

## Syed Hussain, MD and Samuel Blumenthal, MD

Synopsis from the article: [Hussain S, Savin V, Piering W, Tomasi J, Blumenthal S. Phosphorus-enriched hemodialysis during pregnancy: Two case reports. \*Hemodialysis International\* 2005;9:147-52.](#)

Successful pregnancy leading to delivery of a viable infant is an uncommon occurrence either in women with established renal disease or in those with renal failure requiring chronic dialytic treatment. Estimates of conception in dialysis patients ranges from 1.4% per year in Saudi Arabia to 0.5% in the United States. Studies have indicated that adequate dialysis, hemodynamic stability, treatment of anemia, and maintenance of nutrition are the most important factors for a successful pregnancy in the face of chronic hemodialysis.

Current guidelines for dialysis in pregnant women include prolonged dialysis times, generally 20 or more hours per week. Clinically, the frequency of hemodialysis is increased to maintain the predialysis blood urea nitrogen (BUN) value below 50 mg/dL. During a 4-hour dialysis, the loss of phosphorus across the dialyzer membrane can be as high as 2.5 to 3.0 g. This balance remains positive with three times weekly dialysis, due to an intake of 0.8-1.6 g/day of phosphorus by dialysis patients.

In a regimen of six 4-hour treatments a week as required in pregnancy, or in one of slow nocturnal hemodialysis totaling 24 or more hours per week, patients may become phosphorus-depleted. Hypophosphatemia is associated with numerous complications in pregnant women, most commonly affecting cardiac, skeletal muscles, the nervous system and the blood. Hypophosphatemia may also lead to tissue hypoxemia through a decrease in 2,3-diphosphoglycerate (2,3-DPG) in red cells, osteopenia and osteomalacia.

To prevent net phosphorus loss, we measured phosphorus flux and added phosphorus to the dialysate at a concentration of 3.66 mg/dL. Hemodialysis was performed using a Fresenius 2008 machine, a F 70 NR polysulfone dialyzer ( $K_0A$  urea 780 mL/min, Fresenius Medical Care North America, Lexington, MA) with a dual-concentrate, bicarbonate-based dialysate delivery system. Nominal dialysate solute concentrations (mmoles/L) included: Na 143, Cl 107, K 3, Mg 0.5, Ca 1.25, dextrose 11, acetate 2.9, bicarbonate 39. Blood flow rates were kept between 250-300 mL/min with a dialysate flow rate of 500 mL/min.

The pre-dialysis serum inorganic phosphorus level fell progressively after starting daily dialysis. Consequently, dialysates used thereafter were enriched by addition of 90 mmol of phosphorus (Sodium Phosphates Injection USP, Abbott Laboratories, North Chicago, IL) to 3.78 L of the bicarbonate dialysate concentrate (Natura Lyte 6000 RX-10, Fresenius Medical Care North America) yielding a final dialysate phosphorus concentration of 3.66 mg/dL. With the adoption of this approach, stabilization of the pre-dialysis serum inorganic phosphorus value was achieved. This maneuver maintained the serum pre- and post-dialysis inorganic phosphorus concentrations within the normal range throughout the remainder of the pregnancies of both patients.

While the concentration of phosphorus that we added to the dialysate for the two patients described above was chosen empirically, it conforms to the K/DOQI guidelines. The guidelines, in turn, are based on retrospective epidemiologic data suggesting that increasing mortality in dialysis patients is associated with pre-dialysis serum inorganic phosphorus concentrations of lower than 3 mg/dL. Since acute complications of hypophosphatemia rarely occur when the serum inorganic phosphorus level exceeds 2 mg/dL, maintaining serum inorganic phosphorus value at 3 mg/dL during treatment is certainly prudent.

For the first patient, throughout her pregnancy, serum chemistry was maintained at the neighborhood of the following values: BUN 26.2 mg/dL, creatinine 5.4 mg/dL, total CO<sub>2</sub> 19 mmol/L. Pre-dialysis and post-dialysis serum inorganic phosphorus values ranged from 3.2 to 4.7 mg/dL. A daily protein intake of 1.6-1.8 g/kg was prescribed. The first patient was able to carry the pregnancy for 28 weeks with delivery of a healthy infant, while the second patient's pregnancy ended at 25 weeks of gestation with delivery of a nonviable infant.

#### **Commentary by Todd S. Ing, MD**

A pregnant woman suffering from end-stage renal disease requires 20 or more hours of hemodialysis per week in order to have a favorable outcome for the fetus. This measure of intensive, yet appropriate, dialysis regimen using conventional, phosphorus-free dialysates can bring about hypophosphatemia in such a clinical setting. Dr. Hussain and his colleagues pioneered the phosphorus-enriched hemodialysis approach and managed to maintain the serum inorganic phosphorus values of two pregnant dialysis patients within normal physiological limits. A healthy baby was born from one patient while the baby from the other patient unfortunately turned out to be nonviable.