catheters implanted in the last 7 years and specifically looked at the 3-month pandemic period, March through May. Patients with COVID-19 or requiring an acute start were excluded. The increase in PD rates was evident (Figure 1). This can be explained by several factors. First, surgeries including transplantation were canceled; however, none of the patients had an eligible donor. Second, a home-based therapy appealed to patients for obvious reasons during the pandemic. Last is the fact that the majority of patients were referred from other clinics in the area; they were all included in our predialysis education program and given information about different modalities. We believe the patients made the right choice for themselves when given the option.

We, physicians and patients alike, are living through extraordinary times while facing many challenges all at once and the need to adapt is crucial. It has taken COVID-19 to emphasize the advantages of PD and this may be the trend of the future where more patients prefer home-based therapies. We are all responsible for providing the best care for our patients and the time has come once again to step up to the task.

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This letter reflects the personal views of the authors and should not be considered medical advice or recommendation.

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Rapidly rising methemoglobinemia in a patient with severe COVID-19 treated successfully with red cell exchange transfusion

Dear Editor,

The clinical features of coronavirus disease 2019 (COVID-19) are diverse, causing multiple organ failure, cytokine storm, coagulopathy, and still more to be fully characterized. A cluster of methemoglobinemia cases was identified among COVID-19 patients.[1] Methemoglobin cannot bind and release oxygen reversibly and results in decreased oxygen delivery leading to hypoxia.[2] Severe methemoglobinemia can have life-threatening potential and will be further deleterious when compounded by the coexistent cardiopulmonary dysfunction in COVID-19 patients. In this report, red cell exchange (REX) transfusion by apheresis is shown to be an effective treatment of dangerously rising methemoglobinemia that was refractory to other conventional treatments in a patient with severe COVID-19.

A 52-year-old African American male with hypertension, type 2 diabetes mellitus, and morbid obesity (148 kg) was admitted with acute hypoxic respiratory failure. Nasopharyngeal swabs were positive for SARS-CoV-2 by real-time reverse transcription-polymerase chain reaction assay. On hospital day 2 (D2), he was placed on mechanical ventilation and norepinephrine was started. On D3, uncontrolled hyperglycemia required insulin drip, and hemodialysis was initiated for acute kidney injury. He completed a trial of hydroxychloroquine and azithromycin treatment over D3 to D7.

Methemoglobinemia was rising rapidly from his baseline of <1% (normal range 0%-1.5%) to 16.8% on D6, and continued to rise to 25.3% on D7 (Figure 1). Treatments of methylene blue (MB) and ascorbic acid were given on D7 and D8. MB was administered safely without causing hemolysis after confirming that the patient did not have

glucose-6-phosphate dehydrogenase deficiency. Methemoglobinemia, however, was refractory and reached greater than 30% (above the measurable range of the assay) on D9. A venous blood specimen drawn on D9 showed red cells of dark brown color and plasma of dark greenish color, consistent with severe methemoglobinemia and plasma free methemoglobin released from intravascular hemolysis. There was growing concern for the detrimental effects of sharply rising methemoglobinemia in this anemic (Hb 8.3 g/dL) patient with comorbidities of respiratory failure, shock, and renal failure. To mitigate the adverse effects from worsening methemoglobinemia, a REX by apheresis with replacement of 12 red cell units was performed emergently. The patient was on vasopressors at the time, but hemodynamic status remained stable during REX. Post-REX methemoglobin was reduced to 8.7%. During the following 4 days, methemoglobinemia had gradually resolved completely and there was no rebound (Figure 1), suggesting that the oxidizing events had been discontinued. Intravascular hemolysis was also resolved completely after REX.

Acquired methemoglobinemia is usually caused by exogenous oxidizing chemicals or drugs,[2] and hydroxychloroquine could have precipitated methemoglobinemia in this case. Chloroquine was reported to provoke methemoglobinemia when it was used as malarial prophylaxis.[3] Hydroxychloroquine was administered on D3 to D7, and methemoglobinemia rose rapidly over D6 to D9. Hydroxychloroquine has been used for the patients with rheumatoid arthritis and systemic lupus erythematosus, but methemoglobinemia has not been reported among them. It is probable that certain COVID-19-associated conditions and hydroxychloroquine together may confer increased risks for developing methemoglobinemia.

Various modalities of apheresis have been tried for treatment of methemoglobinemia of different etiologies.[4] This case is the first report demonstrating that emergent REX could be a potentially life-saving treatment of refractory severe methemoglobinemia in COVID-19 patients with coexistent compounding comorbidities.

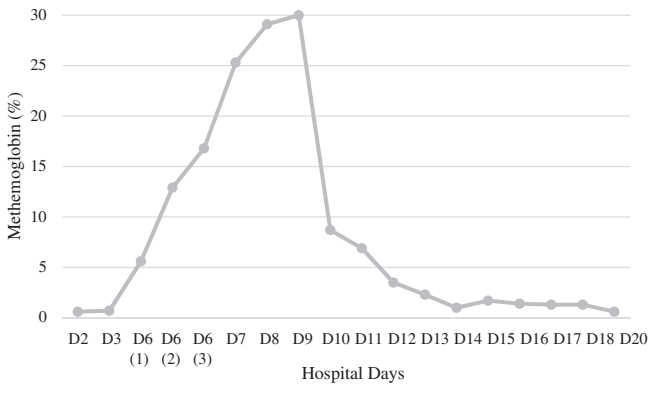

FIGURE 1 The course of methemoglobinemia as measured by blood gas analysis with co-oxymeter. The result of >30% (beyond the measurable range of the assay) on hospital day 9 (D9) was obtained prior to red cell exchange transfusion (REX). The D10 result (8.7%) was obtained after REX. (methemoglobin normal range 0%-1.5%)

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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