

Coronavirus Disease 2019 (COVID-19) and Dialysis: The Experience in Singapore



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Since late 2019, the global community has witnessed the unprecedented exponential increase in the number of cases of coronavirus disease 2019 (COVID-19), a novel coronavirus disease caused by the severe acute respiratory syndrome (SARS) coronavirus 2, which led to the World Health Organization declaring COVID-19 a pandemic on March 11, 2020.¹ As of April 25, 2020, more than 2,700,000 cases and 187,000 deaths have been reported,¹ and the situation is rapidly evolving.

Patients with end-stage kidney disease (ESKD) are immunocompromised, frequently have multiple comorbid conditions, and thus are particularly vulnerable, with increased risk for the development of severe COVID-19 infection. In addition, the nature of community in-center hemodialysis (HD) poses challenges to containment measures when a dialysis patient develops COVID-19 infection. Furthermore, reports of transmission among minimally symptomatic or presymptomatic patients^{2,3} explains in part why COVID-19 is far more challenging to contain. Acute kidney injury and need for kidney replacement therapy (KRT) have also been reported,⁴ and delivering KRT in critically ill COVID-19–infected patients poses unique challenges. Overall, it must be recognized that dialysis patients are a highly susceptible population and that HD centers are a high-risk area, and therefore additional measures must be undertaken to mitigate the risk to dialysis patients in this pandemic.

We report our current strategies for managing dialysis and share the practical issues faced when providing dialysis support for patients during this COVID-19 outbreak.

Local Situation and General Considerations for Dialysis Support

In Singapore, the National Centre of Infectious Diseases (NCID) is a 330-bed purpose-built national specialty center tasked with managing infectious disease outbreaks, and the nephrology department in Tan Tock Seng Hospital supports the NCID for nephrology consults and the provision of dialysis. Since January 23, 2020, Singapore has managed more than 13,000 confirmed cases of COVID-19 infection, with the majority admitted to NCID. Despite initial success in containment,⁵ we are now experiencing successive waves of COVID-19 infections, first due to an increase in imported cases and subsequently with infections predominantly involving workers residing in dormitories. Additional measures have been taken at a national level to mitigate further transmission, while the health care community continues to provide medical care for those infected.

In Singapore, a multiministerial task force has been created to coordinate the pandemic response. The local health authority, Ministry of Health, has led the coordination in health care services between the primary care providers (Public Health Preparedness Clinics and polyclinics) and the public and private hospitals during the pandemic and further optimized health care capacity and services. Suspected cases are identified by criteria defined by Ministry of Health, and criteria are updated from time to time according to local and global epidemiology. The Infectious Diseases Act mandates the notification of all COVID-19 infections, and contact tracing teams actively identify close contacts of patients infected with COVID-19. These asymptomatic close contacts of COVID-19–infected patients are quarantined at home or government quarantine facilities, which include repurposed hotels and chalets in which patients may be isolated if their home is not suitable for home quarantine, through a national coordinated effort.

Health care in Singapore remains generally affordable, with relatively low out-of-pocket payment, through a co-payment model of basic universal health insurance (Medishield Life), optional private insurance add-on, compulsory national medical savings scheme (Medisave), and endowment fund (Medifund) for patients who need additional support. During the current COVID-19 pandemic, the hospitalization costs of residents with COVID-19 infection admitted to public hospitals in Singapore are further fully borne by the government.

Dialysis support provided by our center includes the provision of outpatient HD and peritoneal dialysis (PD) for persons under quarantine, routine HD and PD for hospitalized suspect or confirmed cases, and continuous renal replacement therapy (CRRT) for critically ill patients in the intensive care unit.

The key considerations in planning dialysis services are to ensure adequate resources for the provision of uninterrupted KRT for patients with ESKD while minimizing the risk for transmission of COVID-19 among individual patients, the community, and health care workers. Cross-infection among patients is mitigated with individual isolation rooms for hospitalized confirmed and suspect cases while segregating patients who are close contacts of a confirmed case during the incubation period from other patients in the community. Equipment disinfection is essential to prevent potential iatrogenic COVID-19 transmission. The stability of SARS-coronavirus 2 is demonstrated to be similar to SARS-coronavirus 1 and can be detected on surfaces for up to 72 hours.⁶ Disinfection

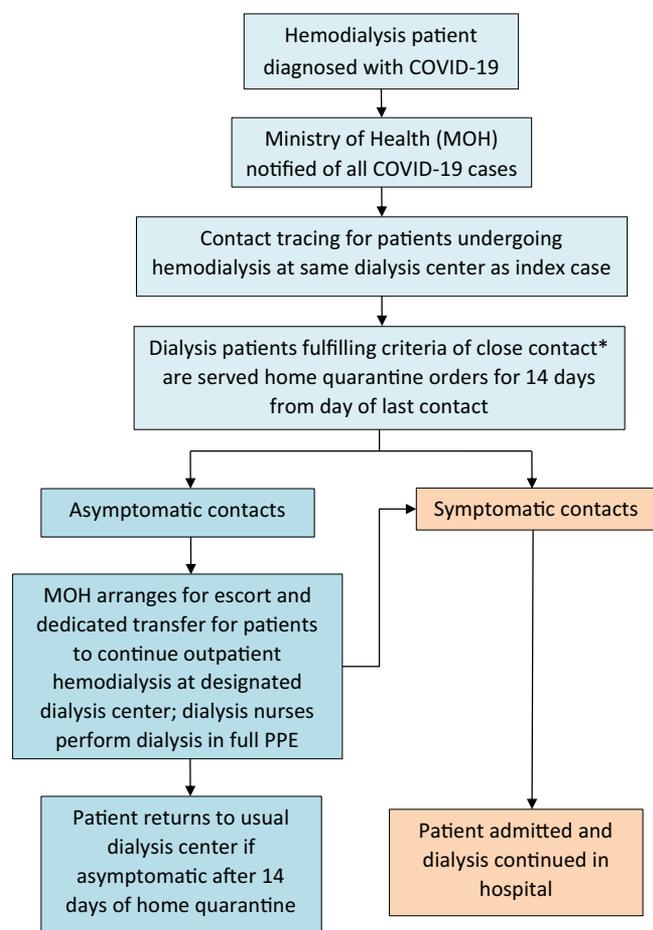


Figure 1. Management of close contacts in a dialysis center with a hemodialysis patient with coronavirus disease 2019 (COVID-19) infection diagnosed. *Close contacts are defined as persons within 2 m of a patient infected with COVID-19 with more than 30 minutes exposure. Asymptomatic patients will be escorted to the designated dialysis center for outpatient dialysis for 14 days from the last contact with the index case. Contacts who develop respiratory symptoms or fever are admitted to exclude COVID-19 infection. Abbreviation: PPE, personal protective equipment.

options previously demonstrated to be effective against other coronaviruses include 70% ethyl alcohol,⁷ 1% povidone-iodine,⁷ accelerated hydrogen peroxide,⁸ 0.05% benzalkonium alkaline,⁸ 0.05% to 0.5% sodium hypochlorite,^{7,9} 0.23% sodium chlorite, and 50 parts per million iodine in iodophor.⁸ The vendor should be consulted to ensure the suitability of any equipment for a specific type of disinfection.

Health care worker infection has been described in multiple countries in the current pandemic, including a cluster of patient and staff infections in a dialysis center in Wuhan, China.^{10,11} Historically, nurses were infected while performing HD during the SARS outbreak.¹² Therefore, all staff are educated about the characteristics of COVID-19, trained in the use of personal protective equipment (PPE), and further reinforced using a video

demonstration for self-paced learning. The PPE comprises waterproof disposable gowns, gloves, goggles, and N95 masks with appropriate fitting.

Team segregation is enforced for all medical personnel to minimize the potential for cross-contamination in the event of transmission in the health care setting and to allow clinical service continuity in the event of staff infection. Staff health surveillance is practiced with twice-daily temperature monitoring and enforced medical leave for staff with respiratory symptoms.

Besides prevention of disease transmission, increase in demand for dialysis services is anticipated and resource allocation is optimized by pooling all dialysis machines for central management at the hospital level. The existing stock of dialysis consumables is also reviewed to ensure sufficient supply because the COVID-19 outbreak has increased global demand and may potentially disrupt global supply chains. Ensuring adequate physician and nursing staffing is also an important consideration because a surge in cases may require activation of a reserve pool of staff at short notice.

Outpatient HD

A key strategy for the prevention of COVID-19 transmission for patients with ESKD in the outpatient dialysis facility is to identify high-risk patients and segregate these patients during the incubation period to prevent a dialysis center cluster. HD patients who are close contacts of confirmed cases (as defined by a person within 2 m of an index patient with >30 minutes' exposure) are identified by contact tracing by the local health authority and placed on quarantine at home or government quarantine facilities. During the period of quarantine (14 days from date of last close contact), persons under quarantine are suspended from continuing dialysis at their usual center and are transferred with an escort from their home to the national designated dialysis center (Fig 1). Most community dialysis centers have further assigned a fixed shift and fixed dialysis chair seating for each individual patient to limit contact between different individuals and to facilitate contact tracing, should the need arise.

Together with the local health authority, the hospital designates a dialysis center as the national home quarantine dialysis center, in which all persons under quarantine are dialyzed on the last shift (separated from the other non-quarantine patients) with a dedicated nursing team. This minimizes any contact that the quarantined patient may have had with other dialysis patients, dialysis center staff, or the general public. Staff and escorts attend to these patients in appropriate PPE. Before patients enter the center, screening is performed to ensure that they do not have fever or respiratory symptoms before proceeding for dialysis. Thorough disinfection of the dialysis facility is conducted after each shift of patients. Patients are admitted for evaluation if they develop symptoms suggestive of COVID-19 infection. This continues until the end of the quarantine period of 14 days, when they then return to

their originating dialysis center. We do not routinely test persons under quarantine for COVID-19 if the patient is asymptomatic. To prevent transmission in the susceptible dialysis population, mask wearing was mandated during outpatient HD as part of a national strategy to reduce community transmission of COVID-19. Challenges encountered include the need to respond to and create capacity to manage a sudden surge in cases, the recruitment of dedicated staff to manage such patients, and the high turnover of patients encountered with different medical and functional needs. A secondary site to cater to surge demand has been designated. As of April 23, 2020, we have provided support to 39 dialysis patients under quarantine period, and none have tested positive for COVID-19 so far.

Outpatient PD

For PD patients placed under home quarantine, PD continues uninterrupted in the patient's home. The carer is reminded of the need to wear a surgical mask, frequent hand washing, and other personal hygiene practices, and the patient is monitored for fever and respiratory symptoms by telephone surveillance. Home visits by health care staff are deferred if nonurgent. If essential, the visit can be conducted with the health care staff donning full PPE.

HD in the Hospitalized Patient

Hospitalized patients with ESKD are continued on their current dialysis modality. Minimizing patient movement to reduce potential interpatient contact is a principal consideration, and all rooms in NCID are fitted with a water tap and drainage infrastructure to facilitate HD at the bedside. A mobile team of dialysis nurses performs 24/7 bedside dialysis, using a fleet of portable reverse osmosis and dialysis machines. When HD is required at NCID general wards, the mobile team nurse transports the machine to the patient's bedside. The nurse dons full PPE and ensures that all relevant equipment needed is available before entering the room to perform dialysis. An estimated additional 30 minutes is required for each session of dialysis, compared to regular dialysis at our dialysis unit. During the dialysis, reducing movement in and out of the isolation room is also crucial to minimize contamination. As far as possible, heparin-free dialysis is avoided to reduce the need for frequent circuit flushing. Use of real-time remote vital sign monitoring (blood pressure, heart rate, and pulse oximetry) using ViSi Mobile (Sotera Wireless) and electronic transmission of data reduce the need to enter the patient's room. Disposable test strips (instead of a photometer) are used for chlorine and chloramine testing, avoiding possible additional equipment contamination. Documentation of dialysis flow sheets is also strictly performed outside the isolation room. Each dialysis machine is dedicated to an individual patient and remains in the patient's room till de-isolation or discharge to minimize equipment movement between patients. Upon discharge or de-isolation of the patient, the dialysis machines are

thoroughly wiped down with 70% ethyl alcohol wipes before use for the next patient.

PD in the Hospitalized Patient

PD patients admitted for suspected or confirmed COVID-19 infection are continued on PD, assisted by a dedicated PD nurse instead of their usual caregiver. Continuous ambulatory PD and automated PD (APD) can usually be safely interchanged for patients in the hospital, with appropriate adjustments of PD prescription, namely fluid tonicity and dwell time. In the context of an outbreak, APD provides the advantage of minimizing nursing contact with patients because only 2 nurse-patient encounters are necessary at the start and end of therapy, as compared to an average of 4 exchanges daily in continuous ambulatory PD. However, APD machine alarms may require urgent attention to troubleshoot and may also increase the frequency and duration of nurse-patient contact. Moreover, the use of APD necessitates the need to push additional equipment into the isolation room. Given these considerations, continuous ambulatory PD is the initial PD modality of choice in our center. Besides PD modality and prescription, adjustments to performing PD exchanges in full PPE are required. However, this adds to the time required to perform PD and should be factored in when planning nursing staffing requirements.

CRRT in the Critically Ill Patient

Critically ill COVID-19–infected patients in the intensive care unit requiring KRT are treated with CRRT as the initial modality. Insertion of temporary dialysis catheters with full PPE is more challenging and is performed by an experienced operator using ultrasound guidance. The use of disposable instrument sets for procedures reduces the need for subsequent sterilization and risk for contamination. In general, the choice of dialysis catheter placement through the internal jugular or femoral approach is dependent on factors such as risk for infection, complications, and operators' preference. However, critically ill COVID-19–infected patients often have severe acute respiratory distress syndrome with high ventilator requirements and may require prone positioning. In the prone position, the internal jugular approach may provide better ease of nursing care, although successful CRRT using a femoral catheter has also been described.¹³

Critically ill COVID-19–infected patients requiring CRRT are assigned a dedicated CRRT machine for their duration of the intensive care unit stay requiring KRT and we avoid the need to share machines between patients to prevent contamination. Extracorporeal membrane oxygenation therapy is also used in patients with acute respiratory distress syndrome and the medical team should be familiar with CRRT incorporation with the extracorporeal membrane oxygenation circuit.¹⁴ Regional citrate anticoagulation is preferred because it extends filter life and prevents circuit clotting, interruption to dialysis, and blood loss. Our current protocol starts with a higher initial calcium replacement that maintains a more stable serum

ionized calcium level and therefore minimizes the frequency of blood sampling or adjustment.

Earlier transition to intermittent HD and acute PD are alternative dialysis modalities that will be considered for critically ill patients when resources are stretched.¹⁵

Conclusions

The provision of dialysis support in the face of the COVID-19 pandemic is constantly evolving. A multidisciplinary team approach is imperative to ensure safe delivery of dialysis. The COVID-19 pandemic has affected many countries globally and we hope that our experience may benefit other centers facing similar challenges.

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