

# The advantages of peritoneal dialysis over hemodialysis during the COVID-19 pandemic

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The outbreak of the coronavirus disease 2019 (COVID-19) since the end of 2019 has had a considerable impact on the global economy and also on the healthcare system. The mismatch of supply and demand in medical resources worldwide, such as masks and protective gowns, has put healthcare workers and patients at a high risk of exposure to infection. This crisis has now become a major challenge particularly to patients undergoing chronic hemodialysis (HD).

HD patients stay in the same space with many other patients and healthcare workers two to three times per week for dialysis treatments that can last for 3-4 hours. In the face of the COVID-19 pandemic, infection clusters can easily occur in the HD unit. Even if the US Centers for Disease Control and Prevention already provided relevant suggestions for infection prevention and control, these patients are still exposed to considerable risks for infection. Patient with confirmed COVID-19 can be asymptomatic, therefore maintaining social distancing is important. However, during the cannulation process for HD, the nurses must be in close contact with multiple patients. It may become a weak spot in the prevention of virus spreading, especially during the shortage of masks worldwide. Moreover, a very high proportion of dialysis patients are the elderly or patients with multiple comorbidities. Once infected with COVID-19, these patients will have higher risks for morbidity and mortality.

Patients with suspected or confirmed COVID-19 in outpatient HD facilities may have to be triaged to a hospital with isolation wards for dialysis, resulting in a shortage of dialysis machines, dialysates, wards, and healthcare workers. In response to this problem, experts may even need to recommend reducing the patient's dialysis frequency and duration and decreasing the dialysate flow rate to a

maximum of 600 mL/min to increase the HD surge capacity. During the COVID-19 pandemic where most of the medical attention is focused on treating infected patients, HD treatments in a hospital not only consumes a large amount of medical resources, but also compromises the healthcare services for patients with non-COVID-related diseases.

In addition to the need for high volumes of clean dialysate, machines, circuits, and spaces, HD requires a large number of healthcare workers such as physicians, nurses, technicians, and janitors. However, the number of such healthcare workers may be reduced due to illness or quarantine. They may also be infected while serving HD patients, resulting in a shortage of dialysis care team members. In the era of the COVID-19 pandemic, maintaining adequate dialysis workforce is challenging.

Compared to HD, peritoneal dialysis (PD) can be performed by patients themselves at home. Physicians can conduct telemedicine consultations and PD prescriptions. It may reduce the patient's chances of getting into contact with other people or going to healthcare facilities, thereby minimizing the risk of COVID-19 infection. For patients with suspected or confirmed COVID-19, they can also be isolated at home without occupying the isolation ward for dialysis.

Home HD is also a dialysis modality that can prevent infection clusters and preserve the healthcare workforce. However, the prevalence of home HD in most developing countries is still quite low today. This may be due to expensive dialysis equipment, a more complex training program, and lack of patient motivation. Moreover, home HD requires a high volume of clean water, which may be difficult to conduct in areas with poor water quality.

**TABLE 1** Comparison of PD and HD in different aspects during COVID-like pandemic or epidemic

| Aspects                       | PD   | HD  |
|-------------------------------|--|---|
| <b>Travel</b>                 | Ease of travel; flexibility in schedule  | HD units may not be readily available   |
| <b>Contact</b>                | Physicians conduct telemedicine consultations; close contact with healthcare workers is not necessary  | Close contact with healthcare workers is needed during needle puncture process  |
| <b>Cluster</b>                | PD can be done at home, thereby minimizing the risk of disease clusters  | The need for frequent HD unit visits and patient clustering increase the risk of virus spreading  |
| <b>Medical resources</b>      | Low risk of PD solution shortage   | The need for a large number of healthcare workers, protective equipment, clean water, dialysis machines, which may be lacking in COVID-like pandemic or epidemic  |
| <b>Workforce</b>              | No need for healthcare workers   | Healthcare workers may be reduced due to illness or quarantine, resulting in a shortage in the workforce  |
| <b>Hemodynamic stability</b>  | Gentle and prolonged removal of body fluids and toxins during PD reduces the risk of hemodynamic instability in infected patients  | Faster removal of toxins and fluids than PD, causing a higher risk of hemodynamic instability   |
| <b>Respiratory symptoms</b>   | PD removes fluids more continuously than HD, which minimizes risk of hypervolemia; however, the intraperitoneal fluid instillation may increase intraperitoneal pressure and may compromise pulmonary function | Fluid accumulation can easily occur in intermittent HD, which may worsen oxygenation  |
| <b>Special considerations</b> | SARS-CoV-2 may be present in peritoneal dialysate of ESRD patient on PD; for prevention of spread of disease, the peritoneal dialysate effluent must be properly collected and managed by the healthcare unit  | Home HD can prevent infection clusters and preserve the healthcare workforce during a pandemic; however, prevalence of home HD in most developing countries is still quite low today due to expensive dialysis equipment, a more complex training program, and lack of patient motivation |

Abbreviations: COVID-19, coronavirus disease 2019; ESRD, end-stage renal disease; HD, hemodialysis; PD, peritoneal dialysis; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) mainly invades the lower respiratory tract, resulting in diffused alveolar damage and respiratory symptoms.<sup>1</sup> Studies have found that about 30% of patients with COVID-19 had dyspnea.<sup>2</sup> The primary findings on the chest computed tomography scan include bilateral ground-glass opacity or consolidation.<sup>3</sup> Patients with severe COVID-19 may develop respiratory failure and require noninvasive or invasive ventilation. For such critically ill patients, current guidelines recommend conservative fluid management, because hypervolemia may worsen oxygenation.<sup>4</sup> PD may be a better choice for them, since it is done more continuously than intermittent HD, resulting in less accumulation of body fluid.

Cardiac involvement was also observed in patients with COVID-19. Cardiac injury may result from myocarditis, profound systemic inflammation, or microvascular dysfunction.<sup>5,6</sup> Several case series reported that 20%-30% of patients with severe COVID-19 have elevated levels of cardiac troponin.<sup>7,8</sup> A case series from two hospitals in New York City showed that 32.6% of inpatients with COVID-19 need vasopressor support.<sup>9</sup> Thus, caution should be taken while performing dialysis therapy on these patients. The gentle and prolonged removal of body fluids and toxins during PD reduces the risk of hemodynamic instability, which makes PD a treatment of choice for critically ill patients with acute kidney injury (AKI) or end-stage renal disease (ESRD). A previous study compared PD with continuous renal replacement therapy in

critically ill patients with AKI and found that patients in the PD group had lower mortality rate at 28 days, faster recovery of renal function, and less complications of infections.<sup>10</sup> Another prospective randomized controlled trial comparing the effect of high volume PD with daily HD on the survival of AKI patients showed that the two groups had similar mortality rates and metabolic control, whereas the PD group was associated with a significantly shorter time to recovery of renal function.<sup>11</sup> PD can thus be effectively and safely applied not only to stable patients with ESRD but also patients with AKI and critically ill patients requiring dialysis.

However, PD may have some potential disadvantages in the COVID-19 pandemic. First, the intraperitoneal fluid instillation may increase intraperitoneal pressure that may eventually compromise pulmonary function. Second, in patients with severe COVID-19, PD-associated peritonitis may alter peritoneal membrane transport function, resulting in decreased ultrafiltration rate and hypervolemia, thereby worsening hypoxia. A temporary transfer from PD to HD may be necessary. Third, gastrointestinal symptoms have been reported in about 18% of patients with confirmed COVID-19.<sup>12</sup> Whether or not the SARS-CoV-2 will invade enterocytes and break the gastrointestinal mucosal barrier, thereby resulting in increased risks for bacteria translocation and peritonitis, is still unknown. Fourth, upon the detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the peritoneal dialysate of ESRD

patients on PD, there is the additional step of ensuring proper handling and disposal of the peritoneal dialysate effluent. For the prevention of the spread of the disease, the patient must exert extra time and effort to hand over the effluent to the healthcare unit where professionals assume the responsibility of proper collection and management of the disposal instead of the patient simply discarding it into the sewer. On the other hand, the gastrointestinal symptoms of COVID-19 may be confused with PD peritonitis, which require additional peritoneal fluid analysis. Table 1 compares PD and HD in different aspects during COVID-like pandemic or epidemic.

In conclusion, PD offers several advantages over HD, especially in the issue of public health and infection control in the current COVID-19 pandemic. Furthermore, AKI is a crucial complication of COVID-19 in addition to cardiopulmonary injury and whether the risk of chronic kidney disease will increase after this pandemic is still unknown.<sup>13</sup> When inpatient HD units become a resource-constrained environment, alternative therapeutic strategies for dialysis patients should be considered. Thus the role of PD will be more important for ESRD patients from now on, not only in the current pandemic but also in any outbreak of other life-threatening infection in the future.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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