregnancy in women receiving peritoneal dialysis (PD) is less frequently reported, but successful outcomes are described (1,6). We report a case of a patient receiving PD who delivered a full-term, normal weight, healthy baby with augmented dialysis dose achieved by supplementary HD during pregnancy, thus enabling PD to be continued and minimizing HD requirements.

CASE REPORT

A 27-year-old female (Gravida 2, Para 1) with ESRD due to reflux nephropathy had received continuous ambulatory PD (CAPD) for 3 years. Pregnancy was confirmed at 7 weeks' gestation and dialysis increased to 9 hours of automated PD (APD) (2-L fills, 4 cycles) per night, in addition to 3 daily 2-L manual exchanges. Throughout the pregnancy, 1.36% glucose dialysis solution was used for PD. She took folic acid 400 mcg daily for the first 12 weeks of pregnancy and prophylactic aspirin 75 mg daily and Cefalexin 500 mg at night for urinary tract infection (UTI) prophylaxis, as she had suffered from recurrent UTIs in her first pregnancy 6 years previously. At 12 weeks' gestation, with combined CAPD and APD, Kt/V was 3.3 and creatinine clearance (CrCl) was 91 L/week/1.73 m^2. Urine output was maintained at 1,260 mL and residual CrCl was 40 L/week/1.73 m^2. Transfer to HD was offered to enable augmentation of dialysis dose with gestation, but the patient declined. Peritoneal dialysis was increased to 4 daily manual exchanges with overnight APD. At 15 weeks' gestation, with combined CAPD and APD, Kt/V was 2.95 and CrCl was 86 L/week/1.73 m^2, with a fall in residual CrCl to 33 L/week/1.73 m^2.

At 19 weeks' she consented to HD via a right internal jugular tunneled venous catheter for 3 hours, 5 times per week, to replace manual daytime PD exchanges, and she continued overnight APD. Blood flow on HD was maintained at 200 mL/min for the first 3 weeks and then increased for the remainder of the pregnancy to 250 mL/min. The tunneled venous catheter was locked after each session of HD with trisodium citrate solution (Duralock-C; Medcomp Medical Components, Inc., Harleysville, PA, USA) to prevent catheter-related clotting. A single bolus of Dalteparin, 2,500 units, was given at the start of each HD session to prevent clot formation in the dialyzer. At 24 weeks, pre-HD urea was 8.9 mmol/L and HD was increased to 4 hours, 5 times per week. As a result of rising venous pressure and early termination of HD due to concerns regarding clotting of the dialyzer, the dose of Dalteparin was increased to 5,000 units at 26^{+4} weeks and a second bolus of Dalteparin, 1,250 units, was administered 2 hours into dialysis from 28^{+3} weeks. No bleeding complications were noted in our patient. At 26^{+5} weeks, despite intravenous iron and increasing doses of erythropoiesis-stimulating agent, Neorecormon, from 6,000 units per week pre-pregnancy to 6,000 units 4 times per week, her hemoglobin (Hb) concentration was 63 g/L, and 2 units of packed red blood cells were administered. A further 3 units of packed red blood cells was required at 27^{+5} weeks but thereafter Hb was maintained between 95 g/L and 98 g/L until term.

At 28^{+5} weeks, pre-HD urea was 15.3 mmol/L, and HD was increased to 4.5 hours, 5 times a week, combined with overnight APD and 3 manual exchanges on days without HD, leading to a reduction in pre-HD urea to 10.1 mmol/L. Ultrafiltration on PD was 600 to 900 mL per day; therefore additional ultrafiltration on HD was never required and she remained normotensive throughout. Hemodialysis was carried out whilst she sat in a standard HD chair, and despite increasing abdominal distention consistent with pregnancy, she did not report any discomfort with sitting for long periods. She also denied any shortness of breath or discomfort for the duration of the pregnancy, with no requirement to reduce the fill volume in the 3rd trimester. There were no episodes of PD peritonitis.

Four-weekly ultrasound scans from 24 to 32 weeks, and then two-weekly ultrasound scans from 32 to 38 weeks confirmed normal fetal growth and normal amniotic fluid volume. At 28 weeks, she was prescribed a course of prophylactic steroids for fetal lung maturation in case of premature delivery. At 34 weeks, anticoagulation on HD was changed to unfractionated heparin, 2,000 units bolus and 1,000 units/hr infusion, to minimize the risk of bleeding complications during delivery. At 37^{+4} weeks, external cephalic version was attempted for breech position of the fetus but was unsuccessful. The patient went into labor spontaneously at 37^{+6} weeks and delivered a healthy baby girl (3,005 g, 25th centile) by semi-elective lower segment caesarean section with no complications.

The following day, the patient had 9 hours of continuous veno-venous hemofiltration in the intensive care unit and then self-discharged at 2 days post-partum. Continuous ambulatory PD was temporarily discontinued post-lower segment caesarean section, but recommenced after 6 weeks. Her urine output has been maintained 4 months post-delivery at 1,210 mL but residual CrCl has reduced to 25 L/week/1.73 m^2.

DISCUSSION

Case series and registry data report live births with PD and HD (1,6,7), but no studies directly compare pregnancy outcomes between modalities. Intensive dialysis is needed to reduce the effects of uremia on the developing fetus (5). Hladunewich *et al.* reported outcomes of pregnancies managed with intensified hemodialysis (median 36 hours per week) achieving mean predialysis blood urea within normal physiological parameters. Comparison with a historic cohort of women receiving less intensive dialysis (< 20 hours per week) demonstrated that live birth rate, birth weight, and gestational age were significantly higher with intensive dialysis (4).

The incidence of pregnancy in women receiving PD is likely to be lower than HD, presumably due to fallopian tube obstruction post-peritonitis and effects of peritoneal fluid on ovum and blastocyst (8). Pregnancy outcomes in PD have been variable, with better outcomes in patients who conceived prior to dialysis (9,10), which is also true for HD, suggesting that residual function is a key factor for successful outcome (4,7). In our case, residual function is likely to have contributed to good blood pressure control and successful outcome.

Reported complications of pregnancies in women on PD include abdominal discomfort, catheter drainage difficulties, polyhydramnios (10), peritonitis (11), and hemoperitoneum due to placental abruption or catheter related trauma (12), which were not observed in our patient. Uterine distention during the 3rd trimester can make management of PD particularly challenging, necessitating a reduction in the dwell volume combined with frequent exchanges over an extended period to maintain adequate clearance, often achieved by admitting the patient to hospital (13). Tidal exchanges have been shown to be an effective means of enhancing clearance and easing abdominal symptoms (14). Our patient was able to tolerate full 2-L dwell volumes during the entirety of her pregnancy, which, in combination with the supplementary HD, contributed to adequate clearance and kept overnight APD to 9 hours, allowing the patient to remain at home.

Caesarean section should only be carried out for the usual obstetric indications and can be transperitoneal or extraperitoneal. Our patient had a transperitoneal caesarean section and recommenced PD 6 weeks later. If the caesarean section is extraperitoneal, PD can be resumed as soon as 24 hours later using small volumes. If a leak then occurs, it is recommended that HD be continued for 2 weeks (15).

An Italian nationwide survey and review of pregnancy management in dialysis patients from 2000 – 2013 (16) concluded that there were insufficient data to recommend PD in pregnant women with ESRD. However, provision of daytime intensive dialysis regimes is challenging for units with limited capacity and requires a large time commitment from the patient. Combination of dialysis modalities in our case facilitated reduced requirement for HD and enabled increased time at home for the

patient with other childcare commitments. Another benefit included minimizing fluid shifts with HD, which may lead to improved placental perfusion and fetal growth.

We report the successful delivery of a healthy infant with no maternal or fetal complications managed with combined PD and HD during pregnancy. This approach may provide an alternative method for intensive dialysis during pregnancy for women who wish to continue with PD.

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The authors have no financial conflicts of interest to declare.

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