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COVID-19 and Kidney Failure in the Acute Care Setting: Our Experience From Seattle

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For weeks we watched as Wuhan, China was ravaged by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), wondering what the future had in store for us. On January 21st 2020, the first case of COVID-19 on US soil was identified 20 miles north of Seattle in the town of Everett, Washington. On Friday February 28th, the nation's first reported death due to COVID-19 infection was disclosed, followed by the 2nd mortality case a mere 48 hours later. Both were end-stage renal disease (ESRD) patients dialyzing with Northwest Kidney Centers in our ambulatory clinics, and subsequently under the care of our Hospital Services team. Over the course of that weekend, our organization was brought to the forefront of the COVID-19 pandemic, mandating an immediate and coordinated response. Our approach to managing the threat in our outpatient facilities has been summarized elsewhere ¹. This editorial will focus on the acute care setting by considering the following three questions:

1) What is the pathophysiology and burden of acute kidney injury (AKI) associated with COVID-19?

While initial reports from Wuhan suggested that the burden of AKI with COVID-19 was relatively low, ranging from 3% to 9% ², subsequent analyses demonstrated incidence rates as high as 15% ³. AKI is more common among patients with more severe disease, particularly in the ICU setting, and considered a negative prognostic factor with respect to survival ⁴.

Conventional wisdom suggests that a maladaptive systemic inflammatory immune response, in the face of a cytokine storm, contributes to hypoperfusion-related injury of the renal tubules ⁵.

In addition to organ dysfunction as a result of immune dysregulation, emerging evidence suggests the possibility of a direct cytopathic effect of SARS-CoV-2. ACE₂ and members of the

serine protease family, essential for viral uptake by host cells, are highly expressed on podocytes and tubule epithelial cells⁶. Reports of albuminuria and hematuria in the setting of COVID-19, along with isolation of viral RNA from the urine, further supports potential viral tropism for the kidney⁷.

2) What are principles of management of kidney failure in these patients?

Presently there is not a targeted treatment against SARS-CoV-2, though a number of drugs are being actively investigated in clinical trials⁸. Care for COVID-19 remains largely supportive, particularly in the ICU setting where general principles for the management of ARDS and sepsis are paramount. An important consideration is the percentage of patients who will ultimately require renal replacement therapy. The need for dialysis usually arises during the 2nd week of infection and affects 5% of ICU patients⁹, patterns that are consistent with estimates from the severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome (MERS) pandemics, both caused by coronaviruses bearing a high degree of sequence homology to SARS-CoV-2.

Inevitably the question arises whether renal replacement therapy should be approached differently in the acute care setting. If cytokine storm is contributing to disease severity in COVID-19, then in theory, convective-based clearance may be superior for removal of large-sized cytokines, when compared to diffusion-based modalities. While this argument has been made repeatedly in the management of sepsis, clinical evidence has been, at best, inconclusive¹⁰. Decisions in our local community around dialysis modality have been informed by the acuity of illness, with continuous renal replacement therapy (CRRT) or slow low efficiency dialysis

(SLED) reserved for those patients who are too sick to tolerate conventional intermittent hemodialysis. In the absence of data clearly demonstrating superiority of one modality over another, choice of dialysis modality should be informed foremost by resources readily available and where local clinical expertise lies.

3) What contingency planning and resource management should be considered in the face of the evolving pandemic?

While the infection fatality rate for SARS-CoV-2 appears lower than prior coronavirus pandemics, overall morbidity and mortality will be much greater due to its greater global penetrance. Our regional hospitals are already under significant strain and resource constraints in the midst of the COVID-19 outbreak and our situation is expected to get much worse. Current modelling predicts that by the second week of April, our region may approach 25,000 cases ¹¹. Based on national estimates that 15% of cases will warrant hospitalization and 5% will require escalation to ICU level care ¹², we are at significant risk of exceeding the regional ICU bed capacity. The ensuing kidney failure disaster, whereby individuals with kidney failure are at risk of not having access to dialysis care, may force tough decisions to be made around resource allocation and patient prioritization ¹³. Contingency planning now is essential. In addition to providing maintenance dialysis care to more than eighteen hundred ESRD patients in the community, Northwest Kidney Centers also partners with eight regional hospitals to provide renal replacement therapy in the acute care setting. We have already initiated the following measures:

- implemented contact-droplet precautions and universal screening protocols across our 19 dialysis facilities, in order to continue providing life-sustaining dialysis care to patients with suspected or confirmed COVID-19, while ensuring safety of all other patients and staff. A guiding principle from the outset was to keep stable ESRD patients out of the acute care setting, so as to not further burden our hospital partners.
- assessed our current CRRT capacity and trended utilization patterns over the course of the COVID-19 outbreak. While we still have sufficient capacity currently, the situation could spiral quickly. Given the diminished clinical impact of COVID-19 in the pediatric population, both in terms of volume and severity, we are speaking with colleagues at Children's Hospital to potentially borrow additional CRRT machines should the clinical demand arise.
- engaged with local healthcare systems to assess resource availability and trend inpatient COVID-19 census, in order to better address evolving needs for renal replacement therapy at a regional level.
- provided regular communication with clinicians regarding capacity concerns and to review prescribing practices. The medical community has responded to requests to reduce treatment time for intermittent HD to 3 hours where clinically appropriate, in order to accommodate clinical demands. ASN guidelines released March 21st for the management of RRT in hospitalized patients with COVID-19 also recommend restricting CRRT to 10 hours at augmented flow rates (40 to 50 ml/kg/hr) if needed¹⁴. Others have suggested acute peritoneal dialysis.

- prioritized staff safety through ongoing education and vigilance around the appropriate personal protective equipment. Communication with our local healthcare partners was important to create alignment around the use of contact-droplet precautions, versus airborne precautions for certain ICU patients and aerosol-generating procedures. Our dialysis staff continue to be our most valued resource - ongoing support and recognition is imperative to sustain resilience. Strategies to help alleviate strain include transitioning from 1:1 nursing assignments to allow simultaneous care of multiple patients.
- managed stock of $K^+=1\text{mEq/L}$ dialysate bath and potassium-binding resins, should frequency of dialysis need to be pared back.

It remains our sincere hope that the social distancing mandates our state has implemented will stem the tide in a meaningful way such that finite resources of our healthcare system do not become overwhelmed. Nonetheless, successful management of the COVID-19 outbreak will demand flexibility, collaboration, and a sense of shared responsibility across the continuum of care.

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